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May 26, 2021

JUN - 8 2021

Director
Office of Environmental Quality Control
State of Hawai'i
235 South Beretania Suite # 702
Honolulu, HI 96813

RE: Transmittal of Revised Final Environmental Impact Statement

Dear Director:

With this letter, the Pet Industry Joint Advisory Council (PIJAC) hereby transmits the documents package for the Revised Final Environmental Impact Statement (Revised FEIS) for the Issuance of Commercial Aquarium Permits for the West Hawai'i Regional Fishery Management Area situated in the West Hawai'i Regional Fishery Management Area in the Puna, South Hilo, North Hilo, Kau, Hamakua, South Kona, North Kona, South Kohala, and North Kohala districts on the island of Hawai'i. We are providing the Revised FEIS for publication of a notice of availability in the next available edition of the Environmental Notice and for evaluation for acceptability under Section 11-200-23, Hawai'i Administrative Rules.

Also enclosed is a distribution list for the verification of OEQC under Section 11-200-20, Hawai'i Administrative Rules. Upon receiving verification from OEQC we will make the Revised FEIS available to those so indicated on the distribution list.

Finally, enclosed is a completed OEQC Publication Form, copies of the Revised FEIS, and an electronic copy of the publication form in MS Word. Simultaneous with this letter, we have submitted the summary of the action in a text file by electronic mail to the OEQC.

Through this letter, a copy of this submittal is being provided to Hawai'i Department of Land and Natural Resources. If you have any questions or if you need additional information, please feel free to contact me.

Sincerely,

James M. Lynch

Enclosures

Cc: Hawai'i Department of Land and Natural Resources (with enclosures)
Kalanimoku Building
1151 Punchbowl St.
Honolulu, HI 96813
Email: dlnr@hawaii.gov

21-160

From: webmaster@hawaii.gov
To: HI Office of Environmental Quality Control
Subject: New online submission for The Environmental Notice
Date: Wednesday, May 26, 2021 1:00:01 PM

Action Name

Issuance of Commercial Aquarium Permits and Commercial Marine Licenses for the West Hawai'i Regional Fishery Management Area

Type of Document/Determination

Final environmental impact statement (FEIS)

HRS §343-5(a) Trigger(s)

- (1) Propose the use of state or county lands or the use of state or county funds
- (2) Propose any use within any land classified as a conservation district

Judicial district

Hawai'i - multiple districts

Tax Map Key(s) (TMK(s))

West Hawai'i Regional Fishery Management Area identified in Figure 1 of RFEIS

Action type

Applicant

Other required permits and approvals

Commercial Aquarium Fishing Permits issued pursuant to HRS §188-31, Commercial Marine License issued pursuant to HRS 189-2,3, West Hawai'i Aquarium Permit issued pursuant to HAR 13-60.4

Discretionary consent required

Commercial Aquarium Fishing Permits issued pursuant to HRS §188-31, Commercial Marine License issued pursuant to HRS 189-2,3,

Approving agency

Hawai'i Department of Land and Natural Resources

Agency contact name

David Sakoda

Agency contact email (for info about the action)

dlnr@hawaii.gov

Email address or URL for receiving comments

david.sakoda@hawaii.gov

Agency contact phone

(808) 587-0104

Agency address

1151 Punchbowl Street, Room 330

Honolulu, HI 96813
United States
Map It

Accepting authority

Hawaii Department of Land and Natural Resources

Applicant

Pet Industry Joint Advisory Council (PIJAC)

Applicant contact name

James Lynch

Applicant contact email

lynchjm.wa@gmail.com

Applicant contact phone

(425) 463-8396

Applicant address

1615 Duke St., #100
Alexandria, Virginia 22314
United States
Map It

Was this submittal prepared by a consultant?

Yes

Consultant

Stantec Consulting Services Inc

Consultant contact name

Terry VanDeWalle

Consultant contact email

terry.vandewalle@stantec.com

Consultant contact phone

(319) 334-3755

Consultant address

2300 Swan Lake Blvd., Suite 202
Independence, IA 50644
United States
Map It

Action summary

The purpose of the Applicant's action is to ensure that commercial aquarium fish collection allows for the lawful, responsible, and sustainable commercial collection of 8 aquarium fish species from nearshore habitats of the West Hawai'i Regional Fishery Management Area (WHRFMA), where collection is currently limited to 40 "White List" species of fish.

The objective of the proposed action is for the Department of Land and Natural Resources (DLNR) to issue 7 Aquarium Permits and 7 corresponding Commercial Marine Licenses for the WHRFMA. The need for the Applicant's action is to allow for commercial aquarium collection in compliance with all applicable laws, rules, and regulations pertaining to the industry.

Attached documents (signed agency letter & EA/EIS)

- 193705834_Hawaii-Revised_FEIS_05-26-2021.pdf
- OEQC-Transmittal-Letter-Hawaii-Revised-FEIS.pdf
- Appendix-D-Distribution-List_updated-05262021.pdf
- 193705834_Hawaii-Revised_FEIS_05-26-20211.pdf
- 193705834_Hawaii-Revised_FEIS_05-26-20212.pdf
- 193705834_Hawaii-Revised_FEIS_05-26-20213.pdf
- 193705834_Hawaii-Revised_FEIS_05-26-20214.pdf
- 193705834_Hawaii-Revised_FEIS_05-26-20215.pdf

Shapefile

- The location map for this Final EIS is the same as the location map for the associated Draft EIS.

Action location map

- Location-File.zip

Authorized individual

James Lynch

Authorization

- The above named authorized individual hereby certifies that he/she has the authority to make this submission.

Revised Final Environmental Impact Statement

Issuance of Commercial Aquarium Permits and Commercial Marine Licenses for the West Hawai'i Regional Fishery Management Area

May 26, 2021

Applicant

Name: Pet Industry Joint Advisory Council (PIJAC)
Address: 1615 Duke St., #100 Alexandria, VA 22314
Phone: 202.452.1525

Approving Agency

Hawai'i Department of Land and Natural Resources
Division of Aquatic Resources
1151 Punchbowl Street, Room 330
Honolulu, HI 96813-3088

APPLICANT PUBLICATION FORM

Project Name:	Issuance of Commercial Aquarium Permits and Commercial Marine Licenses for the West Hawai'i Regional Fishery Management Area
Project Short Name:	Revised FEIS WHRFMA Commercial Aquarium Permits
HRS §343-5 Trigger(s):	Trigger 1 (use of state lands) and Trigger 2 (use of conservation districts)
Island(s):	Hawai'i
Judicial District(s):	Puna, South Hilo, North Hilo, Kau, Hamakua, South Kona, North Kona, South Kohala, North Kohala
TMK(s):	West Hawai'i Regional Fishery Management Area identified in Figure 1
Permit(s)/Approval(s):	Commercial Aquarium Fishing Permits issued pursuant to HRS §188-31, Commercial Marine License issued pursuant to HRS 189-2,3, West Hawai'i Aquarium Permit issued pursuant to HAR 13-60.4
Approving Agency:	Department of Land and Natural Resources
Contact Name, Email, Telephone, Address	David Sakoda; david.sakoda@hawaii.gov, 808-587-0104,1151 Punchbowl Street, Room 330, Honolulu, HI 96813
Applicant:	Pet Industry Joint Advisory Council (PIJAC)
Contact Name, Email, Telephone, Address	Jim Lynch; lynchjm.wa@gmail.com425.463.8396; 1615 Duke St., #100 Alexandria, VA 22314
Consultant:	Stantec Consulting Services Inc
Contact Name, Email, Telephone, Address	Terry VanDeWalle; terry.vandewalle@stantec.com; (319) 334-3755; 2300 Swan Lake Blvd., Suite 202 Independence, IA 50644

Status (select one)	**Submittal Requirements**
__ DEA-AFNSI	Submit 1) the approving agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEA, and 4) a searchable PDF of the DEA; a 30-day comment period follows from the date of publication in the Notice.
__ FEA-FONSI	Submit 1) the approving agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; no comment period follows from publication in the Notice.
____ FEA-EISPN	Submit 1) the approving agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; a 30-day comment period follows from the date of publication in the Notice.
____ Act 172-12 EISPN ("Direct to EIS")	Submit 1) the approving agency notice of determination letter on agency letterhead and 2) this completed OEQC publication form as a Word file; no EA is required, and a 30-day comment period follows from the date of publication in the Notice.
____ DEIS	Submit 1) a transmittal letter to the OEQC and to the approving agency, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEIS, 4) a searchable PDF of the DEIS, and 5) a searchable PDF of the distribution list; a 45-day comment period follows from the date of publication in the Notice.
__XX__ FEIS	Submit 1) a transmittal letter to the OEQC and to the approving agency, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEIS, 4) a searchable PDF of the FEIS, and 5) a searchable PDF of the distribution list; no comment period follows from publication in the Notice.

___ FEIS Acceptance Determination	The approving agency simultaneously transmits to both the OEQC and the applicant a letter of its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS; no comment period ensues upon publication in the Notice.
____ FEIS Statutory Acceptance	The approving agency simultaneously transmits to both the OEQC and the applicant a notice that it did not make a timely determination on the acceptance or nonacceptance of the applicant's FEIS under Section 343-5(c), HRS, and therefore the applicant's FEIS is deemed accepted as a matter of law.
____ Supplemental EIS Determination	The approving agency simultaneously transmits its notice to both the applicant and the OEQC that it has reviewed (pursuant to Section 11-200-27, HAR) the previously accepted FEIS and determines that a supplemental EIS is or is not required; no EA is required, and no comment period ensues upon publication in the Notice.
____ Withdrawal	Identify the specific document(s) to withdraw and explain in the project summary section.
____ Other	Contact the OEQC if your action is not one of the above items.

Project Summary

The purpose of the Applicant's action is to ensure that commercial aquarium fish collection allows for the lawful, responsible, and sustainable commercial collection of 8 aquarium fish species from nearshore habitats of the West Hawai'i Regional Fishery Management Area (WHRFMA), where collection is currently limited to 40 "White List" species of fish. The objective of the proposed action is for the Department of Land and Natural Resources (DLNR) to issue 7 Aquarium Permits and 7 corresponding Commercial Marine Licenses for the WHRFMA, revise the White List from 40 to 8 species, and implement individual catch quotas for the 8 species remaining on the proposed Revised White List.

The need for the Applicant's action is to allow for commercial aquarium collection in compliance with all applicable laws, rules, and regulations pertaining to the industry.

Project Summary

Project Name: Issuance of Commercial Aquarium Permits and Commercial Marine Licenses for the West Hawai'i Regional Fishery Management Area.

Proposed Action: Collection of aquarium fish pursuant to the issuance of 7 Commercial Aquarium Permits under HRS §188-31 and 7 Commercial Marine Licenses under HRS 189-2,3, and implementation of species-specific catch quotas, ensuring lawful, responsible, and sustainable commercial collection of 8 aquarium fish species from nearshore habitats of the West Hawai'i Regional Fishery Management Area.

The Applicant notes that the DLNR and/or BLNR has the authority to impose specific permit conditions, including altering the proposed White List or catch quotas, as appropriate.

Applicant: Pet Industry Joint Advisory Council (PIJAC).

Applicant Contact: Jim Lynch, KL Gates LLP, 206-370-6587

Approving Agency: Department of Land and Natural Resources

Project Location: Throughout the West Hawai'i Regional Fishery Management Area (to depths of 100 fathoms), except in those areas already designated as no collection areas such as Fish Replenishment Areas.

Land Use Classification: N/A

Land Area: N/A NON-MLCDs

Tax Map Key: N/A

State Land District: N/A

Land Owner: State of Hawai'i

Permits Required: Commercial Aquarium Fishing Permits issued pursuant to HRS §188-31, Commercial Marine License issued pursuant to HRS 189-2,3, West Hawai'i Aquarium Permit issued pursuant to HAR 13-60.4.

HRS §343-5 Trigger: Trigger 1 (use of state lands) and Trigger 2 (use of conservation districts). Review of an Environmental Assessment (EA) prepared in 2018 determined an EIS was required based on Significance Criteria #1, #2, #3, #4, and #8. Review of a previous EIS prepared in 2020 resulted in non-acceptance by the Board of Land and Natural Resources (BLNR).

Anticipated Determination: Acceptance

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Executive Summary

In October 2017, the circuit court ruled that, based upon the Supreme Court of Hawai'i's opinion, existing Commercial Aquarium Permits (Aquarium Permits) for use of fine mesh nets to catch aquatic life for aquarium purposes are illegal and invalid. The circuit court ordered the Department of Land and Natural Resources (DLNR) not to issue any new Aquarium Permits pending environmental review. The DLNR has not issued new or additional Aquarium Permits under HRS §188-31 since September of 2017.

In January 2021, the court ruled that Commercial Marine Licenses (CMLs) for commercial aquarium collection were invalid as well, and the DLNR began the process of notifying all current permit holders that the CML could no longer be used for commercial aquarium purposes, updating the Specific Terms and Conditions of the CML to reflect that environmental review was needed prior to using a CML for commercial aquarium purposes.

The Applicant initially prepared and submitted an Environmental Assessment on April 8, 2018, evaluating the impacts of issuance of Aquarium Permits on the island of Hawai'i programmatically to any applicant over a 12-month analysis period. The DLNR determined on July 26, 2018, that preparation of an Environmental Impact Statement (EIS) was required, based on five significance criteria outlined in Title II, Chapter 200, Hawai'i Administrative Rules. An evaluation of the significance criteria, including the five identified by the DLNR, is provided in Section 5.6 of this document.

A Draft Environmental Impact Statement (DEIS) evaluating the impacts of issuance of 14 Aquarium Permits for the West Hawai'i Regional Fishery Management Area (WHRFMA) was published on November 23, 2019[1]. A Final Environmental Impact Statement (FEIS) evaluating the impacts of issuance of 10 Aquarium Permits for the WHRFMA was published on April 23, 2020, and included a change to the proposed action, reducing the number of Commercial Aquarium Permits from 14 to 10[2]. On June 23, 2020 the State of Hawai'i Board of Land and Natural Resources (BLNR) published the FEIS Acceptance Determination of non-acceptance of the FEIS[3].

A Revised DEIS was prepared to address the 14 concerns raised by the BLNR in their non-acceptance determination. It evaluated the impacts of issuance of seven Aquarium Permits, West Hawai'i Aquarium Permits, and corresponding Commercial Marine Licenses (CMLs) for the WHRFMA, creation of a Revised White List consisting of eight species (prohibiting catch of the other 32 species currently on the White List), and the creation of individual catch quotas for each of the eight species on the proposed Revised White List was published on February 23, 2021. **Since the release of the Revised DEIS, edits were made (Appendix E) in response to public comments (see Appendix C), including editing language in the Revised FEIS to clarify that population trends are used as the measure of sustainability to evaluate impacts to fish populations, and edits to the proposed enforcement and compliance measures in Section 3.7.2.**

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[1] http://oeqc2.doh.hawaii.gov/EA_EIS_Library/2019-11-23-HA-DEIS-Hawaii-Island-Commercial-Aquarium-Permits.pdf
[2] http://oeqc2.doh.hawaii.gov/EA_EIS_Library/2020-04-23-HA-FEIS-Hawaii-Island-Commercial-Aquarium-Permits.pdf
[3] http://oeqc2.doh.hawaii.gov/EA_EIS_Library/2020-06-23-HA-Non-Acceptance-Hawaii-Island-Commecial-Aquarium-Permits.pdf

The Applicant has prepared this Revised FEIS to inform the public of the proposed action (i.e., issuance of 7 Aquarium Permits, corresponding CMLs, creation of a Revised White List, and implementation of individual catch quotas for the 8 species on the Revised White List) and the impacts of the proposed action and its alternatives, and to incorporate information gained through public involvement throughout the entirety of the Hawai'i Environmental Policy Act (HEPA) process beginning in 2018. The Preferred Alternative includes issuance of 7 Aquarium Permits and CMLs for the WHRFMA, reduction of the White List from 40 to 8 species, and implementation of individual catch quotas for all 8 species. No Aquarium Permits or CMLs for commercial aquarium collection would be issued under this action for other areas of the state, including East Hawai'i, and collection in the WHRFMA would be limited to the eight species on the proposed Revised White List. Implementation of the Preferred Alternative would ensure the lawful, responsible, and sustainable commercial collection of eight fish species from the WHRFMA.

Aside from the additional conservation measures included in the Preferred Alternative, the issuance of 7 Aquarium Permits and CMLs under the Preferred Alternative does not include any activities different from, or in addition to, those that have occurred in the past. There would be no construction of permanent or semi-permanent infrastructure, no discharges into coastal, surface or ground waters, no dredging, and no significant use of hazardous materials that could be released into the environment. The DLNR's issuance of 7 Aquarium Permits and CMLs is not anticipated to result in significant beneficial or adverse impacts to water and air quality, geology and soil resources, aesthetics, noise, vegetation, terrestrial wildlife, avian species, threatened and endangered species, land use, public health and safety, communications, transportation, utilities, or population and demographics from their current condition.

Populations of all eight species that would be collected under the Preferred Alternative have been either stable or increasing under historic annual collection (2000-2017, after establishment of the WHRFMA), and it is therefore anticipated that those population trends would continue under the collection proposed under the Preferred Alternative.

Two studies have concluded that the aquarium fishery has no significant impact on coral or the reef ecosystem. In addition, herbivores collected by the aquarium fishery typically consist of the smaller size classes which are the least effective sizes for cropping algae. One study found there were no increases in the abundance of macroalgae where the abundance of herbivores was reduced by aquarium collecting, though turf algae is the primary food of herbivores, and thus healthy herbivore populations are critical for healthy coral populations.

The Cultural Impact Assessment (CIA; Appendix A) concluded that cultural impacts would occur if issuance of Aquarium Permits under an alternative would cause a significant decline in the population of a White List Species considered to be a cultural resource, either directly through the collection of fish or indirectly through habitat impacts. It is noted, however, that some believe that collection for aquarium purposes, regardless of impact or sustainability, is a violation of traditional beliefs. While seven of the eight species on the proposed Revised White List have a known cultural use for food, medicinal, religious or ceremonial purposes, it is assumed a negative cultural impact could occur if populations of any of the eight species were impacted. As detailed in Section 5.4, populations of the eight species on the proposed Revised White List are not anticipated to substantially decline under the Preferred Alternative. However, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, the

Preferred Alternative may impact cultural practices, but the extent of the impact is unknown. Under the Preferred Alternative, negative cultural impacts in the WHRFMA would be less than the other action alternatives which include commercial aquarium collection in the WHRFMA due to implementation of the proposed Revised White List (32 species would not be collected at all in the WHRFMA) and individual catch quotas for the remaining 8 species. No negative cultural impacts would occur under the No Action Alternative, and negative cultural impacts under the CML-only Alternative would be limited to East Hawai'i.

The Preferred Alternative does not substantially affect the economy but plays an important role as a nearshore fishery in the state. The Preferred Alternative would add an estimated $2.5 to $10 million over the 5-year analysis period (range of $499,416 to $2,022,686 per year), and another five times this value in indirect economic benefits. Loss of the fishery would result in the loss of income, tax revenue, and jobs.

Abbreviations

BIAAF	Big Island Association of Aquarium Fishermen
BLNR	Board of Land and Natural Resources
CFR	Code of Federal Regulations
CML	Commercial Marine License
CREP	Coral Reef Ecosystems Program
CWCS	Comprehensive Wildlife Conservation Strategy
DAR	Division of Aquatic Resources
DEIS	Draft Environmental Impact Statement
DLNR	Department of Land and Natural Resources
DOCARE	Division of Conservation and Resources Enforcement
DOH	Department of Health
EA	Environmental Assessment
EC	Environmental Council
EIS	Environmental Impact Statement
ENSO	El Niño Southern Oscillation
EQC	Environmental Quality Commission

ESA	Endangered Species Act
ESD	Ecosystem Sciences Division
FEA	Final Environmental Assessment
FEIS	Final Environmental Impact Statement
FMA	Fisheries Management Area
FONSI	Finding of No Significant Impact
FRA	Fish Replenishment Area
Ha	hectares
HAR	Hawai'i Administrative Rule
HDBEDT	Hawai'i Department of Business, Economic Development & Tourism
HEPA	Hawai'i Environmental Policy Act
HRS	Hawai'i Revised Statute
HTA	Hawai'i Tourism Authority
IUCN	International Union for the Conservation of Nature
KMLAC	Ka'ūpūlehu Marine Life Advisory Committee
MLCD	Marine Life Conservation District
MHI	Main Hawaiian Islands
MPA	Marine Protected Areas

NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NWHI	Northwestern Hawaiian Islands
OEQC	Office of Environmental Quality Control
PIFSC	Pacific Islands Fisheries Science Center
PIJAC	Pet Industry Joint Advisory Council
QUEST	Quantitative Underwater Ecological Survey Techniques
RDL	recreational dive limits
SAWCS	Statewide Aquatic Wildlife Conservation Strategy
SCUBA	Self-contained Underwater Breathing Apparatus
SGCN	Species of Greatest Conservation Need
SLH	Session Laws of Hawai'i
SWAP	State Wildlife Action Plan
TL	Total Length
UH	University of Hawai'i
USCG	United Stated Coast Guard
USDA	United States Department of Agriculture

USFWS	United States Fish and Wildlife Service
VHF	very high frequency
WHAP	West Hawai'i Aquarium Project
WHFC	West Hawai′i Fishery Council
WHRFMA	West Hawai'i Regional Fishery Management Area
WHRFWG	West Hawai'i Reef Fish Working Group

1.0 INTRODUCTION

This Revised Final Environmental Impact Statement (FEIS) has been prepared by the Pet Industry Joint Advisory Council (PIJAC; the Applicant) pursuant to the Hawai'i Environmental Policy Act (HEPA). The Revised FEIS evaluates the impacts of issuance of seven Commercial Aquarium Permits (Aquarium Permit), corresponding West Hawai'i Aquarium Permits, and corresponding Commercial Marine Licenses (CML) for the West Hawai'i Regional Fishery Management Area (WHRFMA; Section 1.2.4), pursuant to Hawai'i Revised Statute (HRS) 188-31 (2013; Title 12 – Conservation and Resources; 188 – Fishing Rights and Regulations; 188-31 – Permits to take aquatic life for aquarium purposes) and HRS 189-2,3 (Title 12 – Conservation and Resources; 189 – Commercial Fishing; 189-2 – Commercial License; 189-3 – Monthly Catch Report).

The Applicant has prepared this Revised FEIS to inform the public of the proposed action (i.e., issuance of 7 Aquarium Permits and CMLs for the WHRFMA, creation of a Revised White List, and implementation of individual catch quotas for the 8 species on the Revised White List) and the impacts of the proposed action and its alternatives, and to incorporate information gained through past and current public involvement in order to aid decision makers in making an informed decision regarding the proposed action. The seven permittees covered by this Revised FEIS have verified that they are each legally qualified to apply for, and hold, an Aquarium Fishing Permit, Commercial Marine License, and West Hawai'i Aquarium Permit. The seven permittees covered by this Revised FEIS will file individual permit applications with Department of Land and Natural Resources (DLNR) in parallel with the submission of this Revised FEIS to Office of Environmental Quality Control (OEQC) and DLNR. DLNR will review such applications and take action upon them after further consideration of the Revised FEIS.

A DEIS and FEIS were previously published (see Section 1.1.3 for more details). This Revised FEIS includes an additional alternative which is now the proposed action, a revised No Action Alternative which reflects changes in CML issuance, a new CML-only Alternative which was the previous No Action Alternative, and changes to the Limited Permit Issuance Alternative. The new proposed action reduces the number of Commercial Aquarium Permits to 7, reduces the White List from 40 species to 8 species, and creates individual catch quotas for the 8 species remaining on the proposed Revised White List. These changes have resulted in additional analysis in the environmental consequences presented in Section 5.0. Additional changes in the Revised DEIS and Revised FEIS were made in response to previous public comment, the Board of Land and Natural Resources (BLNR) findings and reasons for non-acceptance of the previous FEIS (Section 1.1.3), comments received as part of coordination with the Consulted Parties, as well as incorporation of new data, including updated population estimates.

Hawai'i Revised Statute 188-31 states that, "Except as prohibited by law, the department (Department of Land and Natural Resources; DLNR), upon receipt of a written application, may issue an Aquarium Permit, not longer than one year in duration, to use fine meshed traps, or fine meshed nets other than throw nets, for the taking of marine or freshwater nongame fish and other aquatic life for aquarium purposes." As set down by the Supreme Court of Hawai'i (SCWC-13-0002125), issuance of an Aquarium Permit constitutes a discretionary State action by the DLNR and is thus subject to the HEPA, which requires that State agencies consider the impact of governmental actions on the environment by preparing an Environmental

Assessment (EA) or an Environmental Impact Statement (EIS) to document the potential impacts of the State action. A Draft Environmental Assessment (DEA) evaluating the impacts of the proposed action of issuing Aquarium Permits to fishermen on the island of Hawai'i and its alternatives was made available for public comment on April 8, 2018. After review of the EA, the DLNR determined on July 26, 2018, that preparation of an EIS was required, based on the significance criteria outlined in Title II, Chapter 200, Hawai'i Administrative Rules. Accordingly, the Applicant prepared a DEIS and FEIS to evaluate the potential impacts of alternatives associated with issuance of 10-14 Aquarium Permits for the WHRFMA, and a No Action Alternative. After review of that FEIS, the BLNR determined on June 23, 2020 to not accept the FEIS. In addition, since that ruling, it has been determined that issuance of a CML for commercial aquarium collection is requires HEPA review.

Accordingly, the Applicant has prepared this Revised FEIS to evaluate the impacts of issuance of seven Aquarium Permits and CMLs for the WHRFMA, establishment of a Revised White List of species, and the creation of individual catch quotas for all species on the proposed Revised White List, as well as to address the BLNR's 14 reasons for non-acceptance of the previous FEIS. Additionally, the No Action Alternative and Limited Permit Issuance Alternative have been revised to reflect changes to CML issuance which have occurred since publication of the previous FEIS, and the previous No Action Alternative is now a new CML-only Alternative. The consequences of the Preferred Alternative and the other alternatives considered on various resources are discussed in this Revised FEIS.

1.1 BACKGROUND

In 2017, the Hawai′i commercial aquarium fishery was the most economically valuable commercial inshore fishery in the State with fiscal year reported landings greater than $2.2 million (DAR 2019a). In 2017, the commercial aquarium fishery on the island of Hawai'i (excluding the other islands) reported landings near $1.4 million, with more than $1.29 million in the WHRFMA alone (DAR 2018a). The fishery developed initially on O'ahu in the late 1940's, went through a period of expansion in the 1970's and has subsequently declined on O'ahu both in terms of catch and overall value (DAR 2014a). The West Hawai′i aquarium fishery has undergone substantial and sustained expansion over the past 40 years. As of 2017, approximately 45% of the aquarium fish caught in the State and nearly 67% of value came from the WHRFMA (DAR 2018a).

Commercial aquarium fish collection in Hawai'i, and especially in West Hawai'i has long been a subject of controversy (DAR 2019a). As early as 1973, public concern over collecting activities prompted Hawai'i's DLNR, then Division of Fish and Game, to suspend the issuance of Aquarium Permits for a week while issues were considered and addressed (DAR 2014a). As a result, Aquarium Permit holders were required to submit monthly catch reports. However, no studies were conducted, and no 'sanctuary' areas were created at that time. The first sanctuary areas were created through a gentleperson's agreement primarily between dive/snorkel operators and commercial aquarium fishers in 1987, and four of these sanctuaries were incorporated into the Kona Coast Fisheries Management Area (FMA) in 1991 (DAR 2004). This interindustry collaboration and cooperation laid the groundwork for a more inclusive management approach to the fishery. The WHRFMA was created by Legislative Act 306 (1998) largely in response to longstanding and widespread conflict surrounding commercial aquarium fish collection (Section 1.2.4). The Act required substantive community input in management decisions (DAR 2019a).

In order to accomplish the mandates of Act 306, a community advisory group, the West Hawai′i Fishery Council (WHFC), was convened by the Division of Aquatic Resources (DAR) in 1998 (Section 1.2.4.1). Consisting of 24 voting members and 6 ex-officio agency representatives from DLNR, Sea Grant, and the Governor's Office, the WHFC's members represented diverse geographic areas and various stakeholder, community, and user groups in West Hawai'i. Four aquarium representatives (three collectors and one aquarium shop owner) were members of the WHFC, 40% of the WHFC were *maka'āinana* (i.e., native fishers) and most of the members were previously on the West Hawai'i Reef Fish Working Group (WHRFWG). The first action of the WHFC was the designation of a network of nine Fish Replenishment Areas (FRAs), in which no aquarium fish collection is allowed. The FRA's, along with existing Marine Protected Areas (MPA; which restrict additional types of fishing/collection as well), comprise 35.2% of the West Hawai'i coastline (DAR 2019a). Although closed to commercial and recreational aquarium fishing, FRAs are still open to other forms of permitted fishing. Concerns over continued expansion of the commercial aquarium fishery and collecting effects in the Open Areas (i.e., areas where aquarium fish collection is allowed) prompted the DLNR in 2013 to establish a 'White List' of 40 species that can be collected by commercial aquarium fishers within the WHRFMA (Section 4.4.1). All other species are off limits within the WHRFMA (DAR 2019a) but can be collected in East Hawai'i.

1.1.1 Status of Aquarium Permits

In October 2012, Earthjustice filed a complaint under the HEPA in the First Circuit Court on behalf of four individuals and three non-governmental organizations. The complaint sought a court order to force the State to comply with the HEPA's requirement to examine commercial aquarium fish collection's effects on the environment before issuing collection permits. The complaint also asked the court to halt collection under existing Aquarium Permits and to stop DLNR from issuing new permits until the environmental review is complete (Earthjustice 2012). On June 24, 2013, the Circuit Court of the First Circuit announced their findings on the case through an 'Order Granting Department of Land and Natural Resources State of Hawai'i's, Motion for Summary Judgment filed February 4, 2013, and Denying Plaintiffs' Motion for Summary Judgment filed February 5, 2013 (Summary Judgment Order), and the Final Judgment in Favor of Defendant and Against Plaintiffs (Judgment), also filed on June 24, 2013. The Hawai'i Intermediate Court of Appeals upheld this decision in August 2016. Permit issuance by DLNR's DAR continued.

Through the appeals process, Earthjustice brought the case before the Supreme Court of Hawai'i. On September 6, 2017, the Supreme Court of Hawai'i ruled that aquarium collection using fine meshed traps or nets is subject to the environmental review procedures provided in the HEPA (SCWC-13-0002125). The issue was remanded to the circuit court for further proceedings. In light of the ruling, DLNR discontinued issuance of new Aquarium Permits and renewal of existing Aquarium Permits (DAR 2017).

On October 27, 2017, the circuit court ruled that, based upon the Supreme Court of Hawai'i's opinion, existing permits for use of fine mesh nets to catch aquatic life for aquarium purposes are illegal and invalid. The circuit court ordered the DLNR not to issue any new permits pending environmental review. The DLNR has not issued new or additional permits under HRS §188-31 since the Supreme Court's opinion was issued in September of 2017 (DAR 2017).

On January 5, 2018 the DLNR issued a press release clarifying that no aquatic life may be taken for commercial aquarium purposes in West Hawai'i until an environmental review is complete.

1.1.2 Status of Commercial Marine Licenses

In January 2020, Earthjustice filed a lawsuit on behalf of three individuals and two non-governmental organizations. The lawsuit sought to "enforce the letter and intent of the courts' prior rulings and ensure that all aquarium collection complies with the environmental review process required under the Hawaii Environmental Policy Act". The lawsuit alleged that the DLNR continued to allow commercial aquarium collection after the October 2017 ruling described in Section 1.1.1 above by issuing or renewing CMLs to commercial aquarium collectors. A motion filed in May 2020 argued that the same HEPA review required for aquarium collection under Aquarium Permits should be required for collection under CMLs.

A Circuit Court Order on November 27, 2020 declared the DLNR's issuance of CMLs for aquarium collection was invalid and illegal. At that time, the DLNR announced that they would not renew or issue new CMLs without a condition prohibiting the taking of marine life for aquarium fishing purposes until Chapter 343 environmental review is completed. The November 27 ruling specifically did not issue an injunction on the existing CMLs, allowing commercial aquarium collection to continue for those permit holders until their CMLs expired (permits are valid for one year, see Section 1.2.2).

A ruling on January 12, 2021 determined that all CMLs for commercial aquarium collection were invalid pending environmental review, banning all commercial aquarium collection. Following that ruling, the DAR updated its "Commercial License and Permit Specific Terms and Conditions" and began the process of notifying existing CML holders about the Court's ruling.

In summary, commercial aquarium collection under both Aquarium Permits and CMLs occurred prior to October 2017. Between October 2017 and November 2020, the DLNR continued to issue CMLs for commercial aquarium collection, which allowed for the continued collection of aquarium fish for commercial purposes in East Hawai'i using gear other than fine mesh nets (which require an Aquarium Permit). After November 27, 2020, the DLNR stopped issuing new CMLs, but the existing CMLs could continue to be used for commercial aquarium collection until expiration until January 12, 2021, when all commercial aquarium collection was banned.

1.1.3 Previous HEPA Documents

PIJAC initially prepared and submitted an EA on April 8, 2018, evaluating the impacts of issuance of Aquarium Permits on the island of Hawai'i programmatically to any applicant over a 12-month analysis period. In accordance with HEPA, the Draft EA was circulated for public review and comment through publication in The Environmental Notice and was also distributed via copies or email to a variety of elected officials, federal agencies, state, county and local offices, and individuals and organizations. Public comments were accepted during a 30-day period following publication. A total of 836 responses were received: 435 supported the conclusions of the DEA and issuance of Aquarium Permits; 398 did not support the conclusions of the DEA and opposed issuance of Aquarium Permits; and 3 did not express support or opposition. Comments received during the comment period were taken into account in assessing impacts

of the proposed action and resulted in some modifications in the Final EA, which are also reflected in this EIS. Responses to comments on the DEA can be found in Appendix B of the Final EA[4].

In the cover letter for the publication of the DEA, the DLNR requested comment on four specific issues:

1. The effects of the Commercial Aquarium Fishery on Achilles Tang (*Acanthurus achilles*), and its sustainability given its life history characteristics, current population trends, and harvest by other fisheries.

2. The adequacy of the analysis presented in the DEA, including but not limited to removal and replenishment rates for vulnerable species; specifically, how is the estimated sustainable range of 5% to 25% annual take of the estimated total population arrived at, and should the threshold be 5% or 25%.

3. The interpretation of data presented in the DEA, including the analysis of NOAA NMFS Coral Reef Ecosystem Project (CREP) data versus DLNR Division of Aquatic Resources West Hawai'i Aquarium Project (WHAP) data.

4. Conservation measures to minimize or avoid impacts to target species, and specifically, whether other alternatives might be proposed to minimize or avoid impacts other than the two presented of no action, with no Aquarium Permits issued, and the preferred alternative of programmatic issuance of Aquarium Permits for the Island of Hawai'i – such as consideration of specific management measures for Achilles tang and other species.

The Applicant's responses to the request for comment along with an independent scientific reviewer's comments on the responses are found in Appendix D of the Final EA. After review of the Final EA, the DLNR determined on July 26, 2018, that preparation of an EIS was required, based on the significance criteria outlined in Title II, Chapter 200, Hawai'i Administrative Rules[5]. Specifically, the DLNR requested further analysis related to five specific significance criteria:

- Significance Criteria #1 – Is the annual take of cumulative numbers of fish as a percentage of the estimated population an irrevocable loss or destruction of said populations?

- Significance Criteria #2 – To what extent does the take of aquarium fish curtail the use of the environment, including:

    - Aquatic invasive algae control

    - Tourism industry

    - Integrity of diverse aquatic ecosystems

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[4] http://oeqc2.doh.hawaii.gov/EA_EIS_Library/2018-08-08-HA-FEA-EISPN-Hawaii-Island-Commercial-Aquarium-Permits.pdf
[5] https://governor.hawaii.gov/wp-content/uploads/2018/07/Final-EA-NOD-Aquarium-Permits-Hawaii-Island-7-26-18.pdf

- Significance Criteria #3 – Does the take of aquarium fish conflict with the state's long-term environmental goals?
- Significance Criteria #4 – To what extent does the take of aquarium fish impact cultural practices in the state?
- Significance Criteria #8 – What is the cumulative impact of the take of aquarium fish when combined with:
    - Commercial take of aquarium fish using other legal methods
    - Recreational take of aquarium fish
    - Commercial and non-commercial take of aquarium fish for consumption (particularly the Achilles Tang and Kole)

A DEIS evaluating the impacts of issuance of 14 Aquarium Permits for the WHRFMA was published on November 23, 2019[6]. An FEIS evaluating the impacts of issuance of 10 Aquarium Permits for the WHRFMA was published on April 23, 2020, and included a change to the proposed action, reducing the number of Commercial Aquarium Permits from 14 to 10[7]. On June 23, 2020, the BLNR published its FEIS Acceptance Determination in which the BLNR decided on non-acceptance of the FEIS[8] based on 14 concerns which were addressed in a Revised DEIS published on February 23, 2021, as summarized below.

1. In order to properly assess the likely impact of the proposed take of the aquarium fish, the FEIS should contain a reasonably reliable estimate of the amount of future take.
    - This concern is addressed by the new Preferred Alternative which has been added to Section 3.7 of the Revised FEIS which includes species-specific individual catch quotas for participants in the WHRFMA. Therefore, a maximum allowable collection for each species is now provided in Section 5.0.
2. Except for the pākuʻikuʻi, or Achilles tang, the FEIS does not contain any daily bag limits on any of the "White List" species which the fishers are allowed to take, and there are no annual limits on the take of any species except that the total take of pākuʻikuʻi would be limited by the fact that only ten permits with a daily limit of five each would be allowed under the proposed action. In addition, there is no scientific basis provided for reducing daily take of pākuʻikuʻi from ten to five per permit, nor any analysis of the impact of that level of take on the population of pākuʻikuʻi.
    - This concern is addressed by the new Preferred Alternative which has been added to Section 3.7 of the Revised FEIS which includes individual catch quotas for all species on

[6] http://oeqc2.doh.hawaii.gov/EA_EIS_Library/2019-11-23-HA-DEIS-Hawaii-Island-Commercial-Aquarium-Permits.pdf
[7] http://oeqc2.doh.hawaii.gov/EA_EIS_Library/2020-04-23-HA-FEIS-Hawaii-Island-Commercial-Aquarium-Permits.pdf
[8] http://oeqc2.doh.hawaii.gov/EA_EIS_Library/2020-06-23-HA-Non-Acceptance-Hawaii-Island-Commecial-Aquarium-Permits.pdf

a proposed Revised White List, and collection of Achilles Tang would no longer be permitted in the WHRFMA. While daily limits are not included, the inclusion of annual individual catch quotas addresses this concern by limiting collection within any given year.

3. The existing regulations of the WHRFMA do not contain any daily or annual bag limits other than for the pākuʻikuʻi, a "slot limit" for yellow tang, and a limit on Kole over 4" long. To project how many fish are likely to be taken, the FEIS relies completely on the historical catch records of these ten fishers for the forty "White List" species. See Tables 5-2 and 5-11. The FEIS concludes that 160,832 fish would be taken annually, based on the maximum number taken by the ten permittees in any year, during the 2000-2017 period. See §5.4.1.5.

    - This concern is addressed by the new Preferred Alternative which has been added to Section 3.7 of the Revised FEIS which includes individual catch quotas for the eight species on the proposed Revised White List. While daily limits are not included, annual individual catch quotas addresses this concern by limiting collection within any given year.

4. It appears that no more than 8 of the 10 fishers were active in any previous year. See Table 4-2. It seems likely that all ten fishers will be active, given they had sufficient interest in the permits to fund the EIS, and that they will have a monopoly on the use of fine-mesh nets to collect fish in the WHRFMA.

    - This concern was determined by the Environmental Council to be arbitrary and capricious.

5. The FEIS has no information about the level of effort of these 10 fishers in prior years, i.e., whether they collected 100, 200, or 300 days a year, for example, and the amount of time spent collecting. It is possible that they could significantly increase their collection efforts and total take.

    - This concern is addressed by the new Preferred Alternative which has been added to Section 3.7 of the Revised FEIS, which implements species-specific individual catch quotas for each of the requested permits.

6. The fishers could also or alternatively change what species they target for collection and increase the impact on some species.

    - This concern is addressed by the new Preferred Alternative which has been added to Section 3.7 of the Revised FEIS, which includes a proposed Revised White List of only eight species and individual catch quotas for each of those species.

7. The data in the FEIS show that these ten fishers take some species at a very different rate than the fishery as a whole. For example, although the percentage taken of all species by the ten in the WHRFMA varies from a low of 7.0% in FY2000 (when only two were active) to 46.4% in FY2017 (Table 5-2), their percentage of take of individual species, at least in certain years, has been much higher. Table 5-11 gives the maximum catch in any one year for each of the "White List" species, and the maximum catch in any one year by the ten. The ten fishers took 83.7% of the lei triggerfish (252/301), 95.5% of the milletseed butterfly fish (402/421), and 89.2% of the Fisher's angelfish (257/288), and 54.6% of the kole (23,014/42,122.) On the other hand, they took only 9.1% of the

ornate wrasse (1130/12,445). This demonstrates that collectors can, and do, selectively target some species more than others. (It is not clear whether the maximum year given for all collectors is the same year as that given for the maximum by the ten fishers. The basic point made here is valid in either case, however.)

- This concern is addressed by the new Preferred Alternative which has been added to Section 3.7 of the Revised FEIS, which includes a proposed Revised White List of only eight species and individual catch quotas for each of those species.

8. In order to assess the likely impact of the take, the FEIS should adequately analyze the sustainable level of take. The FEIS relies on Ochavillo and Hodgson (2006) for the proposition that 5-25% of a population is a sustainable level for annual take. The FEIS has an inadequate justification for the reliance on this publication as the best available science. The FEIS does not provide data for nor statistically analyze the sustainability of that level of take for each type of fish, given each fish species' life span, population size, reproductivity rates and age at first reproduction.

    - This concern is addressed by the new Preferred Alternative which has been added to Section 3.7 of the Revised FEIS, which includes a proposed Revised White List of only eight species, all of which have shown a stable or increasing population size in the WHRFMA over the last 20 years. No species with declining populations will be allowed to be collected in the WHRFMA.

9. In §5.4.1.5, the FEIS uses Table 5-11 to compare the take of various species to the CREP population estimates, to show that they are well below the claimed 5-25% sustainable level. In Table 4-5, however, the harvest/population ratios of four or five species (depending on the year) in the West Hawai'i open areas at 30'-60' depth exceeded 5% for several species, and are as high as 39.67% for the paku'iku'i in 2017-2018. The West Hawai'i open area population estimates may be more relevant than the island-wide CREP data.

    - This concern is addressed by the new Preferred Alternative which has been added to Section 3.7 of the Revised FEIS, which includes a proposed Revised White List of only eight species, all of which have shown an increase in population size in the WHRFMA over the last 20 years. In addition, Section 5.4.1 has been revised to include an analysis of impacts based on Pacific Islands Fisheries Science Center Ecosystem Sciences Division (PIFSC-ESD; formerly Coral Reef Ecosystems Program [CREP]) population estimates within the WHRFMA, WHAP WHRMFA population estimates, WHAP Open Area population estimates, and impacts specific to East Hawai'i.

10. The FEIS has an inadequate discussion of the role of herbivores. Many of the "White List" species are herbivores.

    - This concern has been addressed by adding detail on herbivores to Section 5.4.1 of the Revised FEIS.

11. The FEIS does not adequately discuss relevant negative findings, for example, the reduced numbers of aquarium fish at collection sites found by Tissot and Hallacher (2003). The FEIS need not agree or disprove the negative findings, but it should discuss them.

    - This concern was determined by the Environmental Council to be arbitrary and capricious.

12. The extreme threat of climate change on our reefs warrants extreme caution in reviewing activities that may affect them. The FEIS should further discuss potential effects of present and future levels of climate change including ocean warming, ocean acidification, coral bleaching, extreme storms, and resulting reef destruction and algae growth, and the potential for mitigating harm (i.e., further regulation) if the proposed fishery has unanticipated or greater negative effects with climate change.

    - This concern has been addressed through edits to Section 5.4.3.

13. The FEIS failed to sufficiently consider cultural impacts. The FEIS improperly concluded that the impacts to cultural resources under any of the proposed alternatives would be less than significant based on the flawed premise that cultural impacts would only occur if the proposed action would cause a significant decline in the population of a White List Species considered to be a cultural resource. A number of testimonies expressed misgivings from a cultural standpoint with the proposed activity itself, regardless of impact on resources, and this was not adequately considered in concluding no significant impact.

    - This concern has been addressed through edits to Section 5.3.

14. The FEIS does not adequately discuss the effect of illegal aquarium fishing on the numbers of projected sustainable take of fish species.

    - This concern was determined by the Environmental Council to be arbitrary and capricious. The Applicant does not support or condone poaching or any infractions of the law.

In accordance with HEPA, the Revised DEIS was circulated for public review and comment through publication in The Environmental Notice and was also distributed via copies or email to a variety of elected officials, federal agencies, state, county and local offices, and individuals and organizations. Public comments were accepted during a 30-day period following publication. Comments received during the comment period were taken into account in assessing impacts of the proposed action and resulted in some modifications in this Revised FEIS. Responses to comments on the Revised DEIS can be found in Appendix C and changes from the Revised DEIS to the Revised FEIS can be found in Appendix E.

1.2 RELEVANT POLICIES AND CONTROLS

1.2.1 Hawai'i Revised Statute (HRS) 188-31 [Commercial Aquarium Permits]

Hawai'i Revised Statute 188-31 (2013; Title 12 – Conservation and Resources; 188 – Fishing Rights and Regulations; 188-31 – Permits to take aquatic life for aquarium purposes) states that:

1. Except as prohibited by law, the department, upon receipt of a written application, may issue an aquarium fish permit, not longer than one year in duration, to use fine meshed traps, or fine meshed nets other than throw nets, for the taking of marine or freshwater nongame fish and other aquatic life for aquarium purposes.

2. Except as prohibited by law, the permits shall be issued only to persons who can satisfy the department that they possess facilities to and can maintain fish and other aquatic life alive and in reasonable health.

3. It shall be illegal to sell or offer for sale any fish and other aquatic life taken under an aquarium fish permit unless those fish and other aquatic life are sold alive for aquarium purposes. The department may adopt rules pursuant to HRS chapter 91 for the purpose of this section.

1.2.2 Hawai'i Revised Statute (HRS) 189-2,3 [Commercial Marine Licenses; CMLs]

HRS 189-2 (Title 12 – Conservation and Resources; 189 – Commercial Fishing; 189-2 – Commercial Marine License) states that:

(a) No person shall take marine life for commercial purposes whether the marine life is caught or taken within or outside of the State, without first obtaining a commercial marine license as provided in this section.

(b) Additionally, any person providing vessel charter services in the State for the taking of marine life in or outside of the State shall obtain a commercial marine license.

(c) The department may adopt rules pursuant to chapter 91 necessary for the purpose of this section and to set fees for commercial marine licensing.

(d) The fees for commercial marine licenses and duplicate commercial marine licenses shall be established by the department by rules adopted in accordance with chapter 91.

(e) The department shall suspend, shall refuse to renew, reinstate, or restore, or shall deny any license issued under this section if the department has received certification from the child support enforcement agency pursuant to section 576D-13 that the licensee or applicant is not in compliance with an order of support or has failed to comply with a subpoena or warrant relating to a paternity or child support proceeding. The department shall issue, renew, reinstate, or restore an affected license only upon receipt of authorization from the child support enforcement agency, the office of child support hearings, or the family court.

HRS 189-3 (Title 12 – Conservation and Resources; 189 – Commercial Fishing; 189-3 – Monthly Catch Report) states that:

(a) Upon the demand of the department, every commercial marine licensee shall furnish to the department a report or reports with respect to the marine life taken and any other information the department may require for the purposes of this section.

(b) Any information submitted to the department by any person in compliance with any requirement under this section shall be confidential and shall not be disclosed, except when required under court order or pursuant to subpoena issued by the department of the attorney general, or with the prior written consent of the person submitting the information, or under cooperative agreements with government agencies of the United States for exchange and use of the information specifically to manage marine life. The department, by rule, may establish procedures necessary to preserve the confidentiality, except that the department may release or make public any of the information in the aggregate or summary form which does not directly or indirectly disclose the identity of any person who submits information.

Specific terms and conditions for CMLs were updated on January 13, 2021, and state:

1. Licenses issued to individuals are non-transferable and cannot be used by anyone else.
2. It is illegal to take fish or marine life with intent to sell without a valid commercial marine license. I must be a U.S. citizen, or be legally admitted into the United States of America, or be in compliance with U.S. Customs and Border Protection, Dept. of Homeland Security landing permit requirements in order to qualify for the license.
3. Although the Federal Privacy Act of 1974 was amended to allow disclosure of Social Security Number for federal and state Child Support Enforcement investigation, DLNR has not amended the Hawaii Administrative Rules to require disclosure for licensing purposes. I may, however, voluntarily provide this information.
4. I must pay an individual resident license fee of $100.00 for resident or non-resident.
5. Unless exempted from the report requirement, I must complete and submit fishing reports to DLNR until my license expires.
    a. Submit fishing reports on all fishing activities except for bottomfish fishing trips (refer to “b”) during a month by the tenth day of the following month, for example, the May fishing report must be submitted by June 10th.
    b. Submit the ‘MHI “Deep 7” Bottomfish Fishing Trip Report’ within 5 days after the end of any fishing trip where a Deep 7 botttomfish species (Opakapaka, Onaga, Ehu, Kalekale, Gindai, Lehi, and Hapuupuu) was landed, released or lost to predation.
6. Submit the “Did Not Fish” report postcard to DLNR by the tenth day of the following month, if you did not fish during a month.
7. It is illegal and a violation of this commercial marine license to:
    a. take marine life for commercial aquarium purposes,
    b. possess marine life that has been taken for commercial aquarium purposes, or
    c. possess aquarium collecting gear in state marine waters,

without first completing the required environmental review process under the Hawai‘i Environmental Policy Act (HEPA), HRS Chapter 343.

1.2.3 Hawai'i Environmental Policy Act

The HEPA requires that State agencies consider the impact of governmental actions on the environment because humanity's activities have broad and profound effects upon the interrelations of all components of the environment, and an environmental review process would integrate the review of environmental concerns with existing planning processes of both the State and county governments. The HEPA includes the following statutes and administrative rules: a) HRS Chapter 343, Environmental Impact Statements; b) Hawai'i Administrative Rule (HAR) 11-200, Environmental Impact Statement Rules; c) HAR 11-201, Environmental Council Rules of Practice and Procedure (OEQC 2012).

The authorities governing the HEPA process include:

1. The text of the statute (Chapter 343, HRS) and its implementing administrative rules (Chapters 11-200.1, and 11-201, HAR, Department of Health [DOH]);
2. The State Environmental Policy (Chapter 344, HRS);
3. The enumerated and written advisory opinions of the Attorney General of the State of Hawai'i;
4. The declaratory rulings of the Environmental Quality Commission (EQC) and the Environmental Council (EC); and,
5. The appellate rulings of the Intermediate Court of Appeals and the Supreme Court of the State of Hawai'i.

The HEPA process also alerts decision makers to significant environmental effects that may result from the implementation of certain actions (HRS 343-1). The specific instances when a proposing agency or an approving agency must prepare an EA (for an action not declared exempt under Section 11-200-8, HAR) derive from Section 343-5(a) HRS and are listed in Table 1-1.

Table 1-1. Statutory Triggers for Hawai'i Environmental Policy Act (HEPA).

	Instances	Responsible Agency
1.	Use of State or County lands or use of State or County funds, other than funds to be used for feasibility or planning studies for possible future programs or projects that the agency has not approved, adopted, or funded, or funds to be used for the acquisition of unimproved real property; provided that the agency shall consider environmental factors and available alternatives in its feasibility or planning studies; provided further that an EA for proposed uses under Section 205-2(d)(11) or 205-4.5(a)(13) shall only be required pursuant to Section 205-5(b).	The agency with title to the land or is using funds.
2.	Use of any land classified as conservation district by the state land use commission under Chapter 205.	Office of Conservation and Coastal Lands of the DLNR.
3.	Use within a shoreline area as defined in Section 205A-41. The shoreline area in question is defined by county ordinance and consists of a predetermined distance going inland from the certified shoreline. In the City and County of Honolulu, this is forty feet.	The respective county planning department.

	Instances	Responsible Agency
4.	Use within any historic site as designated in the National Register or Hawai'i Register, as provided for in the Historic Preservation Act of 1966, Public Law 89-665, or Chapter 6E.	The respective county planning department.
5.	Use within the Waikiki area of O'ahu, the boundaries of which are delineated in the land use ordinance as amended, establishing the "Waikiki Special District".	The Department of Planning and Permitting of the City and County of Honolulu.
6.	Any amendments to existing county general plans where the amendment would result in designations other than agriculture, conservation, or preservation, except actions proposing any new county general plan or amendments to any existing county general plan initiated by a county.	The respective county planning department.
7.	Any reclassification of any land classified as a conservation district by the state land use commission under Chapter 205.	The Land Use Commission, except in cases involving less than fifteen-acres (which cases are processed by the respective county planning department).
8.	Any construction of new or the expansion or modification of existing helicopter facilities within the State, that may affect: A. Any land classified as a conservation district by the state land use commission B. A shoreline area 1. Any historic site as designated in the National Register or Hawai'i Register	The respective county planning department where the project is located processes the clearance of this trigger.
9.	Propose any: A. Wastewater treatment unit, except an individual wastewater system or a wastewater treatment unit serving fewer than fifty single family dwellings or the equivalent B. Waste-to-energy facility C. Landfill D. Oil refinery E. Power-generating facility	The agencies of the State or County government that issue discretionary approvals for the listed items.

The Supreme Court of Hawai'i ruled (SCWC-13-0002125) that an environmental review of the Aquarium Permit process is warranted based on the first (use of state lands) and second (use of conservation districts) statutory triggers identified in Table 1-1, above.

Actions that do not fall under one of the triggers are excluded by statute from the HEPA process. Any action that is not excluded by statute must undergo the HEPA environmental review process (OEQC 2012). The analysis within an EA is used to determine whether the impact on the environment would be significant enough to warrant the preparation of a full EIS or would be used to declare a Finding of No Significant Impact (FONSI) thus clearing the HEPA process.

In most cases, an agency determines that an action may have a significant impact on the environment and require an EIS if it meets any of the following 13 criteria:

1. Involves an irrevocable commitment to loss or destruction of any natural or cultural resource;
2. Curtails the range of beneficial uses of the environment;
3. Conflicts with the state's environmental policies or long-term environmental goals as established by law;
4. Substantially affects the economic or social welfare of the community or State;

5. Substantially affects public health;
6. Involves substantial secondary impacts, such as population changes or effects on public facilities;
7. Involves a substantial degradation of environmental quality;
8. Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions;
9. Substantially affects a rare, threatened, or endangered species, or its habitat;
10. Detrimentally affects air or water quality or ambient noise levels;
11. Affects or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, beach, sea level rise exposure area, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters;
12. Substantially affects scenic vistas and view planes identified in county or state plans or studies; or
13. Requires substantial energy consumption or emit substantial greenhouse gases.

Since its inception, the HEPA process has bifurcated into two separate procedural tracks (OEQC 2012):

1. Agency actions (set forth in Section 343-5(b), HRS); refers to those proposed by a government agency; and
2. Applicant actions (set forth in Section 343-5l, HRS); refers to those that are initiated by a private party and “triggers” an environmental review.

The need for this Revised FEIS is based on the proposed action (i.e., DLNR issuance of 7 Aquarium Permits) and the agency determination that an EIS is required due to possible significant impacts on the environment.

The environmental review process described in the findings and purpose section of Chapter 343, HRS, necessitates integrating citizen concerns into the planning process and forewarning decision makers of potential significant environmental effects should implementation take place. The Hawai’i Office of Environmental Quality Control (OEQC) finds that the process of reviewing environmental effects is desirable because environmental consciousness is enhanced, cooperation and coordination are encouraged, and public participation during the review process benefits all parties involved and society as a whole (OEQC 2012).

1.2.4 Act 306 SLH – West Hawai’i Regional Fishery Management Area

Act 306 Session Laws of Hawai’i (SLH 1998) directed DLNR to establish the WHRFMA along the entire west coast of the Island of Hawai'i; ‘bounded by the west coast of Hawai‘i Island, from Ka Lae, Ka‘ū (South Point) to ‘Upolu Point, North Kohala, and extending from the upper reaches of the wash of the waves on shore, seaward to the limit of the State’s police power and management authority.

From Act 306:

The purpose of the WHRFMA shall be to:

1. Ensure the sustainability of the state's nearshore ocean resources;
2. Identify areas with resource and use conflicts;
3. Provide management plans as well as implementing regulations for minimizing user conflicts and resource depletion through the designation of sections of coastal waters in the WHRFMA as FRAs where certain specified fish collecting activities are prohibited and other areas where anchoring and ocean recreation activities are restricted;
4. Establish a system of day-use mooring buoys in high-use coral reef areas and limit anchoring in some of these areas to prevent anchor damage to corals;
5. Identify areas and resources of statewide significance for protection;
6. Carry out scientific research and monitoring of the nearshore resources and environment; and
7. Provide for substantive involvement of the community in resource management decisions for this area through facilitated dialogues with community residents and resource users. The DLNR shall identify the specific areas and restrictions after close consultation and facilitated dialogue with working groups of community members and resource users.

The department shall develop a WHRFMA plan that identifies and designates appropriate areas of the management area in accordance with HRS Chapter 91 as follows:

1. Designate a minimum of thirty percent (30%) of coastal waters in the WHRFMA as FRAs in which aquarium fish collection is prohibited (other fishing still permitted);
2. Establish a day-use mooring buoy system along the coastline of the WHRFMA and designate some high-use areas where no anchoring is allowed;
3. Establish a portion of the FRAs as fish reserves where no fishing of reef-dwelling fish is allowed; and,
4. Designate areas where the use of gill nets as set nets shall be prohibited.

A review of the effectiveness of the WHRFMA plan shall be conducted every five years by the DLNR in cooperation with the University of Hawai'i (UH). The DLNR shall submit a report of its findings and recommendations based on the review to the legislature no later than 20 days before the convening of the regular session following the review. The most recent review was completed in 2019 (DAR 2019c).

1.2.4.1 West Hawai'i Fishery Council

The DAR (DAR 2019c) stated:

> *In order to accomplish the mandates of Act 306, with substantive community input, The West Hawai'i Fishery Council (WHFC) was convened June 16, 1998 under the aegis of DLNR and the University of Hawai'i Sea Grant Program. Consisting of 24 voting members and 6 ex-officio agency representatives from DLNR, Sea Grant, and the Governor's Office, the WHFC's members represented diverse geographic areas and various stakeholder, community and user groups in West Hawai'i. Four aquarium representatives (three collectors and one aquarium shop owner) were members of the WHFC and most of the members were previously on the [West Hawai'i Reef Fish Working Group] WHRFWG.*
>
> *The West Hawai'i Fishery Council provided the vehicle for stakeholders to participate directly in the development of management recommendations. Such participation has important benefits for increasing legitimacy of decisions in the eyes of stakeholders, as well as increasing compliance with decisions and rules subsequently established (Kessler 2004).*

The WHFC developed an FRA plan consisting of nine separate areas along the west coast of the Island of Hawai'i (Figure 1) encompassing a total of 35.2% of the West Hawai'i coastline (including already protected areas). The WHFC's FRA plan was subsequently incorporated by the DLNR into administrative rule. The FRA administrative rule became effective on December 31, 1999.

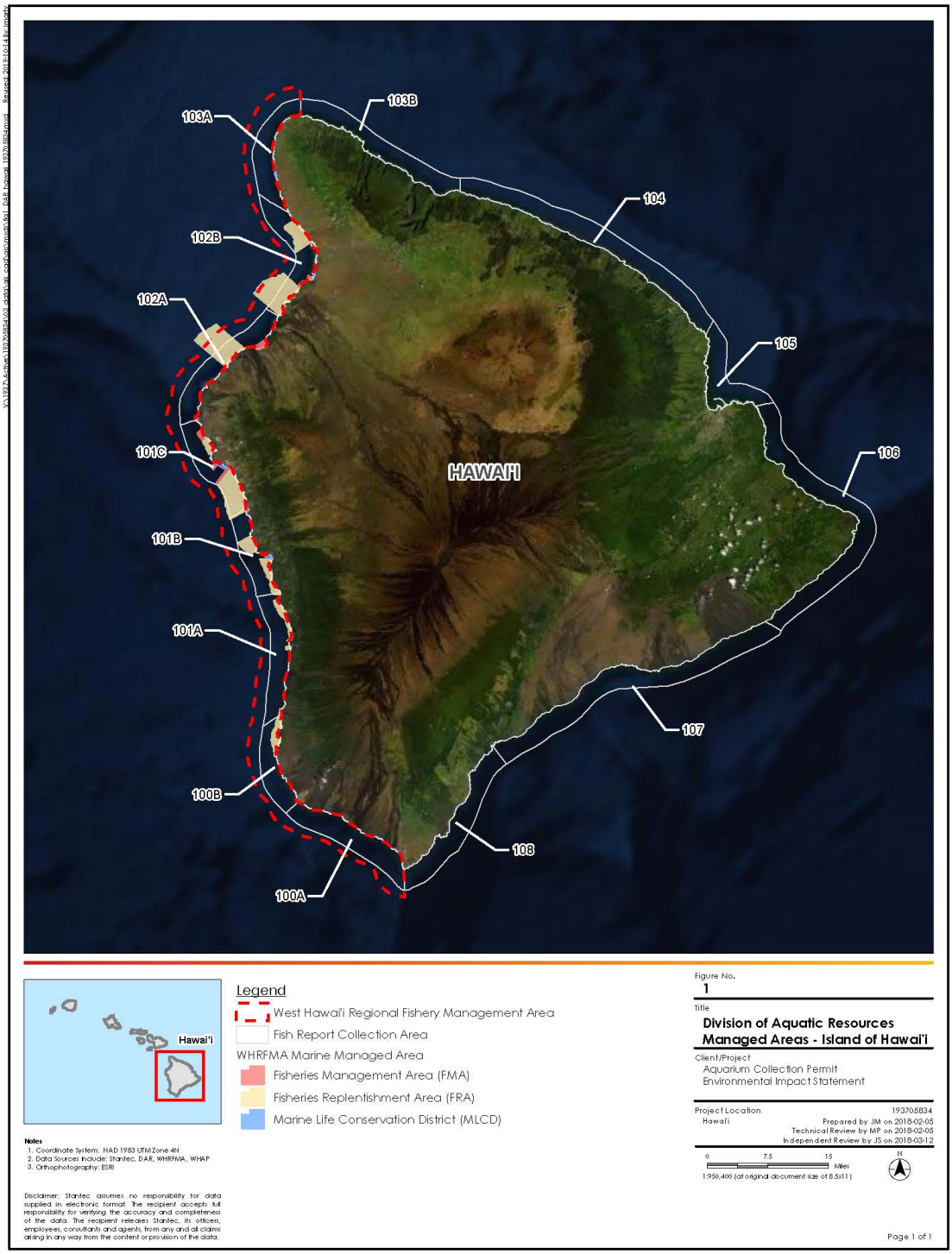


Figure 1. Division of Aquatic Resources Managed Areas - Island of Hawai'i.

The FRAs prohibit all collecting of aquarium animals within their boundaries as well as non-fishing related fish feeding. The seaward boundaries of the FRAs extend to a depth of 600 feet (100 fathoms) and distinctive signs mark the boundaries on shore; although some have fallen into disrepair and are not easily observed (Big Island Association of Aquarium Fishers [BIAAF] pers. comm.).

In addition to the development of the FRA network, the WHFC, in conjunction with the DAR and University of Hawai'i Sea Grant, also implemented the following initiatives:

1. Sea Urchin Limited Harvest: The WHFC developed a management plan permitting the sustainable harvest of *Wana* (long-spine/black sea urchin) at *Makae'o,* the Old Kona Airport Marine Life Conservation District (MLCD). This recommendation was adopted by the DLNR as an administrative rule amendment in 2005.

2. Gill Net Rules: The WHFC developed a set of gill net rule recommendations focused on limiting impacts of large-scale commercial netting while providing for subsistence netting. This recommendation was adopted as an administrative rule amendment in 2005 and served as a model for the statewide gill net rule (HAR §13-75-12.4) which was adopted in 2007.

3. Day-Use Mooring Buoys: In collaboration with the *Malama Kai* Foundation, the WHFC is a working partner in the site selection process and educates communities on the value of day use moorings to preserve our coral reefs.

4. *Ka'ūpūlehu* Marine Reserve: DAR worked with the WHFC and the'Ka'ūpūlehu Marine Life Advisory Committee (KMLAC) to develop draft rules to re-designate the'Ka'ūpūlehu Fish Replenishment Area as a Marine Reserve where the take of nearshore marine life will be prohibited for 10 years, with exceptions to allow for the continued collection of pelagic and deep benthic species using specific fishing gear. The proposal is the initial first step in complying with the statutory mandate of HRS §188F-4(3) to establish a portion of the FRAs where no fishing of reef-dwelling fish is allowed. In October 2014, the BLNR approved holding a Public Hearing on this rule amendment. The rule subsequently took effect on July 29, 2016. Several other local communities are actively engaged in developing management recommendations which include some form of a highly protected nearshore area.

5. Self-contained underwater breathing apparatus (SCUBA) Spear Fishing Prohibition: The WHFC proposed banning SCUBA (and rebreather) spear fishing in West Hawai'i as is the case in most other Pacific island jurisdictions.

6. Pebble Beach User Conflict: The WHFC drafted recommendations addressing a conflict between aquarium collectors and this South Kona community. It recommended creating a new FRA in the Pebble Beach area and opening up to collecting a similarly sized section of another FRA (by a non-residential area). The latter part of the 'swap' was subsequently rejected by aquarium collectors. The Big Island Association of Aquarium Fishermen (BIAAF) agreed to the creation of the Pebble Beach FRA, with nothing in return, as an act of good faith to further mitigate user conflict (BIAAF, pers. comm.). The BIAAF conceded directly with the representatives of the "Friends of Pebble Beach." The meeting was orchestrated by DAR.

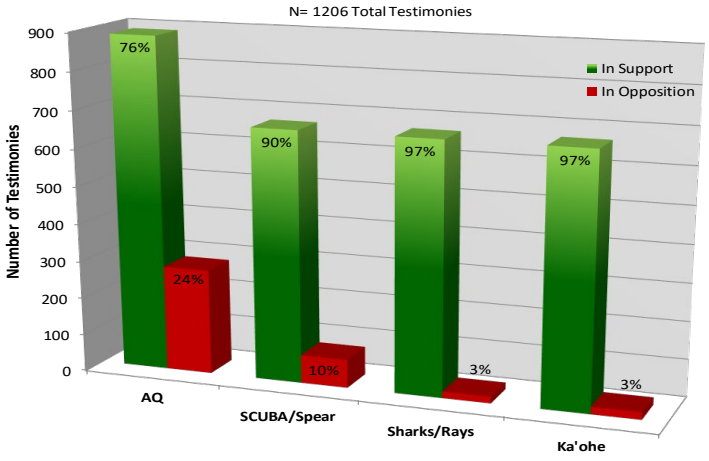
7. Aquarium 'White List' (Section 4.4.1): Working with commercial aquarium collectors the WHFC established a list of 40 fish species permitted for aquarium take. Only those fish found on the White List can be collected live for aquarium use. All other fishes and all invertebrates are off-limits to collecting. Size and bag limits are also established for three of the species on the White List, Yellow Tang, Kole, and Achilles Tang.

8. Species of Special Concern: Prohibition on the take or possession of nine species of inshore sharks and rays and two invertebrate crown-of-thorns predators (Table 1-2).

Table 1-2. List of marine species for which all take or possession is prohibited.

Common Name	Scientific Name	Hawaiian Name
Spotted Eagle Ray	*Aetobatus narinari*	*Hīhīmanu*
Broad Stingray	*Dasyatis lata*	*Hīhīmanu*
Pelagic Stingray	*Pteroplatytrygon violacea*	*Hīhīmanu*
Hawaiian Stingray	*Dasyatis hawaiiensis*	*Hīhīmanu*
Tiger Shark	*Galeocerdo cuvier*	*Manō/niuhi*
Whale Shark	*Rhincodon typus*	*Lele'wa'a*
Whitetip Reef Shark	*Triaenodon obesus*	*Manō lālākea*
Blacktip Reef Shark	*Carcharhinus melanopterus*	*Manō'pā'ele*
Gray Reef Shark	*Carcharhinus amblyrhynchos*	*Manō*
Triton's Trumpet	*Charonia triton's*	*'Ōlē*
Horned Helmet	*Cassis cornuta*	*Pū puhi*

Initiatives identified above and shown in Figure 2 received overwhelming support during the Hawai'i Administrative Rule public hearing process and were adopted as a new administrative rule (HAR 13-60.4) which became effective December 26, 2013.



AQ – Aquarium White List; Ka'ohe – Pebble Beach

Figure 2. Summary of all public testimonies on the WHRFMA rule (DAR 2014a).

1.2.4.2 HAR 13-60.4

In addition to incorporating Act 306 into the Hawai'i Administrative Rules, HAR 13-60.4 identified West Hawai′i Aquarium Permit Terms and Conditions by implementing the following provisions:

- No person shall engage in aquarium collecting activities within the WHRFMA without first having been issued and possessing a West Hawai′i Aquarium Permit in addition to a valid State of Hawai′i aquarium fish permit.
- Collectors must carry either their CML card with both State of Hawai′i and West Hawai′i Aquarium Permit endorsements or their recreational aquarium fish permit card while collecting fish within the WHRFMA.
- In addition to applying any other penalties provided by law, the DLNR may revoke any West Hawai′i Aquarium Permit for any infraction of these rules or the terms and conditions of the permit, and any person whose permit has been revoked shall not be eligible to apply for another West Hawai′i Aquarium Permit (commercial or recreational) until one year from the date of revocation.
- Aquarium collectors (commercial and noncommercial) may take or possess only the 40 "White List" fish species.
- It is prohibited for anyone to take more than 5 Yellow Tang (*Zebrasoma flavescens*) larger than 4.5 inches in total length (TL) or more than 5 Yellow Tang smaller than 2 inches TL per day or possess more than this amount at any time while within the WHRFMA. (Note: This is called a slot limit and is meant to protect the breeding population. Yellow Tang become sexually mature at 4.5 inches TL and begin reproducing [Bushnell 2007]).
- It is prohibited for aquarium collectors to take or possess more than 5 Kole (= Goldring Surgeonfish, Yelloweye, Goldring) (*Ctenochaetus strigosus*) larger than 4 inches TL per day. Again, this measure is meant to protect the breeding population.
- It is prohibited for aquarium collectors to take or possess more than 10 Achilles Tang (*Acanthurus achilles*) of any size per day.
- It is prohibited to possess aquarium collecting gear or possess fish taken for aquarium purposes on a vessel after sunset or before sunrise without prior phone notification to the DAR Kona office. Such notification will allow the possession of more than one day's bag limit for Yellow Tang, Kole and Achilles Tang on multiple day trips.
- Aquarium collection is prohibited within FRAs, FMAs, and MLCDs. Note that a new FRA has been established in South Kona at Ka′ohe Bay (Pebble Beach) where no aquarium collecting, or recreational fish feeding is allowed.
- It is prohibited to take or possess aquarium collecting gear or fish taken for aquarium purposes on a vessel that is adrift, anchored, or moored within any of the areas prohibiting aquarium collecting.

- All aquarium collecting vessels shall be registered every year with the DAR Kona office. The current vessel identification number issued by either the DLNR or the U.S. Coast Guard (USCG) shall serve as the registration number for each vessel. After the initial vessel registration renewal can be done via mail or online.
- All aquarium collecting vessels shall permanently affix the capital letters “AQ” to both sides of the vessel. The ”AQ" letters shall be no less than 6 inches high and 3 inches wide in either black or a color that contrasts with the background color of the vessel.
- Aquarium vessels must fly “a stiff red" flag or pennant from the vessel with the letter "A" as specified by the DLNR. The flag or pennant shall be displayed and clearly visible from both sides of the vessel at all times while aquarium collecting gear or collected aquarium fish, or both are onboard. The flag or pennant shall be provided at cost to West Hawai’i Aquarium Permittees.
- Aquarium vessels must display a dive flag at all times when divers are in the water.
- In the event an aquarium collecting vessel becomes inoperable while at sea, the operator of the vessel shall immediately notify the DLNR’s Division of Conservation and Resources Enforcement (DOCARE) or USCG or both by very high frequency (VHF) radio or by cellular phone.
- It is prohibited to possess or use any net or container employed underwater to capture or hold fish taken for aquarium purposes that is not labeled with the CML number (or numbers) of the person (or persons) owning, possessing, or using the equipment. Clearly mark each piece of the above gear with your CML number. There is no specific marking requirement as to size or color of lettering other than the CML number must be clearly visible and legible.
- Aquarium collectors must submit each month’s daily aquarium fishing trip reports before every 10th day of the following month.
- Recreational aquarium collectors, without a valid CML, may not take more than a total of five of the White list fish specimens per person per day. Recreational aquarium collectors may not sell collected fish.
- A control date was established on August 1, 2005, to possibly limit participation in the WHRFMA commercial aquarium fishery. Persons who begin fishing in the WHRFMA commercial aquarium fishery on or after the control date will not be assured continued participation in the fishery if the DLNR establishes an aquarium limited entry program in the future. Nothing in this chapter shall prevent the DLNR from establishing another control date.
- It is prohibited to engage in or attempt to engage in SCUBA spearfishing and/or possess both SCUBA gear and a spear or speared aquatic life.

As indicated above, HAR 13-60.4 had overwhelming public support, with 76% of all testimony in favor of the rules, and 85% of testimony from West Hawai’i being supportive, the area most closely associated with the rule (Walsh 2013).

Coral/Live Rock Damage

State law prohibits the breaking or damaging, with any implement, any stony coral from the waters of Hawai'i, including any reef or mushroom coral (HAR 13-95-70). It is unlawful to take, break or damage, any implement, any rock or coral to which marine life of any type is visibly attached or affixed (HAR 13-95-71). The taking of sand, coral rubble or other marine deposits is permitted in certain circumstances. The material may not exceed one gallon per person per day, and may be taken only for personal, noncommercial purposes (HRS § 171-58.5, § 205A-44).

Fines per specimen may be imposed for each damaged coral head or colony less than one square meter in surface area or for a colony greater than one square meter in surface area, each square meter of colony surface area and any fraction remaining constitutes an additional specimen. Penalties for damage to live rock are based on each individual rock or if the violation involves greater than one square meter of bottom area, then the penalty is based on each square meter of bottom area.

No liability shall be imposed for inadvertent breakage, damage, or displacement of an aggregate area of less than one half square meter of coral if caused by a vessel with a single anchor damage incident, in an area where anchoring is not otherwise prohibited, and not more frequently than once per year; or by accidental physical contact by an individual person.

Enforcement/Compliance

Enforcement and compliance are within the purview of the State of Hawai'i. DOCARE is responsible for enforcement activities and has full police powers to enforce all State laws and rules involving State lands, State Parks, historic sites, forest reserves, aquatic life and wildlife areas, coastal zones, Conservation districts, State shores, as well as county ordinances involving county parks.

Some penalties for failure to comply with regulations include the following:

- Any lay net within the West Hawai'i Regional Fishery Management Area that is not registered or does not have proper identification tags, as required in subsection (a)(1) and (a)(5), shall be subject to immediate seizure according to section 199-7, HRS, and subject to forfeiture by the department under procedures similar to chapter 712A, Hawai'i Revised Statutes.

- In addition to applying any other penalties provided by law, the department may revoke any West Hawai'i aquarium permit for any infraction of these rules or the terms and conditions of the permit, and any person whose permit has been revoked shall not be eligible to apply for another West Hawai'i aquarium permit until the expiration of one year from the date of revocation.

Any person violating any provision of this chapter, or any term or condition of any permit issued pursuant to this chapter, shall be subject to the provisions of sections 187A-12.5 and 188-70, Hawaii Revised Statutes, or as may be otherwise provided by law. These include the following:

- For violations involving threatened or endangered species, the administrative fines shall be as follows: (1) For a first violation, a fine of not more than $5,000; (2) For a second violation within five

years of a previous violation, a fine of not more than $10,000; and (3) For a third or subsequent violation within five years of the last violation, a fine of not more than $15,000.

  - In addition, a fine of up to $5,000 may be levied for each specimen of threatened or endangered aquatic life taken, killed, or injured in violation of subtitle 5 of title 12 or any rule adopted thereunder.

- For all other violations the administrative fines shall be as follows: (1) For a first violation, a fine of not more than $1,000; (2) For a second violation within five years of a previous violation, a fine of not more than $2,000; and (3) For a third or subsequent violation within five years of the last violation, a fine of not more than $3,000.

  - In addition, a fine of up to $1,000 may be levied for each specimen of all other aquatic life taken, killed, or injured in violation of subtitle 5 of title 12 or any rule adopted thereunder.

- Any criminal penalty for any violation of subtitle 5 of title 12 or any rule adopted thereunder shall not be deemed to preclude the State from recovering additional administrative fines, fees, and costs, including attorney's fees and costs. [L 1998, c 243, §1]

The FRA network is believed to be an unusual exception to the problem of enforcement, as compliance occurs primarily through social pressure (Rossiter and Levine 2013). As stated by Rossiter and Levine (2013):

> *"Aquarium fishers are required to register with DLNR and prominently display signs and flags indicating that they are aquarium collectors. They are not allowed to have aquarium collecting gear onboard their vessels (except during transit) in any area where aquarium fishing is prohibited. These regulations mean that aquarium collectors are highly visible to the public. Given the fact that aquarium fishing is generally an unpopular profession in Hawaii, and that aquarium fishermen could potentially lose their license if caught illegally fishing, the risk of being caught and reported outweighs the potential gain of catching fish within the FRA, contributing to very high levels of compliance with FRA boundaries. In the case of the aquarium industry, community-based enforcement (backed by state regulations) has been adequate to ensure compliance with FRA regulations."*

2.0 PURPOSE AND NEED

2.1 PURPOSE FOR APPLICANT'S ACTION

The purpose of the Applicant's action is to ensure that commercial aquarium fish collection allows for the lawful, responsible, and sustainable commercial collection of eight aquarium fish species from nearshore habitats. The objective of the proposed action is to allow for the issuance of Commercial Aquarium Permits and CMLs to seven fishers for the WHRFMA.

2.2 NEED FOR APPLICANT'S ACTION

The need for the Applicant's action is to allow for commercial aquarium collection in compliance with all applicable laws, rules, and regulations pertaining to the industry.

2.3 PURPOSE FOR APPROVING AGENCY'S (DLNR) ACTION

The purpose of an environmental review process under the HEPA is to provide the Approving Agency (DLNR) with the framework necessary for reviewing the Applicant's action and the environmental effects of issuing Aquarium Permits and corresponding CMLs for the WHRFMA. The HEPA review also provides an opportunity for the public to be involved in the DLNR's decision-making process. The DLNR can also use a properly conducted HEPA analysis to review and improve plans, functions, programs, and resources under its jurisdiction. Furthermore, this Revised FEIS is the mechanism for recording the results of a comprehensive planning and decision-making process surrounding the Applicant's action.

The underlying purpose of the DLNR's action is to determine the level of significance that issuing 7 Aquarium Permits and CMLs for the WHRFMA, may have on the environment, based on the 13 criteria listed in Section 1.2.3, with emphasis on the 5 criteria the DLNR determined to need further evaluation (Section 1.1.3) and on the 14 concerns the BLNR raised during non-acceptance of the previous EIS (Section 1.1.3). The final determination will be either acceptance or non-acceptance.

2.4 NEED FOR APPROVING AGENCY'S (DLNR) ACTION

The need for DLNR's action is the Applicant's submittal of this Revised FEIS, to which the DLNR must respond.

2.5 SCOPE OF ANALYSIS

The scope of this Revised FEIS's analysis incorporates accepted methods, regulations, and historical data to determine past influences the commercial aquarium fishery and its management have had on resources, including socioeconomic, cultural, and biological resources, in order to evaluate the potential direct, indirect, and cumulative impacts that the seven alternatives presented in Section 3.0 would have annually over a 5-year period for the island of Hawai'i, including the WHRFMA. Regarding biological resources, this Revised FEIS focuses primarily on the effects of aquarium fishing on wild populations of White List Species, as it is at the population level that DAR measures changes in White List Species and makes management decisions (e.g., issuance of harvest permits, implementation of bag limits). Therefore, because population effects have already occurred once an individual fish has been removed from the ocean, it is beyond the scope of this analysis to evaluate effects on individual fish once they are removed from the population; nevertheless, post-collection mortality is discussed as an indirect effect in Section 5.4.2.

Commercial Aquarium Permits issued by DLNR under HRS §188-31 are valid for no longer than one year and, therefore, must be renewed annually. Accordingly, every year, DLNR must take an action to issue Aquarium Permits. As Aquarium Permits for the seven fishers who would receive permits under the Preferred Alternative come up for renewal each year, DLNR will presumably evaluate whether there are

significant new circumstances or information relevant to environmental concerns and bearing on the commercial aquarium fishery or its impacts requiring a supplemental or additional HEPA review. Supplemental or additional HEPA review would be triggered if WHAP monitoring data indicate a substantial decline (as determined by DAR) in the population of one or more of the proposed Revised White List species. If this happened, then a temporary moratorium could be instituted until the species rebounds. Under this approach, any changes in resource data (e.g., increase or decrease in population estimates, unforeseen circumstances, etc.) would be addressed, as necessary, by supplemental or additional HEPA documents, allowing for the HEPA process to quickly recognize and address any potential issues. Section 5.0 addresses the cumulative impacts of reasonably foreseeable future commercial aquarium collection.

2.5.1 Resources Evaluated and Dismissed from Further Consideration

This Revised FEIS evaluates the impacts of seven commercial aquarium fish collection alternatives on the nearshore habitat (0-600 feet; 0-100 fathoms) in which commercial aquarium fishing (or lack thereof) would take place over a 5-year period. During the evaluation process, it was determined that some resources typically evaluated in an EIS would not be impacted by any of the alternatives under consideration. The evaluation includes past use and potential impacts by the commercial aquarium fishery because it has been a part of the baseline condition of these resources since the late 1940s. Because a significant increase in commercial aquarium fishing is not anticipated during the 5-year assessment period evaluated in this Revised FEIS, and in fact a decrease when compared to historic conditions is anticipated due to the issuance of only 7 Aquarium Permits and revision of the White List, this Revised FEIS does not anticipate a significant change in the current baseline condition of these resources.

The proposed action and resulting commercial aquarium collection do not include any activities different from or in addition to those that have occurred in the past, though it does limit the species which could be collected and imposes individual catch quotas. There would be no construction of permanent or semi-permanent infrastructure, no discharges into coastal, surface or ground waters, and no dredging, and no significant use of hazardous materials that could be released into the environment.

The DLNR's issuance of 7 Aquarium Permits is not anticipated to result in significant beneficial or adverse impacts to water and air quality, geology and soil resources, aesthetics, noise, vegetation, terrestrial wildlife and avian species, threatened and endangered species, land use, public health and safety, communications, transportation, utilities, or population and demographics from the current baseline condition, therefore, these resources will not be evaluated further.

2.5.2 Resources Retained for Further Analysis

The following resources could be impacted by the alternatives under consideration. Current baseline conditions of these resources are presented in Section 4.0 and impacts to these resources are evaluated in Section 5.0 of this Revised FEIS:

- Socioeconomic Resources
- Cultural Resources
- Physical Resources
    - Climate
- Biological Resources
    - White List Species
    - Non-White List Species
    - Hawai'i Species of Greatest Conservation Need
    - Reef Habitat, including the role of herbivory

3.0 ALTERNATIVES

Reasonable alternatives include those that are practical or feasible from cultural, scientific, technical, and economic perspectives. The HEPA recommends that applicants consider and objectively evaluate reasonable alternatives to the Preferred Alternative and briefly explain the basis for eliminating any alternatives that were not retained for detailed analysis.

The DLNR has been working with stakeholders (e.g., public, various fishing and tourism industries, local governments) since the 1970's, and continues to work with them to ensure the commercial aquarium fishery is environmentally sustainable and prevents degradation of fish populations and the habitats in which they occur. As a result, many aspects of the fishery have changed over the past 40+ years due to the various alternatives recommended by stakeholders and implemented by the DLNR. The Applicant has no legislative or regulatory authority and cannot create, eliminate, or alter conservation areas (e.g., MPAs, FRAs, MLCDs); create, eliminate, or alter current regulations (e.g., bag and size limits, season length, permit term); or change reporting requirements. Despite this, during the public comment period on the Draft EA that was published on April 8, 2018, in response to DLNR concerns and in coordination with the DLNR, the Applicant developed an alternative that required regulation creation by DLNR (i.e., implementation of bag limits). After review of the EA, the DLNR determined on July 26, 2018 that preparation of an EIS was required based on five specific significance criteria outlined in Title II, Chapter 200, Hawai'i Administrative Rules (Criteria 1,2,3,4, and 8, see Section 1.1.3).

Based on public and DLNR comments on the Draft and Final EAs, the Applicant analyzed five alternatives in the previous DEIS, including a new alternative based on issuance of a limited number of Aquarium Permits. Based on concerns raised by the BLNR regarding the previous FEIS, the Applicant added a sixth alternative to this Revised FEIS which includes further limiting the number of Aquarium Permits to be issued, revisions to the White List, and creation of individual catch quotas. In addition, since publication of the previous FEIS, the use of CMLs to collect aquarium fish without the use of fine mesh nets has been banned

pending HEPA review[9]. Therefore, the No Action Alternative has been revised, the previous No Action Alternative has become the CML-only Alternative, and edits have been made to the other alternatives accordingly to reflect this recent change. These alternatives were evaluated based on their capacity to meet the purpose and need of the Approving Agency's action (Sections 2.3 and 2.4). The potential effects on the environment for each alternative are described and analyzed in Section 5.0, Environmental Consequences. The alternatives are summarized in Table 3-1 and discussed in detail in Sections 3.1 through 3.7.

Table 3-1. Summary of alternatives. Preferred alternative in bold.

Alternative	WHRFMA			East Hawai'i		
	Aquarium Permits and CMLs	Aquarium Collection	Catch Quotas	Aquarium Permits	CMLs	Aquarium Collection
No Action	None	None	n/a	None	None	No
CML-Only	None	None	n/a	None	Unlimited #	Yes, without fine mesh nets
Pre-Aquarium Collection Ban	Unlimited #	40 White List Species	No	Unlimited #	Unlimited #	Yes
WHRFMA-Only Programmatic Issuance of Aquarium Permits	Unlimited #	40 White List Species	No	None	Unlimited #	Yes, without fine mesh nets
Achilles Tang Conservation	Unlimited #	40 White List Species	No; bag limit reduced for Achilles Tang	Unlimited #	Unlimited #	Yes
Limited Permit Issuance	10 issued	40 White List Species	No; bag limit reduced for Achilles Tang	None	None	No
Revised White List and Limited Permit Issuance (Preferred) Alternative	**7 issued**	**8 White List Species**	**Yes**	**None**	**None**	**No**

[9] https://dlnr.hawaii.gov/dar/announcements/commercial-fishers-notified-that-all-aquarium-collection-is-banned/

3.1 NO ACTION ALTERNATIVE

Under the No Action Alternative, the court order would remain in place, and no Aquarium Permits would be issued for the entire island of Hawai'i and the taking of aquarium fish or other aquatic life in the WHRFMA for commercial aquarium purposes would be prohibited. In addition, the changes to CMLs would remain in place, and CMLs could not be used to collect aquarium fish for commercial purposes in East Hawai'i. Therefore, no commercial aquarium collection would occur on the island of Hawai'i under this Alternative.

The No Action Alternative meets the DLNR's objectives to ensure an applicant's actions do not lead to degradation of fish populations and the habitats in which they occur in the context of commercial aquarium collection alone (i.e., does not address impacts from other Hawaiian fisheries and influences discussed in Sections 4.0 and 5.0). However, the No Action Alternative does not meet the Applicant's purpose and need to for lawful, responsible, and sustainable commercial collection of approved fish species from nearshore habitats (0-600 feet; 0-100 fathoms).

3.2 CML-ONLY ALTERNATIVE

Under the CML-only Alternative, the court order would remain in place, and no Aquarium Permits would be issued for the entire island of Hawai'i and the taking of aquarium fish or other aquatic life in the WHRFMA for commercial aquarium purposes would be prohibited. Under this Alternative, CMLs for commercial aquarium collection would be issued for fishers in East Hawai'i, and aquarium collection using legal gear or methods other than fine-mesh nets would be allowed. Permittees would abide by all existing rules and regulations set forth in HRS 189-2,3 (Commercial Marine Permit).

3.3 PRE-AQUARIUM COLLECTION BAN ALTERNATIVE

Under the Pre-Aquarium Collection Ban Alternative, the DLNR would issue an unlimited number of Aquarium Permits and CMLs allowing commercial aquarium collection as was done prior to the September 6, 2017 Supreme Court ruling, thereby allowing commercial aquarium fish collection using fine mesh nets (and other legal methods) on the island of Hawai'i, including the WHRFMA. It is assumed that, upon issuance of an Aquarium Permit and CML, a permit condition would be included in each permit limiting the geographic area covered by the permit to the island of Hawai'i. Permittees would abide by all existing rules and regulations set forth in HRS 189-2,3 (Commercial Marine Permit; Section 1.2.2), HRS-188-31 (Section 1.2.1), governing Aquarium Permit use, and would obtain a West Hawai'i Aquarium Permit as required under HAR 13-60.4 (Section 1.2.4.2).

3.4 WHRFMA-ONLY PROGRAMMATIC ISSUANCE OF AQUARIUM PERMITS ALTERNATIVE

Under the WHRFMA-only Programmatic Issuance of Aquarium Permits Alternative, the DLNR would issue an unlimited number of Aquarium Permits and CMLs for the WHRFMA, thereby allowing commercial aquarium fishing collection, including the use of fine mesh nets, within the WHRFMA. No Aquarium Permits would be issued for areas outside of the WHRFMA, but an unlimited number of CMLs would be issued for fishers in East Hawai'i (in East Hawai'i aquarium collection using legal gear or methods other than fine-

mesh nets could occur using CMLs but use of fine mesh nets would not be allowed). It is assumed that, upon issuance of an Aquarium Permit, a permit condition would be included in each permit limiting the geographic area covered by the permit to the WHRFMA. Permittees would abide by all rules and regulations set forth in HRS 189-2,3 (Commercial Marine Permit, Section 1.2.2), HRS-188-31 (Section 1.2.1), governing Aquarium Permit use, and would obtain a West Hawai′i Aquarium Permit as required under HAR 13-60.4 (Section 1.2.4.2).

3.5 ACHILLES TANG CONSERVATION ALTERNATIVE

Under the Achilles Tang Conservation Alternative, which was the preferred alternative in the Final EA, the DLNR would issue an unlimited number of Aquarium Permits and CMLs, thereby allowing commercial aquarium fish collection using fine mesh nets on the island of Hawai'i, including the WHRFMA. Permittees would abide by all rules and regulations set forth in HRS 189-2,3 (Commercial Marine Permit; Section 1.2.2), HRS-188-31 (Section 1.2.1), governing Aquarium Permit use, and would obtain a West Hawai′i Aquarium Permit as required under HAR 13-60.4 (Section 1.2.4.2). In addition, under this alternative, the daily bag limit for commercial aquarium collection of Achilles Tang within the WHRFMA would be reduced from 10 per day to 5 per day.

3.6 LIMITED PERMIT ISSUANCE ALTERNATIVE

Under the Limited Permit Issuance Alternative (the preferred alternative in the April 2020 FEIS) the DLNR would issue Aquarium Permits and CMLs to only 10 aquarium fishers in the WHRFMA, thereby allowing 10 individuals to resume commercial aquarium fish collection in the WHRFMA, including the use of fine mesh nets. No Aquarium Permits or CMLs for aquarium collection would be issued for areas outside of the WHRMA, and therefore no commercial aquarium collection would be allowed in East Hawai'i. It is assumed that, upon issuance of an Aquarium Permit and CML, a permit condition would be included in each permit limiting the geographic area covered by the permit to the WHRFMA. Permittees would abide by all rules and regulations set forth in HRS 189-2,3 (Commercial Marine Permit; Section 1.2.2), HRS-188-31 (Section 1.2.1), governing Aquarium Permit use, and would obtain a West Hawai′i Aquarium Permit as required under HAR 13-60.4 (Section 1.2.4.2). In addition, under this alternative, the daily bag limit for commercial aquarium collection of Achilles Tang within the WHRFMA would be reduced from 10 per day to 5 per day.

3.7 REVISED WHITE LIST AND LIMITED PERMIT ISSUANCE (PREFERRED) ALTERNATIVE

Under the Revised White List and Limited Permit Issuance Alternative, the DLNR would issue Aquarium Permits and CMLs to seven aquarium fishers in the WHRFMA, thereby allowing these seven individuals to resume commercial aquarium fish collection in the WHRFMA, including the use of fine mesh nets. No Aquarium Permits or CMLs for aquarium collection would be issued for areas outside of the WHRMA, and therefore no commercial aquarium collection would be allowed in East Hawai'i. In addition, the 40 White List Species would be reduced to 8 species and each fisher would be allocated an individual catch quota for each species (see Section 3.7.1 below for details).

It is assumed that, upon issuance of an Aquarium Permit, permit conditions would be included in each permit limiting the geographic area covered by the permit to the WHRFMA, limiting collection to the eight species on the proposed Revised White List, and implementing individual catch quotas for each of those eight species. Permittees would abide by all rules and regulations set forth in HRS 189-2,3 (Commercial Marine Permit; Section 1.2.2), HRS-188-31 (Section 1.2.1), governing Aquarium Permit use, and would obtain a West Hawai′i Aquarium Permit as required under HAR 13-60.4 (Section 1.2.4.2). Existing slot limits for Yellow Tang and Kole would remain in effect in addition to the individual catch quotas for all 8 Revised White List Species. Collection of Achilles Tang would not be permitted under this Alternative.

This alternative is based on the best available science, supports the DLNR's purpose to ensure Applicant's Actions do not lead to degradation of fish populations and the habitats in which they occur in the context of commercial aquarium collection, specifically addresses concerns related to declining populations and sustainable collection, and supports the Applicant's purpose and need to for the lawful, responsible, and sustainable commercial collection of eight aquarium fish species from nearshore habitats.

3.7.1 Revised White List and Individual Catch Quotas

The proposed Revised White List is based on the following criteria suggested by the DLNR as to which species to include:

1. No statistically significant population declines in Open Areas between 1999/2000 and 2017/2018 (WHAP data from DAR 2019a)
2. Recent catch (2017 fiscal year) of at least 100 fish (representing at least 0.03% of the total aquarium catch)
3. Open Area population density of at least 0.5 fish/100m^2 (data from DAR 2019a)

A total of 9 of the 40 White list species met these 3 criteria, including Yellow Tang, Kole, Orangespine Unicornfish (*Naso lituratus*), Potter's Angelfish (*Centropyge potteri*), Brown Surgeonfish (*Acanthurus nigrofuscus*), Thompson's Surgeonfish (*Acanthurus thompsoni*), Black Surgeonfish (*Ctenochaetus hawaiiensis*), Fisher's Angelfish (*Centropyge fisheri*), and Bird Wrasse (*Gomphosus varius*). One of these species, the Fisher's Angelfish, is considered a species of special concern in Hawai'i, and the Applicant therefore chose to not include this species, leaving eight species on the proposed Revised White List.

Individual catch quotas for these eight species were set based on either the 20-year historic average catch from the entire WHRFMA fishery (during which the species populations have all been increasing or stable), or to 1% of the 2019 PIFSC-ESD WHRFMA population estimate (see Table 5-16), based on issuance of 7 permits with individual catch quotas (Table 3-2).

An annual species-specific individual catch quota would be allotted to each fisher and therefore the total potential catch shown in Table 3-2 would only occur if all seven fishers individually reached their individual catch quota for all eight species. The DAR will receive the collection data by zone, and can review any necessary changes when they issue the permits on an annual basis. In the unlikely event that all collection occurred within a single AQ reporting zone, the DAR would be able to evaluate this information; however, this would effectively leave the rest of the coast completely free of collecting, and essentially create an FRA

everywhere else. Given that on the island of Hawaii there is connectivity between adjacent reefs (up to 184 kilometers), with fish from protected FRAs being documented to seed unprotected areas (Christie et al. 2010, see Section 4.0), it is assumed that the population growth occurring in other non-fished areas would seed the collection zone where fishing occurred, and therefore the total allowable catch limits are based upon the entire population, not subpopulations along the WHRFMA coast. It is noted that the individual catch quotas may be revised (i.e., increased or decreased) over time during the annual permit renewal period based on re-evaluation by the DLNR of each proposed Revised White List species' population status (e.g., new population estimates, new population trend data, etc.). Changes to the individual catch quotas may require additional HEPA review.

Table 3-2. Proposed Individual Catch Quotas for the proposed Revised White List. Annual limit from January 1 through December 31 of each year.

Species	Individual Catch Quota (per fisher)	Total Potential Catch (all 7 fishers)
Yellow Tang	28,571	200,000
Black Surgeonfish	450	3,152
Orangespine Unicornfish	838	5,872
Kole	4,285	30,000
Bird Wrasse	49	344
Potter's Angelfish	625	4,376
Thompson's Surgeonfish	288	2,016
Brown Surgeonfish	114	800

3.7.2 Additional Enforcement and Compliance Measures

The West Hawai'i aquarium fishery has in the past faced the problem of poaching or otherwise illegally obtained fish, which undermines the conservation and management of the fishery. Historically, the remedy to the problem has been enforcement carried out by DOCARE, which has had limited success due to the large area to be patrolled combined with DOCARE's limited resources.

In the Revised DEIS, as part of this alternative, the Applicant proposed a new Certificate of Origin system that would allow for better tracking and enforcement of the numbers and species of fish caught. Given that the Applicant does not have the authority to implement such a change, and based on comments received from multiple commenters on the Revised DEIS, this has been removed from this alternative. Nonetheless, the Applicant fully supports creation of a Certificate of Origin system or other similar measures (in addition to the catch reports submitted to the DAR) to further monitor an individual fisher's catch to ensure the fisher stays within their individual catch quota.

3.8 ALTERNATIVES CONSIDERED BUT DISMISSED

The following alternatives were considered but dismissed from further consideration:

- Creation of species-specific bag limits for all 40 White List Species

  - This alternative was dismissed because the Preferred Alternative instead ends collection of 32 of the White List Species and imposes individual catch quotas for the remaining 8 species on the proposed Revised White List, thereby negating the need for species-specific bag limits.

- Moratorium on collection of herbivores
  - This alternative was dismissed, as the DAR (2019a) research indicates that aquarium collection is not causing declines in herbivores. The DAR (2019a) reported that herbivore biomass has not changed since 2003 in areas open to commercial aquarium collection, and while not significant, there has been an increasing trend, with a 26.0% increase in herbivore biomass in Open Areas between 2003 and 2017 (DAR 2019a, Gove et al. 2019).

- Moratorium on collection of Species of Greatest Conservation Need (SGCN)
  - The Preferred Alternative includes a moratorium on the three SGCN on the current White List, including the Psychedelic Wrasse (*Anampses chrysocephalus*), Tinker's Butterflyfish (*Chaetodon tinkeri*), and Fisher's Angelfish (*Centropyge fisheri*).

- Moratorium on species experiencing population declines
  - The Preferred Alternative includes a moratorium on species experiencing population declines. The Preferred Alternative includes a proposed Revised White List that only includes eight species whose populations have remained stable or increased.

- Captive Breeding Program
  - A captive breeding program would not meet the purpose and need (Section 2.0). In addition, it is not an economically feasible alternative for the seven fishers requesting permits under the Preferred Alternative due to the financial investment required for equipment and facilities. Not all species have been shown to successfully breed in captivity with current technology.

4.0 AFFECTED ENVIRONMENT

The affected environment is the area and its resources (i.e., socioeconomic, cultural, physical, biological) potentially impacted by the proposed action and the alternatives under consideration. The purpose of describing the affected environment is to define the current baseline of conditions in which the impacts would occur. To make an informed decision about which alternative to select, it is necessary to first understand which resources would be affected and to what extent each alternative would result in changes from the baseline. This section attempts to provide the baseline for this understanding. Relative to the proposed action, the affected environment includes nearshore habitats within the WHRFMA from a depth of 0-600 feet (0-100 fathoms) along the west coast of the island of Hawai'i, although most fishers collect the majority of fish at depths between 30-70 feet (5-11.7 fathoms), with minimal collecting beyond this range.

Commercial aquarium fish collection has been taking place in Hawaiian waters since the late 1940s. In 1953, the territorial government of Hawai'i enacted Act 154, which authorized the Board of Agriculture and Forestry to establish a permit system for the use of fine-mesh nets and traps for the taking of aquarium fish (DAR 2014a). Beginning in 1973, collectors were required to report their monthly catch on a detailed aquarium fish catch report. As of 2014, Aquarium Permit holders are required to keep daily trip reports and submit on a monthly basis. Since 1999 when FRA's were established, the number of commercial aquarium fishers working in West Hawai'i has ranged from 24-63, and in East Hawai'i from <3-18 (DAR 2018a). The 10 commercial fishers who are part of this proposed action made up 2 to 8 of the WHRFMA fishers in any given year from 2000 – 2017. Permitted commercial aquarium fishing has been a part of the socioeconomic, cultural, physical, and biological resources for decades and is considered a part of the baseline condition of the affected environment.

The DLNR's mission statement is to 'Enhance, protect, conserve and manage Hawai'i's unique and limited natural, cultural, and historic resources held in public trust for current and future generations of the people of Hawai'i nei, and its visitors, in partnership with others from the public and private sectors.' In pursuit of this mission, the DLNR has compiled, analyzed, and reported on the many facets of Hawai'i's socioeconomic, cultural, physical, and biological resources that make up the affected environment. The following sections rely heavily on the DLNR's *Hawai'i's Comprehensive Wildlife Conservation Strategy* (CWCS; Mitchell et al. 2005) and the DLNR's Hawai'i's State Wildlife Action Plan (SWAP; DLNR 2015), with numerous other sources cited as appropriate.

4.1 SOCIOECONOMIC RESOURCES

The state of Hawai'i has four local governments: The City and County of Honolulu (island of O'ahu and the Northwestern Hawaiian Islands), the County of Kaua'i (islands of Kaua'i and Ni'ihau), the County of Maui (islands of Maui, Moloka'i, Lāna'i and Kaho'olawe), and the County of Hawai'i (island of Hawai'i). Hawai'i also has a fifth county, Kalawao County, which does not have a separate government unit (Mitchell et al. 2005). Kalawao County covers the former Hansen's disease settlement at Kalaupapa (Moloka'i) and is managed by the National Park Service (NPS) under a cooperative agreement with the State Department of Health (Mitchell et al. 2005).

The population of the island of Hawai'i was estimated at 185,079 in 2010. By 2018, the population is estimated to have grown by 8.4% to 200,983 (Hawai'i Department of Business, Economic Development & Tourism [HDBEDT] 2019). The number of people on the island of Hawai'i at any given time, however, is heavily influenced by tourists. Of the approximately 9.3 million visitors who arrived by air to the state in 2017[10], 19.0% (1.76 million people) spent time on the island of Hawai'i and 9.1% stayed entirely on the island of Hawai'i. Approximately 16.3% of visitors spent time in West Hawai'i while 7.1% spent time on the east side (HTA 2018).

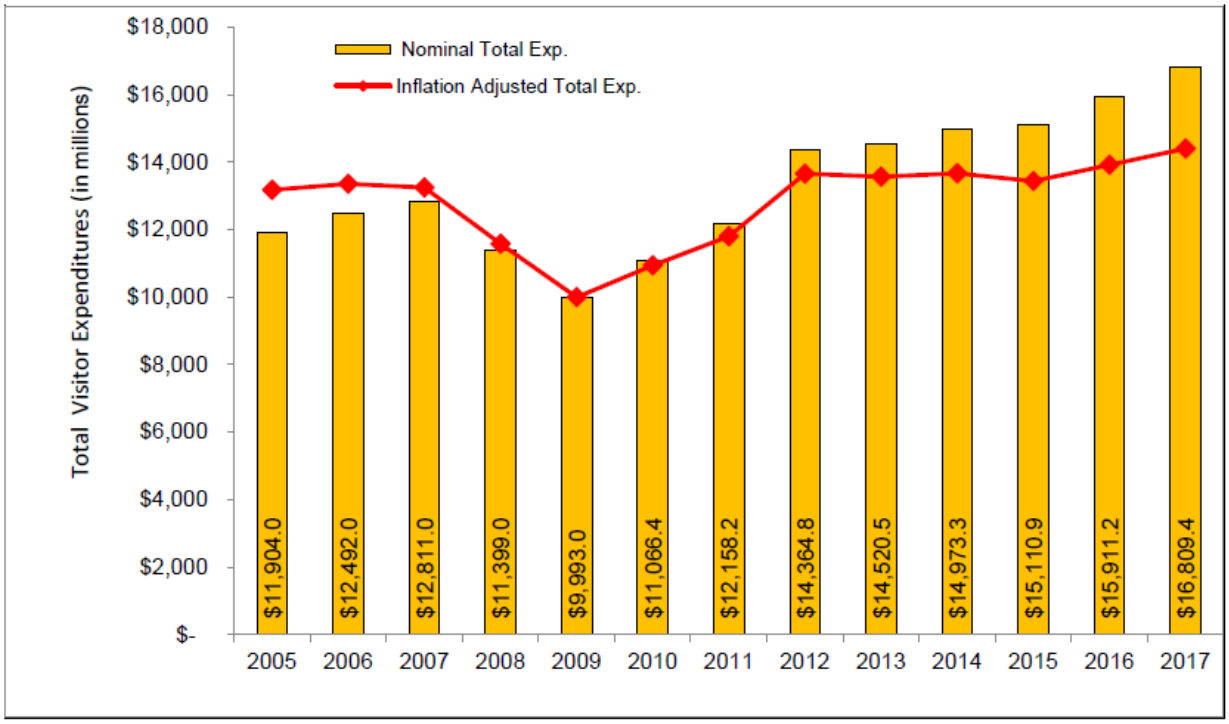
In 2016, Hawai'i employed 647,544 people and generated $31.2 billion in wages and $84.9 billion in gross domestic product. Hawai'i's ocean economy in 2016 employed 118,083 people and generated $4.5 billion

[10] An additional 126,733 visitors arrived via cruise ship (HTA 2018) and are not included in further analysis due to the small proportion of total tourism.

in wages and $8.6 billion in gross domestic product. The ocean economy accounted for 18.2% of Hawai'i's employment, 14.3% of its wages, and 10.2% of its gross domestic product (NOAA 2019).

Much of the state's economy is based on the island's coastal and marine resources. Tourism accounts for the majority of the state's economy, with a significant portion of the tourist activities associated with beaches and marine wildlife (DLNR 2015). Coastal development and land values have both increased with the growth in tourism. In 2002, the Hawai'i Coral Reef Initiative funded a study regarding the economic valuation of the coral reefs of Hawai'i, where the value of coral reefs to the Hawai'i economy was estimated to be about $380 million dollars per year (DLNR 2015). In 2001, Cesar et al. documented the annual recreational value of the coral reefs of the Hawaiian reefs for snorkelers and divers was estimated to be $281 million and $44 million, respectively. Although the direct expenditure per diver is much larger than the direct expenditures of snorkelers, the overall value related to the latter group is much larger due to their large numbers. According to the 2019 National Oceanic and Atmospheric Administration (NOAA) Report on the Ocean and Great Lakes Economy of the United States, in 2016 (most recent data), Hawai'i employed 647,544 people and generated $31.2 billion in wages and $84.9 billion in gross domestic product. Hawai'i's ocean economy then employed 118,083 people and generated $4.5 billion in wages and $8.6 billion in gross domestic product. The ocean economy accounted for 18.2% of Hawai'i's employment, 14.3% of its wages, and 10.2% of its gross domestic product (NOAA 2019). Commercial fish landings in Hawai'i have increased annually since 2006, and NOAA reported total landings in 2013 were valued near $108 million dollars (DLNR 2015).

Hawai'i's tourism industry achieved new records in total visitor spending and visitor arrivals in 2017, marking the sixth consecutive year of record growth in both categories. Total spending by visitors to the Hawaiian Islands increased 5.6% to a new high of $16.21 billion (HTA 2018). When adjusted for inflation, total visitor spending was up 3.5% from 2016 (Figure 3). A total of 9,404,346 visitors came by air or by cruise ship to the state, up 5.3% from the previous record of 8,934,277 visitors in 2016. Total visitor days rose 4.8% compared to 2016. The average spending per day by these visitors ($198 per person) was also higher than 2016 ($197 per person; HTA 2018). Arrivals by airlines in 2017 grew 5.2% to 9,277,613 visitors. Additionally, there were 126,733 visitors who came to the islands by cruise ship, which was an increase of 12.7% from 2016 (HTA 2018).



Note: Implicit price deflator (2009=100)
Source: 2017 State of Hawai‘i Data Book Table 7.35.

Figure 3. Total visitor spending: nominal and real 2005-2017 (HTA 2018).

Total Spending by Category (HTA 2018):

- Lodging was the largest spending category by visitors to Hawai’i, rising 3.4% to $6.96 billion and making up 41.4% of the total visitor spending in 2017.
- Food and beverage was the second largest category, increasing 6.4% to $3.48 billion (20.7%) of total visitor spending in 2017.
- Shopping expenses rose 5.0% to $2.36 billion.
- Transportation expenditures rose 7.9% to $1.67 billion.
- Entertainment and recreation spending rose 10.8% to $1.57 billion.
- Supplemental business spending grew 5.9% to $125.1 million. This includes additional business spending spent locally on conventions and corporate meetings by out-of-state visitors that were not included in personal spending (i.e., costs on space and equipment rentals, transportation, etc.).

The military has a significant presence in Hawai‘i with large Naval installations located on estuarine and coastal areas such as Pearl Harbor and Kāne‘ohe Bay on O‘ahu, the Pacific Missile Range Facility on the

south shore of Kaua‘i, and the Pōhakuloa Training Area on the Hawai’i, the largest United States Department of Defense installation in the state of Hawai’i, or anywhere in the Pacific.

The history of Hawai’i has always included agriculture, and it continues to be an important industry, adding $2.9 billion to the state’s annual economy, and providing 42,000 direct and indirect jobs (HDA 2013). The sugar and pineapple industries boomed during the plantation era, covering thousands of acres of prime agricultural lands. As these industries have been declining, these lands are being converted to smaller farms growing diversified agricultural product (HDA 2013). Specialty exotic fruits, coffee, macadamia nuts, flowers and foliage are examples of crops that have become major exports to destinations around the globe, as well as providing fresh produce and flowers to local Hawaiian markets. High-tech aquaculture ventures have evolved from the early fishponds, farming varieties of fish, shrimp, lobster, abalone, and seaweed (HDA 2013).

4.1.1 Socioeconomic Aspects of the Commercial Aquarium Fishery

Commercial aquarium fishers on the island of Hawai’i often perform day or short overnight trips, operate individually or in small groups of two or three people, and use SCUBA and barrier nets (nets used to exclude, contain, or direct fish) to capture fish (Stevenson et al. 2011). Most aquarium fishers are between the ages of 40 and 60 years, have remained active in the fishery for more than 20 years, and fish approximately 3–4 days per week (Stevenson et al. 2011). Commercial aquarium fishers are required to report their monthly catch on an aquarium fish catch report separate from, and more detailed than, the CML reports.

The commercial aquarium fishery has contributed an average of $2,183,880 (inflation-adjusted 2020 dollars) to the State’s economy over the past 18 years (Table 4-1). According to DAR (2019a), the marine aquarium fishery is the most economically valuable commercial inshore fishery in the State of Hawai’i, with 68% of the value coming from the Island of Hawai’i, mainly West Hawai’i.

Table 4-1. Summary of commercial Aquarium Permits and values by year from 2000-2017 for the State of Hawai’i (DAR 2018a). These data include n.d. data and summation of East and West Hawai’i data, as well as the other islands that make up the state of Hawai’i.

Fiscal Year[1]	Number of Commercial Aquarium Permits	Number Reporting	Total Value	Total Value Adjusted for Inflation[2]
2000	113	82	$1,000,750	$1,499,213
2001	128	75	$936,811	$1,365,368
2002	139	63	$935,009	$1,340,774
2003	123	68	$1,174,168	$1,646,203
2004	145	77	$1,442,946	$1,970,557
2005	142	79	$1,579,370	$2,086,184
2006	186	87	$2,093,857	$2,679,337
2007	195	99	$1,646,167	$2,048,130
2008	178	94	$2,065,816	$2,475,212
2009	197	92	$1,894,015	$2,277,467

Fiscal Year[1]	Number of Commercial Aquarium Permits	Number Reporting	Total Value	Total Value Adjusted for Inflation[2]
2010	178	91	$2,282,618	$2,700,450
2011	172	87	$2,188,227	$2,509,565
2012	166	77	$2,306,179	$2,591,215
2013	153	64	$2,172,561	$2,405,842
2014	165	61	$2,322,564	$2,530,896
2015	163	69	$2,502,178	$2,723,388
2016	166	66	$2,257,021	$2,425,954
2017	226	68	$1,932,747	$2,034,076
Average	**163**	**78**	**$1,818,500**	**$2,183,880**

[1]Fiscal year runs from July 1 through June 30.
[2]http://www.usinflationcalculator.com/, adjusted for 2020 values in February 2020.

In 2017, the commercial aquarium fishery on the island of Hawai'i reported landings near $1.4 million, with more than $1.29 million coming from the WHRFMA (DAR 2018a). For the 10 fishers who would be issued commercial Aquarium Permits under the Limited Permit Issuance Alternative (includes the 7 fishers who would be issued commercial Aquarium Permits under the Preferred Alternative), 2 to 8 fishers reported catch in any given year between 2000 and 2017, contributing from 2.0% to 38.6% to the total overall WHRFMA fishery value (Table 4-2).

Since 2000, the commercial aquarium fishery within the WHRFMA on the island of Hawai'i has averaged annual landings valued at approximately $1.5 million, with a low of approximately $738,568 (inflation-adjusted 2020 dollars) in 2001 and a high of $1,965,381 (inflation-adjusted 2020 dollars) in 2014 (Table 4-2; DAR 2018a).

It should be noted that the dollar value of these fisheries represents only the ex-vessel value, i.e., what the fishers are paid for their catch and does not include the value which would be generated by additional dealer and retail sales. The actual economic value of the catch is thus substantially greater than the ex-vessel value. A study done in 1994 found that the DAR reported total average value for FY 1993/FY 1994 at only $819,957 (Miyasaka 1994), while analysis in 1993 by an aquarium trade group (Hawai'i Tropical Fish Association) estimated the total sales of Hawaiian aquarium fish (including freight and packaging) to be nearly 6 times this, at $4.9 million (Walsh et al. 2003).

As stated in DAR (2019a): "Although specific export data do not exist for the aquarium fishery, it is clear that most of the aquarium catch is shipped out of the state to dealers on the mainland United States, Europe, and Asia (Dierking 2002). This is neither surprising nor atypical for commercial fisheries in Hawai'i. For example, seafood exports of various Hawaiian species exceed 3.7 million pounds annually (Loke et al. 2012)."

Table 4-2. Number of Commercial Aquarium Permits and fishery value for the WHRFMA and East Hawai'i since 2000 (DAR 2018a). n.d. indicates data not disclosed due to Hawai'i confidentiality statute (Section 5.1). These data are applicable to the analysis of the Pre-Aquarium Collection Ban, WHRFMA-only Programmatic Issuance of Aquarium Permits, Achilles Tang Conservation, and Limited Permit Issuance alternatives.

Fiscal Year[1]	WHRFMA								East Hawai'i							Total for Island of Hawai'i (adjusted for inflation[2])
	All Fishers				10 Fishers who disclosed data				All Fishers				10 Fishers who disclosed data			
	# Aquarium Permits	# Permits Reporting	Total Value	Total Value Adjusted for Inflation[2]	# Permits Reporting	Total Value	Total Value Adjusted for Inflation[2]	% Contribution of 10 fishers	# Aquarium Permits	# Permits Reporting	Total Value	Total Value Adjusted for Inflation[2]	# Permits Reporting	Total Value	% Contribution	
2000	24[3]	25	$491,173	$735,821	3	$31,891	$47,776	6.5%	6	3	$11,832	$17,725	0	$0	n/a	$753,546
2001	26	23	$506,749	$738,568	2	$9,943	$14,492	2.0%	8	0	$0	$0	0	$0	n/a	$738,568
2002	37	19	$529,182	$758,831	3	$21,435	$30,737	4.1%	n.d.	n.d.	n.d.	n.d.	0	$0	n/a	$758,831
2003	30	22	$666,153	$933,957	4	$56,481	$79,187	8.5%	9	n.d.	n.d.	n.d.	0	$0	n/a	$933,957
2004	53	30	$866,630	$1,183,512	4	$176,253	$240,700	20.3%	n.d.	n.d.	n.d.	n.d.	0	$0	n/a	$1,183,512
2005	41	34	$1,168,265	$1,543,157	5	$171,215	$226,157	14.7%	11	3	$25,263	$33,370	0	$0	n/a	$1,576,527
2006	63	34	$1,459,004	$1,866,968	5	$165,011	$211,151	11.3%	11	6	$74,519	$95,356	0	$0	n/a	$1,962,324
2007	61	40	$1,065,093	$1,325,169	6	$176,253	$219,291	16.5%	14	4	$33,648	$41,864	0	$0	n/a	$1,367,033
2008	52	31	$1,308,629	$1,567,969	7	$323,256	$387,318	24.7%	17	9	$100,304	$120,182	1	$179	0.2%	$1,688,151
2009	55	30	$1,159,746	$1,394,542	7	$436,046	$524,326	37.6%	13	8	$84,022	$101,033	0	$0	n/a	$1,495,575
2010	60	36	$1,582,644	$1,872,346	7	$566,795	$670,546	35.8%	12	7	$30,062	$35,565	0	$0	n/a	$1,907,911
2011	60	42	$1,473,530	$1,689,916	7	$364,123	$417,594	24.7%	13	6	$41,238	$47,294	0	$0	n/a	$1,737,210
2012	48	28	$1,504,487	$1,690,436	6	$345,418	$388,110	23.0%	16	7	$79,067	$88,839	1	$4,213	5.3%	$1,779,275
2013	45	26	$1,560,517	$1,728,079	6	$319,409	$353,706	20.5%	15	9	$68,234	$75,561	0	$0	n/a	$1,803,640
2014	43	20	$1,570,057	$1,710,890	6	$466,985	$508,873	29.7%	18	7	$131,086	$142,844	1	$1,951	1.5%	$1,853,734
2015	38	19	$1,701,631	$1,852,067	7	$461,444	$502,239	27.1%	13	4	$104,110	$113,314	0	$0	n/a	$1,965,381
2016	37	19	$1,582,011	$1,700,421	8	$522,015	$561,087	33.0%	15	4	$80,441	$86,462	0	$0	n/a	$1,786,883
2017	57	21	$1,290,314	$1,357,962	8	$498,056	$524,168	38.6%	18	4	$91,790	$96,602	1	$8,962	9.8%	$1,454,564
Average	46	28	$1,193,656	$1,425,034	6	$284,002	$328,192	23.0%	13	5	$63,708	$73,067	0	$850	1.3%	$1,498,101

[1]Fiscal year runs from July 1 through June 30
[2]http://www.usinflationcalculator.com/, adjusted for 2020 values in February 2020
[3]Includes permittee that captured individuals in 1999, but reported captures in 2000

On the island of Hawai'i, the total aquarium catch and its value have continued to increase overall since the FRAs were established in 2000, while the number of reporting fishers has fluctuated (Table 4-1 and Table 4-2; DAR 2018a). Since FRAs were established, overall catch has not declined and recent work (Stevenson et al. 2013) has indicated that the economic status of West Hawai'i aquarium collectors has significantly improved since the FRA network was implemented (DAR 2019a)

Of the 40 fish species which can now be collected in West Hawai'i (i.e., White List Species), over 90% of the economic value between 2000 and 2017 was derived from four species: the Yellow Tang which made up 75.3% of the total value; the Achilles Tang which made up 7.1% of the total value; the Kole which made up 5.6% of the total value; and, the Black Surgeonfish which made up 4.9% of the total value. The remaining 36 species made up the remaining 7.2% of value during this time period (DAR 2018a).

For the eight species on the proposed Revised White List, the average, minimum and maximum sold values (based on data provided from the 10 fishers who released their data and reported catch from the WHRFMA) are shown in Table 4-3.

Table 4-3. Average, minimum and maximum per fish values for the 8 species on the proposed Revised White List based on 2017 and 2018 reported sales from fishers who disclosed data (DAR 2019b). Values were calculated by dividing the total value by the number sold. These data are applicable to the analysis of the Revised White List and Limited Permit Issuance Alternative (Preferred Alternative).

Species	Minimum Value	Maximum Value	Average Value
Yellow Tang	$2.00	$8.04	$4.29
Black Surgeonfish	$5.00	$30.08	$15.00
Orangespine Unicornfish	$2.00	$10.89	$4.00
Kole	$2.00	$6.00	$3.00
Bird Wrasse	$1.00	$10.00	$3.00
Potter's Angelfish	$2.00	$15.00	$8.00
Thompson's Surgeonfish	$1.00	$3.00	$2.00
Brown Surgeonfish	**$1.00**	**$1.00**	**$1.00**

4.2 CULTURAL RESOURCES

The cultural significance of each of the 40 White List Species is discussed in Section 4.4.1.

Cultural, historic, and archaeological resources were evaluated within the nearshore habitats (0-600 feet; 0-100 fathoms, where commercial aquarium collection occurs). A Cultural Impact Assessment (CIA) was prepared assessing the potential cultural impacts of issuance of Aquarium Permits, and is included as Appendix A. It should be noted that the CIA was completed assessing the impacts of the Limited Permit Issuance Alternative (the preferred alternative in the April 2020 FEIS), and was not revised to assess the

Revised White List and Limited Permit Issuance (Preferred) Alternative as the analysis of all 40 White List Species and the concept of unlimited catch was considered to still be necessary for analysis of the other alternatives considered in this EIS. A brief overview of cultural resources is provided here.

The ocean, its ecosystem, and the practice of fishing were and continue to be important in Native Hawaiian culture and tradition. The belief system of Native Hawaiians links people with all living and non-living things (Mitchell et al. 2005). Under this belief system, because all components of ecosystems were descended from *Wākea* (sky father) and *Papahanau-moku* (earth mother) and their offspring, *kini akua* (multitude of gods), both living and non-living elements possess spiritual qualities and *mana* (spiritual power). As such, Native Hawaiians, as *kanaka maoli* (native people), are guardians of these ecosystems and their well-being is directly related to the well-being of these ecosystems (Mitchell et al. 2005).

For example, areas such as *wao akua* (upland forests) are sacred places, the realm of the gods (Mitchell et al. 2005). Native Hawaiian land ownership and resource management were often based on a unit called the *ahupuaʻa*, which typically corresponded with what we today call watershed areas. This understanding of the link from uplands to the ocean was ahead of its time (Mitchell et al. 2005). *Kapu* (taboo) systems that limited certain classes or sexes from eating certain animals or fishing in certain places or at certain times may have aided in the conservation of some species (e.g., only men were allowed to eat *honu* (green sea turtle) and only royalty could eat certain fishes) (Mitchell et al. 2005).

Additionally, native species in Hawaiʻi play a significant role in Native Hawaiian culture. Historically, feathers from forest birds were used to make elaborate capes, leis, and helmets for the *aliʻi* (royalty). Whale ivory, shells, and shark's teeth were used for necklaces and other adornments (Mitchell et al. 2005). Fish and sea turtle bones were used as kitchen implements, tools, and fishhooks, while sea turtle shells and scutes were used as containers. Koa (*Acacia koa*) trees were used for the ocean-voyaging canoes (Mitchell et al. 2005).

Native wildlife also play an important role in Native Hawaiian culture as many species such as the *pueo* (*Asio flammeus sandwichensis* [Hawaiian short-eared owl]), ʻ*io* (*Buteo solitarius* [Hawaiian hawk]), ʻ*elepaio* (*Chasiempis sandwichensis* [Hawaiian elepaio]), ʻalalā (*Corvus hawaiiensis* [Hawaiian crow]), sea turtles (e.g., *Caretta* spp., *Chelonia* spp., *Dermochelys* spp., *Eretmochelys*, and *Lepidochelys* spp.), and sharks (*Hexanchus* spp.) are believed to be ʻ*aumakua* (ancestors or guardians) of certain Hawaiian families (Mitchell et al., 2005). Hawaiian names have been given to many of the native wildlife and they have been incorporated into *oli* (chants) and *moʻolelo* (legends).

Native Hawaiian culture also contains specific customs, beliefs, and practices related to fisheries and aquatic resources (Maly and Maly 2003). Historical narratives include specific references to cultural sites, such as *ko'a* (on shore and in ocean fishing shrines and station markers), resources procurement sites (both on land and in the water), and the traditional and customary laws governing the care for, and use of, the wide range of resources from the uplands to the ocean (Maly and Maly 2003). These historical accounts demonstrate that Native Hawaiians worked the land, water, and marine resources and, through a system of religious-based fisheries management protocols, were able to sustain themselves through the natural resources of the islands (Maly and Maly 2003). Native Hawaiian traditions surrounding aquatic resources demonstrate the cultural-historical importance of fisheries and land in the lives of Native Hawaiians and form the basis for Native Hawaiian's cultural attachment to the ocean and fishing today (Maly and Maly 2003).

Historical accounts demonstrate that Native Hawaiians were expert fishermen, and that fishing was a skill passed down generation to generation (Maly and Maly 2003). Native Hawaiians relied on fishing in the ocean for subsistence and consumption and employed traditional fishing methods that included the use of nets, hooks and lines, baskets, and hands (Maly and Maly 2003). In addition to serving as a source of food, aquatic resources and the practice of fishing were also linked to religious practices. Fishing was associated with religious ceremonies and fishermen traditionally worshipped fishing gods and goddesses and performed rituals related to certain species of fish (Maly and Maly 2003).

Numerous other examples of the use of native plants and animals in both daily life and ritual exist. In present day Hawaiʻi, the link between Native Hawaiian culture and native species has not been lost and continues to be practiced in belief systems, as well as in traditional practices such as gathering of native plants for hula, traditional medicines, carving, weaving, and ceremonies (Mitchell et al. 2005).

Today, Native Hawaiian teachings play an increasing role in natural resource management, especially in areas of cultural significance like *Kahoʻolawe* or *Wao Kele o Puna* (island of Hawaiʻi). The CWCS recognizes that the State and its agencies are obligated to protect the reasonable exercise of customarily and traditionally exercised rights of Native Hawaiians to the extent feasible, in accordance with Public Access Shoreline Hawai'i versus Hawai'i County Planning Commission and subsequent case law (Mitchell et al. 2005).

4.2.1 Cultural Aspects of the Commercial Aquarium Fishery

4.2.1.1 In the WHRFMA

From Jokiel et al. (2011):

> *For the past century Hawaiʻi has been dominated by a "Western" model of marine environmental management. Recently, however, there has been a renewed interest in the traditional management practices of ancient Hawaiians. Throughout Hawaiʻi, a growing cultural, sociological, and scientific movement is working to investigate and revive some of these traditional management tools and to integrate them with modern scientific methodology. The native islanders had devised and implemented every basic form of what are now considered modern marine fisheries conservation measures centuries ago, long before the need for marine conservation was even recognized in Western nations (Johannes 1982). Traditional restrictions on fishing in Hawaiʻi were achieved by the use of closed seasons, closed areas, size restrictions, gear restrictions, and restricted entry. Additional social, cultural, and spiritual controls strengthened the conservation ethic under the old system. Ancient Hawaiians used a holistic approach that we might now recognize and strive for as integrated coastal management. Bridging the gap between traditional management and Western science represents a challenge to researchers, government agencies, resource managers, cultural practitioners and organizations, and to the people of Hawaiʻi.*

Act 306 and formation of the WHFC (Section 1.2.4) played a significant role in bridging that gap by creating a new aquarium fish management plan that is much closer to the traditional Hawaiian system. Commercial aquarium fish collection has been on-going in Hawai'i since the late 1940's, with most fishers active in the fishery for more than 20 years and many active for 35 – 40 years. Protecting and preserving the reef, the

fish, and the cultural heritage of both Hawai'i and the fishery, is in their best personal and business interest. Commercial aquarium fish collection is not a part of Native Hawaiian culture; however, Native Hawaiians do participate in and support the fishery and Hawaiian culture has been a significant aspect of the fishery's management since the 1970's. Although the process has been contentious at times, the WHFC has been successful. See Section 1.2.4.1 for a further description of their contributions and accomplishments. Section 4.4.1 summarizes the cultural significance of the White List Species.

4.2.1.2 Public and Private Aquariums

More than 700 million people visit zoos and aquariums worldwide each year, and these zoos and aquariums spent more than $350 million on wildlife conservation in 2008 (Gusset and Dick 2011). Visits to aquariums may be for entertainment or educational purposes (as cited in Cracknell et al. 2015), but there are psychological benefits as well. Cracknell et al. (2015) looked at the behavioral, physiological and psychological reactions of people viewing a large aquarium exhibit, and found greater reduction in heart rate, greater increases in self-reported mood, higher interest, and longer spontaneous viewing times when species diversity within the aquarium was higher. Aquarium fish are also sold to home aquaria owners, of which 70% report that their fish are calming and stress reducing (Kidd and Kidd 1999, as cited in Cracknell et al. 2015), and for this reason aquariums are often present in health care settings as well, to provide a relaxing and calm environment (Cracknell et al. 2015).

4.3 PHYSICAL RESOURCES

The Hawaiian Archipelago is composed of 8 main islands and approximately 124 smaller islands, reefs, and shoals spanning over 1,500 miles that vary in size from fractions of acres to thousands of square miles (Mitchell et al. 2005). The Archipelago was formed over the last 70 million years through volcanic eruptions from a relatively stationary hotspot beneath the slowly moving seafloor. The island of Hawai'i is the youngest island, with island age increasing to the northwest as the Pacific plate carries the older islands away from the hotspot (Mitchell et al. 2005). Millions of years of erosion, subsidence, and reef building resulted in the formation of the atolls which form the Northwestern Hawaiian Islands and the submersion under the sea surface of the seamounts which used to be islands (Mitchell et al. 2005).

Located over 2,000 miles from the nearest continent, Hawai'i is the most remote island chain in the world (Mitchell et al. 2005). Despite its relatively small area (less than 4.1 million acres), an elevation range from sea level to 13,796 feet results in Hawai'i containing all the major known ecological zones. With a wide temperature range due to the elevational gradient and with average annual rainfall ranging from less than 15 inches to over 480 inches per year, Hawai'i displays most of the earth's variation in climatic conditions. Finally, Hawai'i possesses many natural wonders: the most active volcano in the world, the wettest place on earth, the tallest seacliffs, and extensive coral reefs (Mitchell et al. 2005).

Due to the large number and the varied geology of the islands, Hawai'i has diverse marine habitats, which range from estuaries, tidepools, sandy beaches, and seagrass beds to nearshore deep waters, extensive fringing and atoll reef systems, and smaller barrier reef systems (DLNR 2015). However, introduced mangroves have altered native coastal habitats in a number of places. The distribution of marine ecosystems in Hawai'i is a result of island age, reef growth, water depth, exposure to wave action,

geography, and latitude. The marine habitats found on each island depend on the type of island: large and young, mature, or drowned islands and seamounts (DLNR 2015). Large and young islands such as the island of Hawaiʻi have recent lava flows and few, living structural coral reefs. Beaches are rocky except around bays, and drowned reefs may be found in deep waters or off parts of the east coast of Maui. Mature islands, such as Oʻahu and Kauaʻi in the Main Hawaiian Islands (MHI) and Nihoa and Necker in the Northwestern Hawaiian Islands (NWHI) are the most diverse, with habitat types ranging from estuaries and sandy beaches to rocky beaches and fringing and barrier reefs to lagoons with patch or pinnacle reefs. Drowned islands, such as atolls in the rest of the NWHI, are the remains of volcanic islands with habitats ranging from coral islets and benches to caves and terraces along the slope of the atoll (DLNR 2015).

4.3.1 Climate

Features of Hawai'i's climate include mild temperatures throughout the year, moderate humidity, persistence of northeasterly trade winds, significant differences in rainfall within short distances, and infrequent severe storms (Price 1983). For most of Hawai'i, there are only two seasons: "summer," between May and October, and "winter," between October and April. Hawai'i's length of day and temperature are relatively uniform throughout the year. Hawai'i's longest and shortest days are about 13.5 hours and 11 hours, respectively, compared with 14.5 and 10 hours for Southern California and 15.5 hours and 8.5 hours for Maine (Price 1983). Uniform day lengths result in small seasonal variations in incoming solar radiation and, therefore, temperature. On a clear winter day, level ground in Hawai'i receives at least 67% as much solar energy between sunrise and sunset as it does on a clear summer day. By comparison the percentages are only 33 and 20 at latitudes 40 and 50 degrees respectively (Price 1983).

Over the ocean near Hawai'i, rainfall averages between 25-30 inches per year. The islands receive as much as 15 times that amount in some places and less than one third of it in others. This is caused mainly by orographic or mountain rains, which form within the moist trade wind air as it moves from the sea over the steep and high terrain of the islands (Price 1983). Over the lower islands, the average rainfall distribution resembles closely the topographic contours. Amounts are greatest over upper slopes and crests and least in the leeward lowlands. On the higher mountains, the belt of maximum rainfall lies between 2,000-3,000 feet and amounts decrease rapidly with further elevation. As a result, the highest slopes are relatively dry (Price 1983). Another source of rainfall is the towering cumulus clouds that build up over the mountains and interiors on sunny calm afternoons. Although such convective showers may be intense, they are usually brief and localized. Hawai'i's heaviest rains are come from winter storms between October and April. While the effects of terrain on storm rainfall are not as great as on trade wind showers, large differences over small distances do occur, because of topography and location of the rain clouds. Differences vary with each storm. Frequently, the heaviest rains do not occur in areas with the greatest average rainfall. Relatively dry areas may receive, within a day or a few hours, totals exceeding half of their average annual rainfall (Price 1983). The leeward and other dry areas receive their rainfall mainly from a few winter storms. Therefore, their rainfall is usually seasonal and, their summers are dry. In the wetter regions, where rainfall comes from both winter storms and trade wind showers, seasonal differences are much smaller (Price 1983).

At the opposite extreme, drought is not unknown in Hawai'i, although it rarely affects an entire island at one time. Drought may occur when there are either no winter storms or no trade winds (Price 1983). If there are no winter storms, the normally dry leeward areas are hardest hit. A dry winter, followed by a normally dry

summer and another dry winter, can have serious effects. The absence of trade winds affects mostly the windward and upland regions, which receive a smaller proportion of their rain from winter storms (Price 1983).

The waters surrounding Hawai‘i are affected by seasonal variations in climate and ocean circulation. The surface temperature of the oceans around Hawai‘i follow a north-south gradient and range from 75˚F in the MHI to 68˚F to 72˚F in the NWHI in winter and spring to 79˚F - 81˚F throughout all the islands in the late summer and fall (DLNR 2015). The depth of the thermocline, where water temperature reaches 50˚F, is 1,500 feet northwest of the islands and 1,000 feet off the island of Hawai‘i. Surface currents generally move east to west and increase in strength moving southward (DLNR 2015). The seas are rougher between islands than in the open ocean, because wind and water are funneled through the channels. Waves generated by north Pacific low-pressure systems are larger in the winter months than in the spring and are generally bigger on the northern shores of the islands than the southern shores. Marine organisms have adapted to these general climatological and oceanographic conditions (DLNR 2015).

Climate and oceanographic indicators highlight long-term trends and recent anomalous conditions in West Hawai‘i’s natural environment. The El Niño Southern Oscillation (ENSO), an irregular, large-scale climate phenomenon that drives changes in regional oceanic and atmospheric conditions, has shifted over the last four decades towards increased frequency and severity in El Niño conditions, with the recent 2015 El Niño as one of the strongest on record (Gove et al. 2016). Rainfall, which can influence salinity, temperature, sediment load, and nutrient concentrations in the marine environment, has been at or below the long-term average over the past 15 years while the intensity of short-term events has increased over the same time period. Long-term sea level, an important indicator for coastal erosion and flooding, is rising by an estimated 0.15 inch per year and is expected to reach 1.6 feet higher than present day levels by 2100. Sea surface temperature, an indicator of regional and climatic forcing that is highly influential to a myriad of ecological processes, was anomalously warm in recent years and reached a record level of thermal stress in September 2015, resulting in widespread and severe coral reef bleaching in West Hawai‘i (Gove et al. 2016).

4.3.2 Physical Aspects of the Commercial Aquarium Fishery

Commercial aquarium fishers typically interact with physical resources within recreational dive limits (RDL), generally from 35-70 feet deep (BIAAF, pers. comm.). Deeper waters are fished to a lesser extent, in depths beyond RDL (130 feet). Habitats most often fished are shallow water reefs consisting of rich coral growth over rocky substrate. These reefs can be adjacent to the shoreline or apart and isolated far offshore, with the distance usually dictated by how fast the bathymetric relief occurs. Deep water fish are caught off the edge (ledge) of the reefs where the depth drops off rapidly. Coral cover diminishes and typically the habitat consists of rocks and sand.

Aquarium fish collection is generally carried out by divers equipped with some form of underwater breathing apparatus (e.g., SCUBA, surface supplied air, rebreather equipment). Most fishing activity occurs off of a boat, although some shore diving does occur infrequently. Divers use hand nets, usually in combination with the placement of short, bottom-set barrier nets. Nets are typically 30 feet in length and 6 feet in height. Sometimes even smaller fence nets are used. Most often the netting is considered “fine” with a stretched

mesh size less than 1 inch. The net is always made of monofilament. Other gear may include “poker sticks” (i.e., lightweight fiberglass poles used to herd fish), catch baskets or keeps (i.e., containers into which catch is transferred).

Once the fisher(s) reaches the bottom he/she quickly identify fish of interest. Fish are typically gathered into groups utilizing poker sticks to move fish along the reef until a satisfactory number have accumulated. At this point, the fisher with the barrier net looks for a natural demarcation in the reef (e.g., strip of sand or rubble) to set the net. The net is set in a “V” formation to corral the fish as they are advanced into the net. The net is pulled back, halfway up creating a “pocket” and hooked onto bare substrate with some sort of fastener (e.g., rubber band). At this point the net is set and the fisher circles back on the gathered fish. The fish are then directed to the net and into the pocket. From the pocket, the fish are either scooped with a hand net, or collected by hand and transferred into a catch basket. All incidental catch is released immediately, and the net is gathered up. At the end of the dive the catch baskets are clipped onto a line suspended off the boat for a slow decompression.

In lieu of collection with fine mesh nets, other gear types are legal to use when collecting aquarium fish with a CML outside the WHRFMA. These methods can include using larger sized nets, fishing pole and hook-and-line fishing, slurp guns which suction aquatic specimens directly into the diver’s catch bag, and night fishing.

4.4 BIOLOGICAL RESOURCES

Because of Hawai‘i’s geographical isolation, many of its coastal and marine species are endemic (i.e., native or restricted to a certain country or area) to the Hawaiian Archipelago (including Johnston Atoll). Approximately 15 to 25% of the marine species are endemic to the Hawaiian Archipelago, one of the largest proportions of marine endemism for any island chain in the world (Randall 2007, DLNR 2015). Of the 612 known nearshore fish species in Hawai’i, 25% are endemic to the Hawaiian Archipelago (Randall 2007). Yet because of the isolation, Hawai‘i has relatively low marine species richness (i.e., diversity), with approximately 580 shallow reef fish species in contrast to areas of the Pacific further west with thousands of species. In total though, Hawai‘i still has over 6,000 marine species (DLNR 2015).

Toonen et al. (2011) conclude that the Hawaiian Archipelago is not a single, well-mixed marine community, but rather there are at least four significant multi-species barriers to dispersal along the length of the island chain, and that species that appear capable of extensive dispersal, such as Yellow Tang and Kole, show significant population differentiation within the Hawaiian Archipelago. In addition, there are significant consensus genetic breaks that restrict gene flow between islands, including a barrier between the island of Hawai’i and the rest of the MHI. Conversely, around the island of Hawai’i, there is connectivity between adjacent reefs (up to 184 kilometers), with fish from protected FRAs being documented to seed unprotected areas, highlighting the effectiveness of protected areas (Christie et al. 2010).

4.4.1 White List Species

Concerns over continued expansion of the commercial aquarium fishery and its effects in the Open Areas prompted DLNR in 2013 to establish a ‘White List’ of 40 species which can be taken by aquarium fishers in the WHRFMA (Table 4-4). All other species of fish and invertebrates are off limits within the WHRFMA.

Although other aquatic life is allowed to be collected from the eastern side of the island of Hawai'i, these 40 species represent the majority of fish that are collected in East Hawai'i.

Table 4-4. White List Species (DAR 2019, Appendix A). Bolded species are proposed for inclusion on the Revised White List as part of the Preferred Alternative.

Common Name(s)	Scientific Name	Hawaiian Name(s)	Hawaiian Status[1]
Yellow Tang	***Zebrasoma flavescens***	***lāʻī pala, lauʻī pala***	**Indigenous**
Achilles Tang	*Acanthurus achilles*	*pākukui, pākuikui, pākuʻikuʻi*	Indigenous
Black Surgeonfish (Chevron Tang)	***Ctenochaetus hawaiiensis***	**species of *kole***	**Indigenous**
Shortnose (Geoffroy's) Wrasse	*Macropharyngodon geoffroy*	species of *hīnālea*	Endemic
Goldrim Tang	*Acanthurus nigricans*	unknown	Indigenous
Fourspot Butterflyfish	*Chaetodon quadrimaculatus*	*lauhau*	Indigenous
Orangeband (Shoulder) Surgeonfish	*Acanthurus olivaceus*	*naʻenaʻe*	Indigenous
Orangespine Unicornfish (Clown Tang, Naso Tang)	***Naso lituratus***	***umaumalei, kala umaumalei***	**Indigenous**
Forcepsfish	*Forcipiger flavissimus*	*lauwiliwili nukunuku ʻoiʻoi*	Indigenous
Spotted Boxfish (Boxfish)	*Ostracion meleagris*	*pahu, moa*	Indigenous
Yellowtail Coris (Clown Wrasse)	*Coris gaimard*	*hīnālea ʻakilolo*	Indigenous
Milletseed (Lemon) Butterflyfish	*Chaetodon miliaris*	*kīkākapu*	Endemic
Kole (Goldring Surgeonfish, Yelloweye, Goldring)	***Ctenochaetus strigosus***	***kole, kole makaonaona***	**Endemic**
Pencil Wrasse	*Pseudojuloides cerasinus*	species of *hīnālea*	Indigenous
Bird Wrasse	***Gomphosus varius***	***hīnālea ʻiʻiwi***	**Indigenous**
Blacklip Butterflyfish (Coral Butterflyfish)	*Chaetodon kleinii*	*kīkākapu, kapuhili, lauhau, lauwiliwili*	Indigenous
Potter's Angelfish	***Centropyge potteri***	**unknown**	**Endemic**
Ornate Wrasse (Pinkface)	*Halichoeres ornatissimus*	*lāʻō*	Endemic
Black Durgon	*Melichthys niger*	*humuhumu ʻeleʻele*	Indigenous
Gilded Triggerfish (Blue-throat Triggerfish)	*Xanthichthys auromarginatus*	species of *humuhumu*	Indigenous
Lei Triggerfish	*Sufflamen bursa*	*humuhumu lei, humuhumu umaumalei*	Indigenous
(Forster's) Blackside Hawkfish	*Paracirrhites forsteri*	*hilu, hilu pilikoʻa*	Indigenous
Thompson's Surgeonfish	***Acanthurus thompsoni***	**species of *kala***	**Indigenous**
Pyramid Butterflyfish	*Hemitaurichthys polylepis*	*kapuhili*	Indigenous
Multiband (Pebbled) Butterflyfish	*Chaetodon multicinctus*	*kīkākapu*	Endemic

Common Name(s)	Scientific Name	Hawaiian Name(s)	Hawaiian Status[1]
Hawaiian Dascyllus (Domino)	*Dascyllus albisella*	*ʻālo‘ilo‘i*	Endemic
Saddle Wrasse	*Thalassoma duperrey*	*hīnālea lauwili*	Endemic
Redbarred Hawkfish	*Cirrhitops fasciatus*	*piliko‘a*	Endemic
Eightline Wrasse	*Pseudocheilinus octotaenia*	species of *hīnālea*	Indigenous
Fourlined Wrasse	*Pseudocheilinus tetrataenia*	species of *hīnālea*	Indigenous
Brown Surgeonfish (Lavender, Forktail Tang)	***Acanthurus nigrofuscus***	***mā‘i‘i‘i, mā‘i‘i***	**Indigenous**
Hawaiian Whitespotted Toby (Puffer)	*Canthigaster jactator*	unknown	Endemic
Bluestripe Snapper (Taape)	*Lutjanus kasmira*	unknown	Invasive
Peacock Grouper (Roi, bluespot Peacock Grouper)	*Cephalopholis argus*	unknown	Invasive
Psychedelic Wrasse	*Anampses chrysocephalus*	species of *hīnālea*	Endemic
Tinker's Butterflyfish	*Chaetodon tinkeri*	*kīkākapu, kapuhili, lauhau, lauwiliwili*	Indigenous
Longfin Anthias	*Pseudanthias hawaiiensis*	unknown	Endemic
Flame Wrasse	*Cirrhilabrus jordani*	species of *hīnālea*	Endemic
Fisher's Angelfish	*Centropyge fisheri*	unknown	Indigenous
Eyestripe Surgeonfish (Palani)	*Acanthurus dussumieri*	*palani*	Indigenous

[1]Indigenous species are species that are native to Hawai‘i (but may also be found elsewhere). Endemic species are found only within the Hawaiian Islands (including Johnston Atoll). Invasive species were introduced due to humans.

The following sections provide a brief overview of the ecology and cultural significance of each White List Species. Further details on the cultural significance can be found in Appendix A. Population estimates presented below are based on the NOAA’s PIFSC-ESD and the DAR WHAP (see Section 4.4.7 for discussion of PIFSC-ESD data and WHAP data). Population estimates derived from both data sets have varying degrees of variability (described in Section 4.4.7) and are not a measure of absolute abundance. In addition, the PIFSC-ESD estimates are island-wide in depths of 0-98 feet (0-30 meters). The WHAP population estimates include only the WHRFMA in depths of 30-60 feet. The difference in survey methods and area often leads to large differences in population estimates between the two data sets.

4.4.1.1 Yellow Tang (*Zebrasoma flavescens*) [Proposed for Revised White List]

Ecology

The Yellow Tang is one of the most popular aquarium species, growing to 8 inches, oval in shape and laterally compressed, with a small mouth and eyes set high on the head. Adults are bright yellow and have modified scales along the base of the tail which can be exposed when the fish flexes its tail. These modified scales or spines are used for defense from predators and competition for feeding areas. At night, the yellow color darkens, and a white band appears along the lateral line (University of Hawai’i 2016). The Yellow Tang is found from shallow surge zones to a depth of 130 feet and occur in the Pacific Ocean: Ryukyu, Mariana, Marshall, Marcus, Wake, and Hawaiian Islands (Froese and Pauly 2019).

The Yellow Tang is the only solid yellow fish common throughout Hawai'i. This species is found in subtropical waters and is rare on the western extremes of its range. Flexible comb-like teeth are used to pick algae and seaweed that grow along the reefs. Young Yellow Tangs are associated with finger coral (*Porites compressa*) which is abundant in the coastal waters of the island of Hawai'i, but less so on O'ahu (Dr. Bruce Carlson, pers. comm.). They spend a large amount of time feeding and aggressively protect prime feeding territories (University of Hawai'i 2016).

Yellow Tang are broadcast spawners. Many broadcast spawners migrate to the edge of the reef-drop off to spawn at dusk or dawn (Thresher 1984). Males and females simultaneously release eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Yellow Tang at the 0-98-foot depth in hardbottom habitats was approximately 6,417,481 individuals, with an estimated 329,557 individuals in East Hawai'i and 6,087,924 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Yellow Tang at the 30-60-foot depth was approximately 1,663,775 individuals and in 2017/2018 was approximately 2,867,048 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 5,690,643 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has increased significantly in Open Areas, MPAs, and FRAs (DAR 2019a).

Cultural Significance

The yellow tang, called *lāʻī pala* or *lauʻī pala* in Hawai'i, although small was considered a delicacy and also involved in healing rituals.

4.4.1.2 Achilles Tang (*Acanthurus achilles*)

Ecology

A member of the surgeonfish family, the Achilles Tang grows to 10 inches, is laterally compressed, and has a small mouth and eyes set high on the head. Adults are recognized by the bright orange patch at the base of the tail, where modified scales can be exposed when the fish flexes its tail. These modified scales or spines are used for defense from predators and competition for feeding areas (University of Hawai'i 2016).

The Achilles Tang is known in the West Pacific, Oceanic Islands of Oceania to the Hawaiian Islands and Pitcairn Islands as well as Wake, Marcus, and Mariana Islands. In the Eastern Central Pacific, they are found around the southern tip of Baja, California, Mexico, and other offshore islands (Froese and Pauly 2018). The Achilles Tang is present throughout Hawai'i and found near exposed coral reefs and rocky shores. Flexible comb-like teeth are used to pick algae and seaweed that grow along the reefs. They spend a large amount of time foraging and aggressively protecting prime feeding territories (University of Hawai'i 2016).

Achilles Tang are broadcast spawners. Many broadcast spawners migrate to the edge of the reef-drop off to spawn at dusk or dawn (Thresher 1984). Males and females simultaneously release eggs and sperm

into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Achilles Tang at the 0-98-foot depth in hardbottom habitats was approximately 212,651 individuals, with an estimated population of 185,259 individuals in East Hawai'i and 27,392 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Achilles Tang at the 30-60-foot depth was approximately 21,627 individuals and in 2017/2018 was approximately 13,796 individuals (DAR 2014a, 2019a). As discussed and analyzed in Section 5.0, the WHAP estimate is low because it does not assess the primary habitat and location of the Achilles Tang population on the island of Hawai'i. The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 21,494 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has remained stable in MPAs (though shown a non-significant negative trend) and declined significantly in both FRAs and Open Areas (DAR 2019a).

Cultural Significance

The Achilles Tang is commonly referred to in Hawai'i as *pāku'iku'i*. The spelling and pronunciation of the Hawaiian names, which include *pākukui*, *pākuikui*, and *pāku'iku'i*, vary. They were considered "good eating" (Pukui and Elbert 1986) and were also noted to be associated with Hawai'i Island and correlated with the *kukui* tree (*Aleurites moluccana*) that grows on land.

4.4.1.3 Black Surgeonfish (Chevron Tang) (*Ctenochaetus hawaiiensis*) [Proposed for Revised White List]

Ecology

The Black Surgeonfish is widespread throughout the tropical waters of the Pacific Ocean. Juveniles have blue and purple patterns on an orange to red background, these colors fade as the individual matures. Modified scales are present along the base of the tail which can be exposed when the fish flexes its tail. These modified scales or spines are used for defense from predators and competition for feeding areas (Randall and Clements 2001). The Black Surgeonfish is the 5th most collected aquarium fish in Hawai'i (DAR 2010).

Black Surgeonfish inhabits high energy shallow surge zones (International Union for the Conservation of Nature [IUCN] 2017). The genus *Ctenochaetus* feed on fine detrital material. They whisk the sand or rocky substratum with their teeth and utilize suction to draw in the detrital material that consists of diatoms, small fragments of algae, organic material, and fine inorganic sediment (Randall and Clements 2001). Species of *Ctenochaetus* share the presence of a thick-walled stomach (Randall and Clements 2001), this character is significant with respect to the nutritional ecology of this genus (Choat et al. 2002).

Black Surgeonfish are broadcast spawners. Many broadcast spawners migrate to the edge of the reef drop off to spawn at dusk or dawn (Thresher 1984). Males and females simultaneously release eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Black Surgeonfish at the 0-98-foot depth in hardbottom habitat was approximately 425,426 individuals, with an estimated 110,361 individuals in East Hawai'i and 315,065 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Black Surgeonfish at the 30-60-foot depth was approximately 34,678 individuals, and in 2017/2018 was approximately 98,067 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 156,701 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has increased significantly in Open Areas, MPAs, and FRAs (DAR 2019a).

Cultural Significance

The Black Surgeonfish, also called *ukole* or *pākole*, is a species in the *kole* (meaning "raw" or "red") family. Its cultural significance is tied to another surgeonfish commonly known as Kole (see Section 4.4.1.13).

4.4.1.4 Shortnose (Geoffroy's) Wrasse (*Macropharyngodon geoffroy*)

Ecology

The Shortnose Wrasse is endemic throughout the Hawaiian Islands and Johnston Atoll (Lobel 2003) and is found at depths between 20 and 100 feet. It has dark blue spots on a yellow to orange background. Research suggests that the Shortnose Wrasse is common throughout its range (Craig 2010). This species inhabits mixed sand, rubble patches, and coral reefs where it feeds on mollusks (Lieske and Myers 1994). Distinct pairs are formed during breeding (Breder and Rosen 1966).

Shortnose Wrasse are broadcast spawners, with males and females simultaneously releasing eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Shortnose Wrasse at the 0-98-foot depth in hardbottom habitat was approximately 92,579 individuals, with an estimated 44,480 individuals in East Hawai'i and 48,099 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Shortnose Wrasse at the 30-60-foot depth was approximately 3,222 individuals, and that estimate remained the same for 2017/2018 (3,222 individuals; DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 4,669 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has remained stable in Open Areas, MPAs, and FRAs (DAR 2019a).

Cultural Significance

Hīnālea, occasionally shortened to *ālea*, is a name broadly applied to various species known commonly as wrasses and is applied to most of the smaller wrasses that have no known Hawaiian names (Hoover 2007). There are specific traditional fishing methods associated with wrasses. *Melomelo* involved using a carefully curated stick to attract the fish (Kahāʻulelio 2006). They were also caught in basket traps woven from plant-based fibers, including a diving basket known as *hīnaʻi hoʻoluʻuluʻu* which was made from the vines of the

ʻāwikiwiki (Canvalia galeata). Standing nets known as *kūkulu ʻupena* and 18-foot long fishing poles called *ke kāmākoi* made of bamboo or *hau* (*Hibiscus tiliaceus*) were also used to catch *hīnālea* (Manu et al. 2006). The *ke kāmākoi* were used in the nearshore reefs where the fisher could cast from shore. Yet another traditional method of catching *hīnālea* involved poison, a net called ʻ*upena holahola* was used with certain piscicidal plants (i.e., containing a substance poisonous to fish) that were crushed and placed around a fishing hole, where the toxins from the crushed plants would diffuse into the water and paralyze the trapped fish, causing the *hīnālea* to float to the surface into the *holahola* net (Manu et al. 2006).

The *hīnālea* is considered a popular fish of the Hawaiian diet, and they are referenced in many *moʻolelo*, or stories. They were also considered important for ceremonies, including as offerings for gods responsible for conceiving a child, and were also noted in several accounts of gods and goddesses.

4.4.1.5 Goldrim Tang (*Acanthurus nigricans*)

Ecology

The Goldrim Tang has a black to purplish-blue body with a small white mark on the cheek between the mouth and eyes. The fins are dark blue with lighter blue highlights along the edges. The tail is blue with a yellow vertical bar. A yellow stripe runs along the body, against the anal and dorsal fins, forming a wishbone-shaped marking. This species can be found throughout the eastern Indian Ocean to the Hawaiian Islands. Adults grow to about 8 inches and have a spine along the base of the tail used for defense against predators (Myers 1991). The Goldrim Tang is found along outer reefs at water depths between 6 and 220 feet and feed almost entirely on algae.

Spawning occurs in monogamous pairs during which time they can be alone or in small groups. Initially, larvae develop among plankton and then move to reefs where juveniles develop to adults (Kuiter and Tonozuka 2001). Goldrim Tang are broadcast spawners. Many broadcast spawners migrate to the edge of the reef drop off to spawn at dusk or dawn (Thresher 1984). Males and females simultaneously release eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Goldrim Tang at the 0-98-foot depth in hardbottom habitat was approximately 92,218 individuals, with an estimated 21,495 individuals in East Hawai'i and 70,723 in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Goldrim Tang at the 30-60-foot depth was approximately 7,517 individuals, and in 2017/2018 was approximately 5,966 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 13,832 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has remained stable in Open Areas, MPAs, and FRAs (DAR 2019a).

Cultural Significance

While the Goldrim Tang is indigenous to Hawai'i, there are no known Hawaiian names or known cultural significance (Appendix A).

4.4.1.6 Fourspot Butterflyfish (*Chaetodon quadrimaculatus*)

Ecology

The upper half of the Fourspot Butterflyfish is black with two white spots. The lower half is yellow with a light blue trim around the dorsal and anal fins. They are sometimes confused with angelfish but lack a cheekspine. This species is found throughout the Indian Ocean.

Individuals are frequently found on exposed reefs between 6 and 140 feet where they feed mainly on coral polyps. Fourspot Butterflyfish are often observed alone; however, they form district pairs during breeding (Breder and Rosen 1966).

Fourspot Butterflyfish are broadcast spawners. Many broadcast spawners migrate to the edge of the reef drop off to spawn at dusk or dawn (Thresher 1984). Males and females simultaneously release eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Fourspot Butterflyfish at the 0-98-foot depth in hardbottom habitat was approximately 505,167 individuals, with an estimated 378,603 individuals in East Hawai'i and 126,564 in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Fourspot Butterflyfish at the 30-60-foot depth was approximately 22,000 individuals, and in 2017/2018 was approximately 15,034 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 18,932 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has remained stable in FRAs, and has decreased significantly in Open Areas and MPAs (DAR 2019a).

Cultural Significance

The Fourspot Butterflyfish was named *lauhau*, which has been translated as "brightly colored butterfly fish". They are known for a characteristic of creating disturbances in the sea pool, and this can also be used to reference a boisterous person (Pukui 1983). They were traditionally caught using the *kūkulu 'upena* method, or a standing net, which was cast from the shore. Conflicting reports exists as to whether or not this species was valued as a food fish.

4.4.1.7 Orangeband (Shoulder) Surgeonfish (*Acanthurus olivaceus*)

Ecology

The Orangeband Surgeonfish occurs in tropic waters of the Indo-west Pacific. The head and anterior half of the Orangeband Surgeonfish are distinctly paler than that of the dark grayish brown posterior. Juveniles are bright yellow. Orangeband Surgeonfish are commonly found in small groups near reefs at depths of 30 to 150 feet (Randall and Clements 2001) where they feed on detritus, diatoms, and algae (Myers 1991).

Orangeband Surgeonfish are broadcast spawners. Many broadcast spawners migrate to the edge of the reef drop off to spawn at dusk or dawn (Thresher 1984). Males and females simultaneously release eggs

and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Orangeband Surgeonfish at the 0-98-foot depth in hardbottom habitat was approximately 1,162,438 individuals, with an estimated 885,926 individuals in East Hawai'i and 276,512 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Orangeband Surgeonfish at the 30-60-foot depth was approximately 26,101 individuals, and in 2017/2018 was approximately 53,694 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 77,641 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has increased significantly in Open Areas and MPAs and has remained stable in FRAs (and shown a non-significant increasing trend in density; DAR 2019a).

Cultural Significance

The Orangeband Surgeonfish is commonly referred to as *na'ena'e* ("quick, alert") (Pukui and Elbert 1986). The name *na'ena'e* is also applied to a native daisy known for its small yellow, orange, purple, or white flower (Pukui and Elbert 1986). A review of cultural-historical literature (see Appendix A) did not reveal any additional cultural information for the Orangeband Surgeonfish.

4.4.1.8 Orangespine Unicornfish (Clown Tang) (*Naso lituratus*) [Proposed for Revised White List]

Ecology

The Orangespine Unicornfish has a black dorsal fin, with the black continuing onto the back as a pointed projection, with a pale blue line at base. The anal fin is mainly orange while the caudal fin is yellow. The caudal peduncle bears two forward-directed spines (Randall and Clements 2001). Orangespine Unicornfish are found at depths of 16 to 100 feet along coral, rock, and rubble of seaward reefs. They feed mostly on leafy brown algae and sometimes in groups (Randall and Clements 2001). Distinct pairs are formed during breeding.

Orangespine Unicornfish are broadcast spawners. Many broadcast spawners migrate to the edge of the reef drop off to spawn at dusk or dawn (Thresher 1984). Males and females simultaneously release eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

The species is found throughout the Indo-Pacific from the Red Sea (except the Gulf of Oman and Persian Gulf) south to Natal and east to Hawai'i and French Polynesia. In the western Pacific from Suruga Bay to the southern Great Barrier Reef (Randall and Clements 2001).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Orangespine Unicornfish at the 0-98-foot depth in hardbottom habitat was approximately 991,409 individuals, with an estimated 478,551 individuals in East Hawai'i and 512,857 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Orangespine Unicornfish at the 30-60-foot depth was approximately 150,642 individuals, and in 2017/2018 was approximately 180,099 individuals (DAR2014a,

2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 266,945 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has increase significantly in Open Areas and MPAs and has remained stable in FRAs (DAR 2019a).

Cultural Significance

The Orangespine Unicornfish is also known as the *umaumalei*. This species has been paired with its land counterpart the *ʻūlei* (Hawaiian Rose; *Osteomeles anthyllidifolia*) (Beckwith 1951; Liliuokalani 1978). While the *umaumalei* is a specific species within the family Acanthuridae, some traditional accounts classify it under the name *kala* or *kala umaumalei* (Ka Nupepa Kuokoa 1867; Titcomb 1972).

Kala in all of its forms was a popular Hawaiian delicacy, containing white meat and usually eaten broiled over coals and rarely eaten raw. The soft parts of the fish are described as good *palu* (fish bait). *Kala* is very abundant and easy to catch which is why it is eaten often (Titcomb 1972). The skin of the kala was also used to cover the *pūniu*, a small drum that was lashed onto the thigh of a *hula* dancer.

During the spawning seasons, certain fish were prohibited from being caught and consumed, which included *kala* (Titcomb 1972). They were traditionally caught in the *ʻie kala* (lit. *kala* basket), which has been described as the largest type of *hīnaʻi* (basket fish trap) (Manu et al. 2006). Additional methods for catching *kala* included the use of a *holoholo*, a net tied to a 12-foot-long piece of *alaheʻe* (*Canthium odoratum*) wood. The net was lowered down in an area with swift-ebbing tides with one person holding the net and the other corralling fish into it (Manu et al. 2006). *Hinaʻi pai kala*, was a method of using a plaited basket as a net. The basket was filled with *limu kala* (seaweed), *kalo* (taro) and pumpkin and then let down for the fish to feed. This process was continued until the fish became plump and accustomed to feeding in the basket, then a “catching net” was lowered down to collect *kala*.

4.4.1.9 Forcepsfish (*Forcipiger flavissimus*)

Ecology

The Forcepsfish has a long black snout, and the head is dark brown to black above and white below. The body is yellow with a black spot on the anal fin. Adults can grow up to 8 inches. This species is widespread throughout the Hawaiian Islands and the tropical waters of the Indo-Pacific area (University of Hawai’i 2016).

The Forcepsfish typically lives along exposed outer reefs containing abundant coral growth, caves, and ledges, and occasionally within lagoon reefs. This species usually occurs in pairs but may also be encountered as solitary animals or in small groups. It feeds on a variety of small animals including hydroids, fish eggs, and crustaceans, but prefers tube feet of echinoderms, pedicellaria of sea urchins, and polychaete tentacles (Myers 1991).

Forcepsfish are broadcast spawners. Many broadcast spawners migrate to the edge of the reef drop off to spawn at dusk or dawn (Thresher 1984). Males and females simultaneously release eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Forcepsfish at the 0-98-foot depth in hardbottom habitat was approximately 461,496 individuals, with an estimated 251,206 individuals in East Hawai'i and 210,290 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Forcepsfish at the 30-60-foot depth was approximately 43,999 individuals, and in 2017/2018 was approximately 39,734 (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 81,490 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has remained stable in Open Areas and MPAs and has increased significantly in FRAs (DAR 2019a).

Cultural Significance

The Forcepsfish is also known as the *lauwiliwili nuku 'oi'oi*. A review of cultural-historical literature (see Appendix A) did not reveal any additional cultural information related to this species.

4.4.1.10 Spotted Boxfish (Boxfish) (*Ostracion meleagris*)

Ecology

The Spotted Boxfish is Hawai'i's most common boxfish. Juvenile and female Spotted Boxfish are brown to green with white spots while the males have orange bands and spots on the side of the body. They are found throughout the Hawaiian Islands and inhabit clear lagoons and seaward reefs from 3 to 100 feet. Juveniles are often observed among rocky boulders (Myers 1991).

Spotted Boxfish live in small haremic groups, usually one male to several females. They forage alone within their home ranges for sponges, worms, mollusks, copepods, and algae. Males defend territories against other males (Myers 1991).

Spotted Boxfish are broadcast spawners, with males and females simultaneously releasing eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Spotted Boxfish at the 0-98-foot depth in hardbottom habitat was approximately 63,258 individuals, with an estimated 51,362 individuals in East Hawai'i and 11,626 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Spotted Boxfish at the 30-60-foot depth was approximately 9,322 individuals, and in 2017/2018 was approximately 12,877 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 19,468 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has remained stable in Open Areas, MPAs, and FRAs (DAR 2019a).

Cultural Significance

The Spotted Boxfish, commonly known as *pahu*, meaning "box" or moa (a Proto Polynesian word; Pakui and Elbert 1986) were traditionally *kapu* (forbidden) for women to eat (Kent 1986). Titcomb (1972) adds that there was little flesh on this fish and that they were not eaten.

4.4.1.11 Yellowtail Coris (Clown Wrasse) (*Coris gaimard*)

Ecology

Juvenile Yellowtail Coris are bright red with white spots, as individuals mature into females they fade to orange with blue spots and a bright yellow tail. Like other wrasses (Family Labridae) adults may undergo a sex change from female to male. Males are distinguished by a green bar on the side of the body and a dark band on the upper and lower fins and numerous blue spots (University of Hawai'i 2016).

The Yellowtail Coris is a solitary species that is found in mixed coral, sand and rubble of outer reefs, lagoons, and seaward reefs. They feed primarily on mollusks, crabs, and tunicates (Myers 1991). Prominent canine teeth help this fish pick small crustaceans and mollusks from the reef. Active during the day, they take shelter in reef crevices or bury in sand at night (University of Hawai'i 2016).

Distribution ranges are from Western Australia, Cocos – Keelings Islands, Christmas Island in the eastern Indian Ocean, Southern Japan to New South Wales, Lord Howe Island and east to Hawaiian Islands (Randall 2007). Phylogeographic analyses show that the Hawaiian population is genetically distinct from elsewhere in the Pacific (Ahti et al. 2016).

Yellowtail Coris are broadcast spawners, with males and females simultaneously releasing eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Yellowtail Coris at the 0-98-foot depth in hardbottom habitat was approximately 264,366 individuals, with an estimated 118,139 individuals in East Hawai'i and 146,227 individuals in the WHRFMA. WHAP data indicate the 2104 WHRFMA Open Area population of Yellowtail Coris at the 30-60-foot depth was approximately 19,762 individuals, and in 2017/2018 was approximately 18,256 (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 34,322 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has remained stable in Open Areas, MPAs, and FRAs (DAR 2019a).

Cultural Significance

The Yellowtail Coris is also known as the *hinālea 'akilolo,* which were noted for their medicinal value. The word *'akilolo* means "brain biting," (Pukui and Elbert 1986), and this species was used by *kahuna* (priests) as a *pani*, or closing medicine, for someone suffering from a head sickness or disease. This variety was also a highly favored delicacy for eating because of its sweet taste. It was traditionally "eaten with salt, dried, broiled over coals or wrapped in *ti* leaves and then baked or broiled" (Titcomb 1972). See also Section 4.4.1.4 for a discussion of the cultural significance of *hinālea,* which include Yellowtail Coris.

4.4.1.12 Milletseed (Lemon) Butterflyfish (*Chaetodon miliaris*)

Ecology

The Milletseed Butterfly fish is endemic to Hawai'i and the most common species of butterflyfish in Hawai'i including the Johnston Atoll (Lobel 2003). The species is named for the seed-sized black specks that are distributed in vertical rows on its lemon-yellow body. Other distinctive features are a black mask through the eye and a black spot near the tail. Adults reach lengths of 6.5 inches (University of Hawai'i 2016).

Habitat for this species includes coastal fringing reefs, lagoons, and outer reefs, with juveniles found on shallow inner reefs from April to June (IUCN 2017). The Milletseed Butterflyfish feeds primarily on zooplankton above the reef, but sometimes cleans other fishes and is also known to feed on nests of damselfish eggs if left unprotected.

Milletseed Butterflyfish are broadcast spawners. Many broadcast spawners migrate to the edge of the reef drop off to spawn at dusk or dawn (Thresher 1984). Males and females simultaneously release eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Milletseed Butterflyfish at the 0-98-foot depth in hardbottom habitat was approximately 507,893 individuals, with an estimated 493,360 individuals in East Hawai'i and 14,533 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Milletseed Butterflyfish at the 30-60-foot depth was approximately 7,085 individuals, and in 2017/2018 was approximately 2,148 individuals (DAR2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 2,259 individuals (Dr. Bill Walsh, personal communication, 2020). However, much of the Milletseed Butterflyfish population occurs below the 60-foot depth surveyed by the WHAP and below the 98-foot depth surveyed by the PIFSC-ESD, and therefore the population is underestimated by both surveys.

Cultural Significance

The name *kīkākapu* is used to describe a number of butterflyfish species and were considered sacred (Titcomb 1972). Fornander (1916) reported the name is used in many chants. The Milletseed Butterflyfish is called *lau wiliwili* or *lauhau wiliwili*, meaning "*wiliwili* leaf," because its shape is believed to resemble the endemic *wiliwili* tree (*Erythrina sandwicensis*).

4.4.1.13 Kole (Goldring Surgeonfish, Yelloweye, Goldring) (*Ctenochaetus strigosus*) [Proposed for Revised White List]

Ecology

The Kole is endemic to the Hawaiian Islands (Randall and Clements 2001) and Johnston Atoll (Lobel 2003). It is brown with light blue to yellow horizontal stripes over its body which change into spots towards the face. It also has a yellow ring surrounding the eye.

Individuals are usually solitary and mainly found in shallow water, although it has been recorded at depths of 370 feet. This species is herbivorous, grazing on diatoms and algae from the sand or reef (Randall and Clements 2001), and has also been commonly observed to clean algal growths from the shells of sea turtles (Work and Aeby 2014).

Kole are broadcast spawners. Many broadcast spawners migrate to the edge of the reef drop off to spawn at dusk or dawn (Thresher 1984). Males and females simultaneously release eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Kole at the 0-98-foot depth in hardbottom habitat was approximately 7,986,475 individuals, with an estimated 1,331,404 individuals in East Hawai'i and 6,655,072 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Kole at the 30-60-foot depth was approximately 3,616,529 individuals and in 2017/2018 was approximately 5,312,745 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 9,555,712 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has increased significantly in Open Areas, MPAs, and FRAs (DAR 2019a).

Cultural Significance

Kole, meaning "raw" or "red" (Pakui and Elbert 1986), are also known as *ukole* or *pākole*. The *kole makaonaona* (specifically, *Ctenochaetus strigosus),* is the more popular eating variety of *Kole*. Pukui (1983) explains that the English word "story" was Hawaiianized to "*kole*," and that this proverbial saying uses *kole* as a metaphor for describing the excitement of getting together to share stories.

Although the *kole* is known as being tough-skinned, it is considered a favorite fish to eat raw. *Kole* was also important for traditional practices and customs relating to the home, as it was believed to *hole*, or strip, the house of unwanted spiritual energy (Titcomb 1972).

4.4.1.14 Pencil Wrasse (*Pseudojuloides cerasinus*)

Ecology

Body color and pigmentation has been shown to vary geographically in the Pencil Wrasse; however, the most common coloration is a salmon pink body with yellowish fins. A blue to yellow double stripe extends from the head to the tail. Adults can grow up to 5 inches (Myers 1991). This species is found throughout Indian and Pacific oceans from east Africa to the Hawaiian Islands.

The Pencil Wrasse is found in clear lagoons, outer reef faces, and coral rubble at depths of 7 to 200 feet. They are also common among live coral and areas with large algae clumps (Myers 1991). When threatened, they will hide among the rubble, bury in the sand, or try to out-swim predators. Pencil Wrasses feed on small, benthic invertebrates, mainly fan worms and small crustaceans that they pluck from the substrate. The Pencil Wrasse is found in areas with abundance of sand and gradual bathymetric relief; typically, north western region of the Big Island (BIAAF pers. comm.).

Pencil Wrasse are broadcast spawners, with males and females simultaneously releasing eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Pencil Wrasse at the 0-98-foot depth in hardbottom habitat was approximately 101,737 individuals, with an estimated 14,314 individuals in East Hawai'i and 87,423 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Pencil Wrasse at the 30-60-foot depth was approximately 19,390 individuals, and in 2017/2018 was approximately 17,182 (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 27,016 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has remained stable in FRAs and MPAs, and has increased significantly in Open Areas (DAR 2019a).

Cultural Significance

See Section 4.4.1.4 for a discussion of the cultural significance of *hināIea,* which includes the Pencil Wrasse.

4.4.1.15 Bird Wrasse (*Gomphosus varius*) [Proposed for Revised White List]

Ecology

The Bird Wrasse has an elongated body and is laterally compressed. Adults can reach 12 inches and are easily recognized by their long snout; juveniles lack the snout and are thus difficult to identify. The first third of the body is lightly colored and the posterior is grayish with a dark border. Males tend to be more uniformly colored (Myers 1999).

The Bird Wrasse is commonly found along external slopes, reefs, and lagoons at depths of 6 to 100 feet (Myers 1991). This wrasse feeds mainly on small benthic crustaceans, and sometimes on small fishes, brittle stars, and mollusks. The Bird Wrasse is a sequential hermaphrodite, meaning juveniles develop first into females and then change to males based on external stimuli (Randall et al 1990).

Bird Wrasse are broadcast spawners. Many broadcast spawners migrate to the edge of the reef drop off to spawn at dusk or dawn (Thresher 1984). Males and females simultaneously release eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Bird Wrasse at the 0-98-foot depth in hardbottom habitat was approximately 616,723 individuals, with an estimated 196,231 individuals in East Hawai'i and 420,492 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Bird Wrasse at the 30-60-foot depth was approximately 43,254 individuals, and in 2017/2018 was approximately 66,581 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 130,529 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this

species has remained stable in Open Areas and has increased significantly in MPAs and FRAs (DAR 2019a).

Cultural Significance

See Section 4.4.1.4 for a discussion of the cultural significance of *hinālea,* which includes the Bird Wrasse.

4.4.1.16 Blacklip Butterflyfish (Coral Butterflyfish) (*Chaetodon kleinii*)

Ecology

The body of the Blacklip Butterflyfish is yellow/brown with one or two broad lighter vertical bars, one running from the dorsal spine to the belly, and one from the middle of the back to the center of the body. A black bar runs vertically across the eye, the part before this is whitish, with a black snout. The color varies somewhat across its range (Burgess 1978).

The Blacklip Butterflyfish is found along rocky reefs and coral-rich areas of lagoons, channels, and outer reef slopes at depths of 6-200 feet. This species is mostly solitary but has been observed in pairs, and occasionally in large groups of up to about 30 individuals, sometimes high in the water column. It is a facultative corallivore, feeding on hard and soft corals, as well as algae, hydroids, and zooplankton (Myers 1991). Distinct pairing has been observed during breeding (Breder and Rosen 1966). Its range includes the east coast of Africa to the Hawaiian Islands and South Wales (Randall 2007).

Blacklip Butterflyfish are broadcast spawners. Many broadcast spawners migrate to the edge of the reef drop off to spawn at dusk or dawn (Thresher 1984). Males and females simultaneously release eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Blacklip Butterflyfish at the 0-98-foot depth in hardbottom habitat was approximately 430,909 individuals, with an estimated 387,141 individuals in East Hawai'i and 43,768 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Blacklip Butterflyfish at the 30-60-foot depth was approximately 5,593 individuals, and in 2017/2018 was approximately 39,734 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 44,203 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has increased significantly in Open Areas and FRAs and has remained stable in MPAs (DAR 2019a).

Cultural Significance

The Blacklip Butterflyfish is a member of the butterflyfish genus, which were sometimes eaten, but more commonly caught and used for certain rituals and ceremonies. The Blacklip Butterflyfish, along with Tinker's Butterflyfish, were commonly referred to as *kīkākapu, kapuhili, lauhau*, or *lauwiliwili*. The term *kapuhili* translates as "…many taboos inherited from chiefly ancestors or from the gods; person with many taboos" (Elbert and Pukui 1986). The name *kīkākapu* is used to describe a variety of butterflyfish species which were considered sacred (Titcomb 1972). Fornander (1916) reported the name is used in many chants.

4.4.1.17 Potter's Angelfish (*Centropyge potteri*) [Proposed for Revised White List]

Ecology

The bright orange and blue Potter's Angelfish is an endemic species found along Hawaiian reefs and the Johnston Atoll (Lobel 2003). Like other angelfishes, this species is recognized by a heavy, curved spine on its "cheek" near the edge of the gill cover. However, because it generally only reaches approximately 5 inches, it is considered a 'pygmy' angelfish. Its slender, disc-shaped body is well-suited to life on a coral reef.

Individuals limit their movements to a well-defined area close to the shelter of finger coral branches, usually at depths of at least 15 feet. Active by day, it feeds on algae and detritus on dead coral surfaces. At night, it remains alert but inactive, protected within the coral. Angelfishes are very dependent upon the protection of coral caves and crevices and are rarely seen over sandy stretches or other areas that offer little cover. They are often territorial and spend most of their time near the bottom in search of food. They have small mouths and many flexible, comb-like teeth used for plucking or scraping food from the rocks (University of Hawai'i 2016).

Peak reproductive activity occurs from mid-December through May. They spawn at dusk during the week before full moon (Allen 1985a). Among angelfishes, a sex reversal from female to male can be part of the life history. Most small individuals are female and larger, more colorful individuals are male. Larger, brighter males are usually accompanied by smaller, drabber females, forming a harem. A dominant female Potter's Angelfish changes sex to become the harem master if the male is removed (University of Hawai'i 2016).

Potter's Angelfish are broadcast spawners, with males and females simultaneously releasing eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Potter's Angelfish at the 0-98-foot depth in hardbottom habitat was approximately 674,388 individuals, with an estimated 236,771 individuals in East Hawai'i and 437,617 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Potter's Angelfish at the 30-60-foot depth was approximately 237,149 individuals, and in 2017/2018 was approximately 265,488 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 424,980 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has increased significantly in Open Areas, MPAs, and FRAs (DAR 2019a).

Cultural Significance

The Potter's Angelfish is named after Frederick A. Potter, who was the first Director of the Honolulu Aquarium. The species is endemic, but a review of cultural-historical literature (see Appendix A) did not reveal any specific Hawaiian names or any specific cultural information related to this species.

4.4.1.18 Ornate Wrasse (Pinkface) (*Halichoeres ornatissimus*)

Ecology

This small wrasse has a pinkish head that is marked with horizontal green lines. The throat and belly are blue; scales on the sides are marked by a vertical, crescent-shaped stripe followed by blue. The dorsal fin is dark red with green spots and is traced by green and blue lines. A large dark spot on the dorsal fin and one just behind the eye are common identifiers. Males usually have more intense coloration than females (University of Hawai'i 2016). The Ornate Wrasse range extends from the Philippines to the Great Barrier Reef, New Caledonia, and east to the Hawaiian Islands (Randall 2007).

The Ornate Wrasse has an elongate soft body that is tapered and spindle-shaped. The dorsal fin is continuous, rounded, and soft. The pectoral fins are used extensively for swimming with up and down motions. The snout has a pointed mouth, fleshy lips, and canine teeth used in plucking small crustaceans and mollusks from the reef. Special bones in the gill area called pharyngeal bones help the wrasse crush the shells of their prey. The Ornate Wrasse is diurnal, feeding during the day, and sheltering in reef crevices or burying in sand patches at night. The Ornate Wrasse, like others within this family (Labridae) undergo sex changes as they develop (University of Hawai'i 2016).

Ornate Wrasse are broadcast spawners, with males and females simultaneously releasing eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Ornate Wrasse at the 0-98-foot depth in hardbottom habitat was approximately 1,349,749 individuals, with an estimated 898,641 individuals in East Hawai'i and 451,108 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Ornate Wrasse at the 30-60-foot depth was approximately 192,404 individuals, and in 2017/2018 was approximately 196,879 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 254,626 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has significantly declined in Open Areas and FRAs and has increased significantly in MPAs (DAR 2019a).

Cultural Significance

The Ornate Wrasse is also referred to as *lā'ō* (Titcomb 1972). A review of cultural-historical literature (see Appendix A) did not reveal any additional cultural information for the Ornate Wrasse.

4.4.1.19 Black Durgon (*Melichthys niger*)

Ecology

The Black Durgon is a triggerfish with bright white lines running along its dorsal and anal fins. The body is black with blue lines.

The habitat preference of the Black Durgon includes open waters and shallow exposed reefs at water depths of 15 to 115 feet. The diet consists primarily of calcareous algae and zooplankton. A study conducted in the Fernando de Noronha Archipelago showed the feces and vomit of Spinner dolphins (*Stenella longirostris*) formed part of the diet of Black Durgon. The study showed individuals could discern the postures dolphins assumed prior to voiding and would position themselves for effective feeding (Sazima et al. 2003). The Black Durgon has a circumtropical distribution (Randall 2007).

The Black Durgon produce demersal eggs that may or may not be tended by a parent, usually the female. Unlike most other families of reef fishes, the balistids (i.e., triggerfish) exhibit extensive maternal care of eggs. Eggs are typically deposited in shallow pits excavated by the parents as an adhesive egg mass containing bits of sand and rubble. Triggerfish eggs hatch in as little as 12 hours and no more than 24 hours (WPRFMC 2005).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Black Durgon at the 0-98-foot depth in hardbottom habitat was approximately 1,602,006 individuals, with an estimated 514,378 individuals in East Hawai'i and 1,087,628 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Black Durgon at the 30-60-foot depth was approximately 38,033 individuals, and in 2017/2018 was approximately 92,354 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 186,595 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has increased significantly in Open Areas, MPAs, and FRAs (DAR 2019a).

Cultural Significance

The *humuhumu*, meaning "to sew, stitch," is a general name used to refer to many different varieties of trigger fish, including, but not limited to, the *humuhumu 'ele'ele* or the Black Durgeon (Titcomb 1972). The species was historically eaten, using a variety of methods, and with varying reports on its tastiness or popularity. If *humuhumu* were caught in large numbers, then the remains, particularly the head, would be tossed into the fire to help keep the fire burning because of its oils.

Titcomb (1972) documents a gathering method for these fish that involved lowering a basket with cooked pumpkins or sweet potatoes as bait onto a school of fish. While the fish attacked the bait in a frenzy the basket would be hoisted up and the fish caught.

4.4.1.20 Gilded Triggerfish (Bluethroat Triggerfish) (*Xanthichthys auromarginatus*)

Ecology

The Gilded Triggerfish is found throughout the Indian and Pacific oceans from east Africa to the Hawaiian Islands. The female Gilded Triggerfish lacks the blue patch on the throat and yellow tail of the male. Both sexes have a blue ring around the eye and a lavender/gray blue body with gray to white spots that make a linear pattern. Adults can grow up to 12 inches.

This species is found along drop-offs and ledges at water depths of 75 to 480 feet. This species prefers current-swept areas with abundant invertebrate growth. Small groups have been observed at 10-20 feet above the bottom feeding on zooplankton, specifically copepods (Breder and Rosen 1966).

The Gilded Triggerfish produce demersal eggs that may or may not be tended by a parent, usually the female. Unlike most other families of reef fishes, the balistids (i.e., triggerfish) exhibit extensive maternal care of eggs. Eggs are typically deposited in shallow pits excavated by the parents as an adhesive egg mass containing bits of sand and rubble. Triggerfish eggs hatch in as little as 12 hours and no more than 24 hours (WPRFMC 2005).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Gilded Triggerfish at the 0-98-foot depth in hardbottom habitat was approximately 69,871 individuals, with no population estimate available for East Hawai'i, and thus all 69,871 individuals are from the WHRFMA estimated population. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Gilded Triggerfish at the 30-60-foot depth was approximately 11,186 individuals, and in 2017/2018 was approximately 3,222 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 8,895 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has decreased significantly in Open Areas, MPAs, and FRAs (DAR 2019a).

Cultural Significance

The Gilded Triggerfish is a species of *humuhumu.* See Section 4.4.1.19 for a discussion of the cultural significance.

4.4.1.21 Lei Triggerfish (*Sufflamen bursa*)

Ecology

The Lei Triggerfish is found throughout the Indian and Pacific oceans from east Africa to the Hawaiian Islands. This species is also known as the boomerang triggerfish for the characteristic V-shaped mark behind the eye which is yellow-orange or brown-green. Adults can grow up to 9.5 inches.

This species is common on clear inner and outer reefs and drop-offs from 10 to 300 feet, where they feed on crabs, bivalves, gastropods, algae, echinoids, tunicates, worms, eggs, and detritus. Lei Triggerfish have been shown to form distinct pairing during breeding (Breder and Rosen 1966).

The Lei Triggerfish produce demersal eggs that may or may not be tended by a parent, usually the female. Unlike most other families of reef fishes, the balistids (i.e., triggerfish) exhibit extensive maternal care of eggs. Eggs are typically deposited in shallow pits excavated by the parents as an adhesive egg mass containing bits of sand and rubble. Triggerfish eggs hatch in as little as 12 hours and no more than 24 hours (WPRFMC 2005).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Lei Triggerfish at the 0-98-foot depth in hardbottom habitat was approximately 1,050,651 individuals, with an estimated 685,297

individuals in East Hawai'i and 365,354 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Lei Triggerfish at the 30-60-foot depth was approximately 76,440 individuals, and in 2017/2018 was approximately 92,354 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 142,699 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has remained stable in Open Areas and FRAs and has increased significantly in MPAs (DAR 2019a).

Cultural Significance

The *humuhumu lei or humuhumu umaumalei*, or the Lei Triggerfish (Titcomb 1972) is a species of *humuhumu.* See Section 4.4.1.19 for a discussion of the cultural significance.

4.4.1.22 (Forster's) Blackside Hawkfish (*Paracirrhites forsteri*)

Ecology

The Blackside Hawkfish is yellow with a broad black or dark brown lateral band on the rear half of the body. The sides of the head and the front of the body are whitish or grey, with red speckles but there is considerable color variation among adults (Randall 1986). Geographical differences in color have also been recorded in juveniles (Myers 1999). This species ranges throughout the Indian and Pacific oceans. Adults can grow up to 8 inches.

The Blackside Hawkfish is commonly found in clear lagoons or seaward reefs at a depth of 15 to 115 feet (Lieske and Myers 1994). To hunt, the hawkfish perches on branches of coral and ambushes small fish, crustaceans, and shrimp. This species is a sequential hermaphrodite, meaning juveniles develop into females and then change to males based on external stimuli (Myers 1999).

Blackside Hawkfish are broadcast spawners, with males and females simultaneously releasing eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Blackside Hawkfish at the 0-98-foot depth in hardbottom habitat was approximately 226,763 individuals, with an estimated 149,287 individuals in East Hawai'i and 77,476 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Blackside Hawkfish at the 30-60-foot depth was approximately 20,508 individuals, and in 2017/2018 was approximately 23,625 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 39,371 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has remained stable in MPAs and FRAs, and has decreased significantly in Open Areas (DAR 2019a).

Cultural Significance

The Blackside Hawkfish is known by many names, including *hilu, 'ele'ele, lauwili, melemele, moelola, pano, pāni'o, piliko'a, 'ula* and *uli,* but is most commonly referred to as *hilu* (Pukui and Elbert 1986). Considered

an “excellent eating” fish, *hilu* was traditionally either eaten raw, dried or salted and baked or broiled (Malo 1951). Because of the quiet demeanor of the species, it was associated with quiet children or ladylike behavior (Titcomb 1972; Handy and Pukui 1998).

4.4.1.23 Thompson's Surgeonfish (*Acanthurus thompsoni*) [Proposed for Revised White List]

Ecology

The body of the Thompson’s Surgeonfish is uniformly black to dark brown. The caudal fin is pale with a small dark spot below the pectoral fin. This species ranges throughout the Indian and Pacific Oceans.

This species inhabits steep outer reef slopes and drop-offs of 16 to 230 feet deep. Thompson’s Surgeonfish have been observed schooling in groups feeding on zooplankton, fish eggs and crustaceans (Randall 1956).

Thompson’s Surgeonfish are broadcast spawners. Many broadcast spawners migrate to the edge of the reef drop off to spawn at dusk or dawn (Thresher 1984). Males and females simultaneously release eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai’i population of Thompson’s Surgeonfish at the 0-98-foot depth in hardbottom habitat was approximately 503,768 individuals, with an estimated 302,538 individuals in East Hawai’i and 201,230 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Thompson’s Surgeonfish at the 30-60-foot depth was approximately 91,728 individuals, and in 2017/2018 was approximately 271,693 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 380,593 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has increased significantly in Open Areas, FRAs, and MPAs (DAR 2019a).

Cultural Significance

The Thompson’s Surgeonfish is a species of *Kala* (Pukui and Elbert 1986). See Section 4.4.1.8 for more information on *kala.*

4.4.1.24 Pyramid Butterflyfish (*Hemitaurichthys polylepis*)

Ecology

The Pyramid Butterflyfish has a dark brown-yellow area that fully masks the head and extends to a line from the first rays of the dorsal fin to the start of the pelvic fins. The rest of its body is white. Large yellow-orange areas at the top of the side form a characteristic pyramidal pattern, giving this species its name. This species is found throughout the tropical and subtropical waters of the Indian and Pacific oceans (Myers 1999).

This fish aggregates in large schools in open water at the edges of steep outer reef slopes at depths of 10 to 200 feet (Lieske and Myers 1994). The Pyramid Butterflyfish feeds mostly on plankton and forms pairs during breeding (Breder and Rosen 1966).

Pyramid Butterflyfish are broadcast spawners. Many broadcast spawners migrate to the edge of the reef drop off to spawn at dusk or dawn (Thresher 1984). Males and females simultaneously release eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

CREP (2018) data indicate that the 2016 island of Hawai'i population of Pyramid Butterflyfish at the 0-98-foot depth in hardbottom habitat was approximately 23,217 individuals, and no population estimate was provided in 2019 (PIFSC-ESD 2020). WHAP data indicate the 2012/2013 WHRFMA Open Area population of Pyramid Butterflyfish at the 30-60-foot depth was approximately 56,677 individuals, and in 2017/2018 was approximately 37,586 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 42,610 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has decreased significantly in Open Areas and MPAs and has remained stable in FRAs (DAR 2019a).

Cultural Significance

Butterflyfish, while sometimes eaten, appear to have been more commonly caught and used for certain rituals and ceremonies. The Pyramid Butterflyfish, along with other species of butterflyfish, were known as *kapuhili,* which translates as "…many taboos inherited from chiefly ancestors or from the gods; person with many taboos" (Elbert and Pukui 1986, as cited in Appendix A).

4.4.1.25 Multiband (Pebbled) Butterflyfish (*Chaetodon multicinctus*)

Ecology

The Multiband Butterflyfish is endemic to the Hawaiian Islands and Johnston Atoll (Lobel 2003). The body is white with five or six brown vertical bands. A dark vertical bar runs along the eye and a black band along the tail fin. The distinguishing feature is an overall covering of small spots which create a pattern of horizontal and vertical lines along the body.

The Multiband Butterflyfish inhabits heavy coral areas of lagoon and seaward reefs at depths of 15 to 100 feet. This species mainly feeds on the polyps of small corals but also supplement their diet with worms, shrimps, hydroids, and algae fragments. This species is often seen in monogamous pairs and defending an established territory (Breder and Rosen 1966).

Multiband Butterflyfish are broadcast spawners. Many broadcast spawners migrate to the edge of the reef drop off to spawn at dusk or dawn (Thresher 1984). Males and females simultaneously release eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Multiband Butterflyfish at the 0-98-foot depth in hardbottom habitat was approximately 1,121,463 individuals, with an estimated 320,777

individuals in East Hawai'i and 800,686 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Multiband Butterflyfish at the 30-60-foot depth was approximately 580,196 individuals, and in 2017/2018 was approximately 378,843 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 810,451 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species declined significantly in Open Areas, FRAs, and MPAs (DAR 2019a).

Cultural Significance

The name *kīkākapu* is used to describe a number of butterflyfish species and were considered sacred (Titcomb 1972). See also Section 4.4.1.16 for a discussion of the cultural significance of *kīkākapu,* which includes the Multiband Butterflyfish.

4.4.1.26 Hawaiian Dascyllus (Domino) (*Dascyllus albisella*)

Ecology

The Hawaiian Dascyllus is endemic to shallow, protected coral reefs around the Hawaiian Islands and Johnston Atoll (Lobel 2003). The center of the body is pale white, and the edges are dark gray to black.

This species feeds on zooplankton, invertebrates, and algae at water depths of 3 to 160 feet. Adults are most often observed in protected areas of shallow water with coral or rocky bottoms (Lieske and Myers 1994). Breeding occurs in pairs with eggs deposited in substrate and the males guarding and aerating (Breder and Rosen 1966).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Hawaiian Dascyllus at the 0-98-foot depth in hardbottom habitat was approximately 109,944 individuals, with an estimated 22,690 individuals in East Hawai'i and 87,254 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Hawaiian Dascyllus at the 30-60-foot depth was approximately 57,796 individuals, and in 2017/2018 was approximately 63,359 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 83,475 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has remained stable in Open Areas and MPAs and has increased significantly in FRAs (DAR 2019a).

Cultural Significance

The Hawaiian Dascyllus is also known as the *'ālo'ilo'i.* The young stages of the fish are called *'a*, or *'a'a* and also referred to as "*'a'akimakau* (bait nibbling) which "is a term for a variety or perhaps an alternative name" (Malo 1951). The *'ālo'ilo'i* is referenced in the *'ōlelo no'eau*, "*he 'ālo'ilo'i, ka i'a waha iki o ke kai*," literally translated as "an 'ālo'ilo'i, a fish of the sea that has a small mouth" (Pukui 1983). Pukui (1983) relates that this was "said of one who always has little to say." *'Ālo'ilo'i* were considered "a tasty fish," and were preferred "eaten raw or cooked on hot ashes" (Titcomb 1972). A method of collecting *'ālo'ilo'i* for consumption was the *kūkulu 'upena*, or a standing net, which was cast from shore.

4.4.1.27 Saddle Wrasse (*Thalassoma duperrey*)

Ecology

The Saddle Wrasse is a common and endemic reef fish of Hawai'i and Johnston Atoll (Lobel 2003). It is found at depths ranging from 16 to 98 feet. This species has a blue head, green body with a prominent red saddle and purple highlights around the edges of the fins (University of Hawai'i 2016).

This species is commonly observed alone, in pairs, or in small groups close to the reef where they forage for small crustaceans, mollusks, worms, urchins, and brittlestars. Canine teeth are used to pick these invertebrates from the reef. Most individuals begin life as females, when older they show the typical blue, red, and green pattern. Females that change to males, which is common in the wrasse family (Labridae) and have a white bar behind the red saddle. These sex-changed males are called "terminal phase" males and become dominant territory holders that maintain a harem of females (University of Hawai'i 2016).

Saddle Wrasse are broadcast spawners, with males and females simultaneously releasing eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Saddle Wrasse at the 0-98-foot depth in hardbottom habitat was approximately 5,889,162 individuals, with an estimated 3,319,375 individuals in East Hawai'i and 2,569,788 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Saddle Wrasse at the 30-60-foot depth was approximately 537,688 individuals, and in 2017/2018 was approximately 140,947 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 773,758 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has declined significantly in Open Areas and FRAs and has remained stable in MPAs (DAR 2019a).

Cultural Significance

The Saddle Wrasse is also known as *hinālea lauwili*, which is believed to have been named in reference to the *wiliwili* tree which has bright orange flowers. The species is often mentioned in *mo'olelo* (stories) and is referenced in traditional fishing practices as well. The fish was historically eaten, though the hard scales on the fish meant that it was usually skinned, and it was often eaten raw. See also Section 4.4.1.4 for a discussion of the cultural significance of *hinālea,* which include the Saddle Wrasse.

4.4.1.28 Redbarred Hawkfish (*Cirrhitops fasciatus*)

Ecology

The Redbarred Hawkfish is found throughout the Hawaiian Islands and Indo-Pacific oceans in a variety of reef habitats at depths of 3 to 170 feet. Primary habitats include seaward reefs and areas with abundant coral growth (Lieske and Myers 1994). Bright red bands and speckles are found on the body, adults grow to 5 inches. This species feeds primarily on small fish, shrimp, and crab and occasionally on zooplankton

(Randall 1985). The name hawkfish comes from their habit of "swooping" down on prey or invaders from "perches".

Redbarred Hawkfish are broadcast spawners, with males and females simultaneously releasing eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Redbarred Hawkfish at the 0-98-foot depth in hardbottom habitat was approximately 174,165 individuals, with an estimated 162,539 individuals in East Hawai'i and 11,626 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Redbarred Hawkfish at the 30-60-foot depth was approximately 9,665 individuals, and in 2017/2018 was approximately 6,443 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 8,902 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has remained stable in Open Areas, FRAs, and MPAs (DAR 2019a).

Cultural Significance

The Redbarred Hawkfish is also known as *piliko'a,* which means "clinging to coral" (Titcomb 1972). A review of cultural-historical literature (see Appendix A) did not reveal any additional cultural information for the Redbarred Hawkfish.

4.4.1.29 Eightline Wrasse (*Pseudocheilinus octotaenia*)

Ecology

The Eightline Wrasse is widespread from east Africa to the Hawaiian Islands. This species has variable color patterns from yellowish/orange to a pink/reddish body. The distinguishing feature of this species are the eight horizontal stripes, ranging from orange to a maroon red. They have a pointed head and mouth which enable them to feed on coral reef invertebrates such as, mollusks, sea urchins, fish eggs, and crab larvae (Myers 1991, 1999).

The Eightline Wrasse inhabits corals and seaward reefs at depths of 6 to 164 feet (Myers 1991) and forms distinct mating pairs (Breder and Rosen 1966). This species is diurnal, feeding during the day and resting at night.

Eightline Wrasse are broadcast spawners, with males and females simultaneously releasing eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Eightline Wrasse at the 0-98-foot depth in hardbottom habitat was approximately 376,989 individuals, with an estimated 127,551 individuals in East Hawai'i and 249,438 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Eightline Wrasse at the 30-60-foot depth was approximately 187,557 individuals, and in 2017/2018 was approximately 187,930 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot

depth was 271,982 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has declined significantly in Open Areas, FRAs, and MPAs (DAR 2019a).

Cultural Significance

See Section 4.4.1.4 for a discussion of the cultural significance of *hināIea,* which include the Eightline Wrasse.

4.4.1.30 Fourline Wrasse (*Pseudocheilinus tetrataenia*)

Ecology

The Fourline Wrasse is found in the tropical waters of the north and south Pacific. This species has a green body with blue and purple fins and four horizontal stripes that run across the upper half of the body. Each stripe is made up of three smaller stripes: one black, one blue and one red stripe. The eye is red with two white lines on it.

This species is secretive and inhabits seaward reefs, among coral or rubble at depths of 20 to 144 feet. This species uses the small heads of live coral to hide from predators (Myers 1991) and is thought to mainly feed on demersal eggs, copepods, amphipods, alpheid shrimp, crabs, larval shrimp, and gastropods (Myers 1999). The Fourline Wrasse forms distinct pairing during breeding (Breder and Rosen 1966).

Fourline Wrasse are broadcast spawners, with males and females simultaneously releasing eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Fourline Wrasse at the 0-98-foot depth in hardbottom habitat was approximately 206,325 individuals, with an estimated 114,627 individuals in East Hawai'i and 91,698 individuals in the WHRFMA. WHAP data indicate the 2104 WHRFMA Open Area population of Fourline Wrasse at the 30-60-foot depth was approximately 327,758 individuals, and in 2017/2018 was approximately 227,663 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 348,400 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has increased significantly in Open Areas and FRAs and has decreased significantly in MPAs (DAR 2019a). Due to this species' secretive behavior, visual counts usually underestimate its numbers,

Cultural Significance

See Section 4.4.1.4 for a discussion of the cultural significance of *hināIea,* which includes the Fourline Wrasse.

4.4.1.31 Brown Surgeonfish (Lavender, Forktail Tang) (*Acanthurus nigrofuscus*) [Proposed for Revised White List]

Ecology

The Brown Surgeonfish is one of the 10 most collected aquarium fish in West Hawai'i (DAR 2018a). This species is common throughout the Indo-Pacific oceans and is one of the most abundant surgeon fishes (Randall 2002). It is a small but aggressive fish with bluish gray vertical stripes along the body. The pectoral fins are pale with the upper edge narrow and black; pelvic fins are brown. Lips blackish brown, and the dorsal fin base has a prominent black spot larger than 1/2 the eye diameter; a smaller spot is present on base of the anal fin.

The Brown Surgeonfish is often found on hard substrates of lagoons and seaward reefs at depths of 6 to 82 feet (Domeier and Colin 1997) where it feeds exclusively on filamentous algae. Adults are usually observed in small groups but can also form large schools in open water. Juveniles are often associated with mixed species aggregations (Kuiter and Tonozuka 2001) and forms large spawning groups of up to several thousand individuals (Domeier and Colin 1997). Phylogeographic analyses reveal that the Hawaiian population is genetically connected to other locations in the Central Pacific, comprising a very large management unit in terms of both geography and numbers of individuals (Eble et al. 2011).

Brown Surgeonfish are broadcast spawners. Many broadcast spawners migrate to the edge of the reef drop off to spawn at dusk or dawn (Thresher 1984). Males and females simultaneously release eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Brown Surgeonfish at the 0-98-foot depth in hardbottom habitat was approximately 8,113,895 individuals, with an estimated 3,777,626 individuals in East Hawai'i and 4,336,269 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Brown Surgeonfish at the 30-60-foot depth was approximately 1,646,996 individuals, and in 2017/2018 was approximately 2,980,402 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 4,140,802 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has increased significantly in Open Areas, FRAs, and MPAs (DAR 2019a).

Cultural Significance

The Brown Surgeonfish is also known as the *māʻiʻi*. The name *māʻiʻiʻi* is also applied to a taro variety (*Colocasia* spp.) and has sometimes been used to refer to other species of surgeonfish (Pukui and Elbert 1986). Traditionally, the *māʻiʻi* was considered a good eating fish that could be eaten both raw and cooked but was best when broiled (Titcomb 1972).

4.4.1.32 Hawaiian Whitespotted Toby (Puffer) (*Canthigaster jactator*)

Ecology

The Hawaiian Whitespotted Toby is endemic to Hawai'i and the Johnston Atoll (Lobel 2003). This species belongs to the pufferfish family (Tetraodontidae) and reaches lengths of 4 inches. The body is brown with white spots, the eye is green.

Hawaiian Whitespotted Toby are common in lagoon and seaward reefs at depth of 3 to 290 feet (Mundy 2005). This species has also been found to utilize man-made structures (Brock 1981) and has been shown to feed on sponges, algae, detritus, tunicates, polychaetas, bryozoans, sea urchins, brittle stars, crabs, peanut worms, shrimps, zoanthids, fishes, amphipods and foraminiferans (Randall 1985). It often is afflicted with parasitic worms (nematodes), causing it to become inflated (Deardorff and Stanton 1983).

Breeding behavior has not been documented for the Hawaiian Whitespotted Toby; however, the eastern pacific white-spotted toby (*Canthigaster punctatissima*) has been found to be sexually dimorphic. It is likely that the toby's breeding behavior is similar. Males and females guard their territories against others of the same sex. Male areas include the smaller territories of multiple females. Males mate with a female from their harem one at a time.

The Hawaiian Whitespotted Toby is a broadcast spawner, with males and females simultaneously releasing eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Hawaiian Whitespotted Toby at the 0-98-foot depth in hardbottom habitat was approximately 825,012 individuals, with an estimated 443,961 individuals in East Hawai'i and 381,051 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Hawaiian Whitespotted Toby at the 30-60-foot depth was approximately 250,573 individuals, and in 2017/2018 was approximately 249,141 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 328,806 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has decreased significantly in Open Areas and MPAs and has remained stable in FRAs (DAR 2019a).

Cultural Significance

The Hawaiian Whitespotted Toby is one of three endemic pufferfish that inhabit Hawai'i's waters (Hoover 2007). The common name "Toby" originated in Australia. A review of cultural-historical literature (see Appendix A) did not reveal any specific Hawaiian names or cultural information related to the Hawaiian Whitespotted Toby; however, tobies are sometimes referred to generally as *makimaki* (Hoover 2007). Other names traditionally used for pufferfish include *'o'opu hue*, possibly an alteration of *ōpūhue (*calabash, gourd*),* and *kēkē* (potbelly).

4.4.1.33 Bluestripe Snapper (Taape) (*Lutjanus kasmira*)

Ecology

The Bluestripe Snapper is an introduced species in Hawai'i. It has a bright yellow body and fins with four horizontal blue stripes. The yellow fades to white in the lower third of the body. The body is moderately compressed laterally, with an average length of 13.5 inches (Allen 1985b). This species is found throughout the Indo-Pacific oceans.

The Bluestripe Snapper inhabits shallow-water reefs (100 to 500 feet) where it feeds on shrimp, cephalopods, gastropods, crabs, and small fish. This species also utilizes artificial structures in shallow bays throughout its range. Juveniles have been found to use seagrass beds until reaching maturity (Lieske and Myers 1994). The introduction of this fish into Hawai'i included at least one non-native parasite that has spread to local fishes (Gaither et al. 2013).

Bluestripe Snapper are broadcast spawners. Many broadcast spawners migrate to the edge of the reef drop off to spawn at dusk or dawn (Thresher 1984). Males and females simultaneously release eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Allen 1985b, Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Bluestripe Snapper at the 0-98-foot depth in hardbottom habitat was approximately 1,700,565 individuals, with an estimated 1,525,714 individuals in East Hawai'i and 174,851 individuals in the WHRFMA. However, these are low estimates because much of the Bluestripe Snapper population occurs below the 98-foot depth surveyed by the PIFSC-ESD (2020) and is not observable by the methods of the survey. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Bluestripe Snapper at the 30-60-foot depth was approximately 7,830 individuals, and in 2017/2018 was approximately 33,290 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 79,907 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has increased significantly in Open Areas and FRAs and remained stable in MPAs (DAR 2019a). The large difference in these estimates results from the larger survey area of the PIFSC-ESD survey which samples more of the population.

Cultural Significance

Introduced initially from the Marquesas to the Hawaiian Islands in 1958 for commercial fishing purposes, the Bluestripe Snapper, more commonly known by its Tahitian name *ta'ape*, has not fared well in Hawai'i's fish consumer market. These fish, which tend to school in great numbers, are often regarded by local fishermen as a pest. Given that it arrived in Hawaiian waters so recently, there are currently no known Hawaiian names for this fish or any traditional cultural uses.

4.4.1.34 Peacock Grouper (Roi, Bluespot Peacock Grouper) (*Cephalopholis argus*)

Ecology

The Peacock Grouper is widely distributed throughout the Indo-Pacific oceans and has been introduced to the Hawaiian Islands. Individuals can reach a length of up to 24 inches and are identified by white vertical stripes on the back half of a brown colored body. Peacock Grouper was thought to present a risk to native species of Hawai'i (Dierking 2007). However, a recently completed 5.5-year study found that removal of the Peacock Grouper did not translate into sustained increases in prey, nor to increases in total fish biomass (Giddens et al. 2017).

This Peacock Grouper prefers exposed reef front habitats with a water depth of 3 to 30 feet, while juveniles utilize thick pockets of coral (Myers 1999). Individuals use a variety of hunting techniques to capture prey. They may hover and wait, stalk prey, and follow larger predators such as eels and attack missed prey (Hoover 2008). Dierking et al. (2009) found reef fishes were the principal diet component (97.7% by % Index of Relative Importance [IRI]) of Peacock Grouper, with all 10 of the most abundant species on West Hawai'i reefs found in the stomachs of Peacock Grouper. Some fishes that were rare in the reef environment in West Hawai'i were found to be important components of the diet, while others, although highly abundant on West Hawai'i reefs, had low dietary importance. Crustaceans were the only other higher taxonomic group in the diet but were of minor importance (2.3% by %IRI) (Dierking et al. 2009).

Peacock Grouper are broadcast spawners. Many broadcast spawners migrate to the edge of the reef drop off to spawn at dusk or dawn (Thresher 1984). Males and females simultaneously release eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984). Males defend territories and their harem of up to six females from other males.

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Peacock Grouper at the 0-98-foot depth in hardbottom habitat was approximately 452,303 individuals, with an estimated 172,341 individuals in East Hawai'i and 279,962 individuals in the WHRFMA. WHAP data indicate the 2012/2013 WHRFMA Open Area population of Peacock Grouper at the 30-60-foot depth was approximately 24,610 individuals, and in 2017/2018 was approximately 51,546 individuals (DAR 2014a, 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 101,016 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has remained stable in Open Areas, FRAs, and MPAs (DAR 2019a).

Cultural Significance

The Peacock Grouper, more commonly known as the roi, and was introduced to Hawai'i from French Polynesia in 1956 to enhance the local fisheries. Because this species was so recently introduced to Hawaiian waters, a review of cultural-historical literature (see Appendix A) did not reveal any specific Hawaiian names or cultural information related to it.

4.4.1.35 Psychedelic Wrasse (*Anampses chrysocephalus*)

Ecology

The Psychedelic Wrasse is endemic to the Hawaiian Islands and is found among seaweed coral reefs at depths from 40 to 450 feet (Lieske and Myers 1994). This species is dark brown with white spots and a red tail. However, like others in the wrasse family, as the females mature they undergo a color and sexual transition to the "terminal phase" male. These males have a bright orange head covered in blue spots and radiating lines. Psychedelic Wrasse terminal phase males are usually only found in depths greater than 50 feet (DLNR 2015). The main prey for the Psychedelic Wrasse are macro-invertebrates found among the rocks and corals it inhabits. Females usually form small groups with a single male (Lieske and Myers 1994).

Psychedelic Wrasse are broadcast spawners, with males and females simultaneously releasing eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Psychedelic Wrasse at the 0-98-foot depth in hardbottom habitat was approximately 12,789 individuals, with an estimated 6,976 individuals in East Hawai'i and 5,813 individuals in the WHRFMA. However, the Psychedelic Wrasse occupies habitat below the 98-foot depth surveyed by the PIFSC (2020) study. As such, this is likely a low estimate, because much of the population is not observable by the methods of the study. WHAP estimated a population size of 1,071 in 2017/2018 but noted that this is a deeper water species that is only occasionally recorded on surveys, and thus the population is underestimated (DAR 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 1,966 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has remained stable in Open Areas, FRAs, and MPAs (DAR 2019a).

The Psychedelic Wrasse is a DLNR SGCN (Section 4.4.3), but is considered a species of 'Least Concern' by the International Union for the Conservation of Nature and Natural Resources (IUCN; 2017).

Cultural Significance

See Section 4.4.1.4 for a discussion of the cultural significance of *hināIea,* which includes the Psychedelic Wrasse.

4.4.1.36 Tinker's Butterflyfish (*Chaetodon tinkeri*)

Ecology

The Tinker's butterflyfish is identified by a gold mask over the eye, with a diagonal demarcation separating a white lower/front part of the body and head from a black upper rear portion. Tinker's Butterflyfish is found from Hawai'i Island through O'ahu (DLNR 2015), and the Johnston Atoll to the Marshall Islands (Lobel 2003). Tinker's Butterflyfish can be found at least as deep as 400 feet on O'ahu and Hawai'i (Richard Pyle, Bernice Pauahi Bishop Museum, pers. comm.) on coral reef slopes. Common prey species for Tinker's Butterflyfish include small invertebrates, crabs, and worms (Pyle 2001).

Tinker's Butterflyfish are broadcast spawners, with males and females simultaneously releasing eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

CREP (2018) data indicate that the 2016 island of Hawai'i population of Tinker's Butterflyfish at the 0-98-foot depth in hardbottom habitat was approximately 18,475 individuals. However, the vast majority of the population occurs well below the 98-foot depth surveyed by the CREP/PIFSC-ESD and is not observable by the methods of the survey. No population estimate was provided for Tinker's Butterflyfish in 2019 (PIFSC-ESD 2020). WHAP could not produce estimates of this species because the species occurs in habitats not adequately surveyed by WHAP transects (DAR 2014a, 2019a).

The Tinker's Butterflyfish is a DLNR SGCN (Section 4.4.3) but is considered a species of 'Least Concern' by the IUCN (2017).

Cultural Significance

See Section 4.4.1.16 for a discussion of the cultural significance of *kīkākapu,* which includes the Tinker's Butterflyfish.

4.4.1.37 Longfin Anthias (*Pseudanthias hawaiiensis*)

Ecology

The Longfin Anthias can grow up to 4 inches and is bright yellow to orange with red and purple along the fins. It is endemic to Hawai'i and the Johnston Atoll (Lobel 2003) and is found in caves or coral rubble along steep drop-offs from 85 to 400 feet deep (Randall 2007). This species feeds primarily on larvae of crustaceans and fish eggs (Bachhet et al. 2006).

Longfin Anthias are broadcast spawners, with males and females simultaneously releasing eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

Most of the Longfin Anthias population occurs below the 98-foot depth surveyed by the PIFSC-ESD and the 60-foot depth surveyed by the WHAP, and therefore the species is not observable by the methods of either survey. As such, data are not available to produce a reliable WHRFMA or island-wide population estimate.

Cultural Significance

Although endemic to the islands, a review of cultural-historical literature (see Appendix A) did not reveal any specific Hawaiian names or cultural information for the Longfin Anthias.

4.4.1.38 Flame Wrasse (*Cirrhilabrus jordani*)

Ecology

The Flame Wrasse is endemic to the Hawaiian Islands and the Johnston Atoll (Lobel 2003, Lieske and Myers 1994). Females are bright red on the dorsal part of the body fading to a light pink on the ventral side. The fins are opaque with some yellow features on the face. Females grow to about 3 inches before they begin to transform into a male. As the male matures the dorsal remains bright red fading into a vibrant yellow orange.

The Flame Wrasse utilizes seaward reefs and forms groups above large drop-offs at a depth of 15 to 600 feet, where it feeds exclusively on zooplankton along the ocean floor (Lieske and Myers 1994). Prime Flame Wrasse habitat became an FRA when Act 306 was implemented (BIAAF, pers. comm.). During breeding males and females form pairs for mating (Breder and Rosen 1966).

Flame Wrasse are broadcast spawners, with males and females simultaneously releasing eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

Most of the Flame Wrasse population occurs below the 60-foot depth surveyed by the WHAP and below the 98-foot depth surveyed by the PIFSC-ESD, and therefore the species is not observable by the methods of either survey. As such, data are not available to produce a reliable WHRFMA or island-wide population estimate.

Cultural Significance

See Section 4.4.1.4 for a discussion of the cultural significance of *hinālea,* which includes the Flame Wrasse.

4.4.1.39 Fisher's Angelfish (*Centropyge fisheri*)

Ecology

The Fisher's Angelfish is mostly orange with a thin blue outline highlighting the belly and anal fin, the caudal fin is pale yellow. Adults attain a length of only 2 inches. This angelfish is found throughout Hawai'i and the Johnston Atoll (Lobel 2003). Small groups have been observed feeding on algae and small shrimp associated with coral along outer reef slopes at depths between 10 and 200 feet (Pyle 2001). This species is hermaphroditic and changes sex as it matures. It is distributed from the east coast of Africa to the islands of French Polynesia and Hawaiian Islands and in the western Pacific from southern Japan to New South Wales (Randall 2007).

Fisher's Angelfish are broadcast spawners, with males and females simultaneously releasing eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Fisher's Angelfish at the 0-98-foot depth in hardbottom habitat was approximately 280,059 individuals, with an estimated 11,697 individuals in East Hawai'i and 268,363 individuals in the WHRFMA. WHAP estimated the Open Area population of this species in 2017/2018 at 59,064 individuals but noted that the species typically occurs at deeper depths, and is only occasionally encountered during surveys, and the population is thus underestimated (DAR 2019a). The WHAP WHRFMA population estimate (including Open Areas, FRAs and MPAs) in 2017/2018 at the 30-60-foot depth was 59,258 individuals (Dr. Bill Walsh, personal communication, 2020). Since the establishment of the WHRFMA, this species has increased significantly in Open Areas and remained stable in FRAs and MPAs (DAR 2019a)

The Fisher's Angelfish is a DLNR SGCN (Section 4.4.3) but is considered a species of 'Least Concern' by the IUCN (2017).

Cultural Significance

A review of cultural-historical literature (see Appendix A) did not reveal any specific Hawaiian names or cultural information for the Fisher's Angelfish.

4.4.1.40 Eyestripe Surgeonfish (Palani) (*Acanthurus dussumieri*)

Ecology

The Eyestripe Surgeonfish is found throughout the Indo-Pacific region. This large surgeon fish can reach lengths of 21 inches with a body that is mostly yellow with purple highlights. A characteristic bright yellow band goes behind each eye to the gill cover (Myers 1991). The tail is blue to dark purple.

The Eyestripe Surgeonfish feeds on both green and brown algae and detritus from the ocean floor (Myers 1991), and are commonly found along clear corals, lagoons, and outer reefs at depths of 13 to 430 feet. Adults are usually observed alone and pair only for mating (Myers 1999).

Eyestripe Surgeonfish are broadcast spawners. Many broadcast spawners migrate to the edge of the reef drop off to spawn at dusk or dawn (Thresher 1984). Males and females simultaneously release eggs and sperm into the water column where the eggs are fertilized before floating to the surface until they hatch 20-30 hours later (Thresher 1984).

PIFSC-ESD (2020) data indicate that the 2019 island of Hawai'i population of Eyestripe Surgeonfish at the 0-98-foot depth in hardbottom habitat was approximately 415,213 individuals, with an estimated 365,994 individuals in East Hawai'i and 49,219 individuals in the WHRFMA. WHAP could not produce estimates of this species because the species occurs in habitats not adequately surveyed by WHAP transects, though in 2017/2018 they did estimate 1,185 individuals across the WHRFMA (Dr. Bill Walsh, personal communication, 2020).

Cultural Significance

The Eyestripe Surgeonfish is also known as *palani*. *Palani*, meaning "to stink, smell sour or rancid" (Pukui and Elbert 1986), is a well-recognized trait of this fish that is documented in *moʻolelo* and *ʻōlelo noʻeau*.

Palani were commonly raised in fishponds, particularly for ceremonial uses or were reserved for the *ali'i* and were kept for breeding, while the offspring were raised tame so that they could be easily removed by hand (Handy and Handy 1972). *Palani* were considered *kapu* (taboo) to men (Titcomb 1972).

4.4.2 Non-White List Wildlife Species

Marine species in Hawaiʻi include over 1,200 species of fishes, with around 500 species adapted to live on coral reefs, and the rest adapted to the pelagic open surface waters, mesopelagic, or bathypelagic zones (middle or deep waters), estuaries, or sandy bottoms (DLNR 2015). At the top of the food chain are the apex predators such as the many sharks and large predatory reef and pelagic fishes of Hawaiʻi. Over 5,000 marine invertebrates are known from Hawaiʻi and include over 100 species of hard, soft, and precious corals as well as hundreds of types of snails, crabs, shrimps and small numbers of worms, jellyfish, sponges, starfish, and tunicates (DLNR 2015). Five marine turtles occur in Hawaiʻi; two are common residents that nest on Hawaiʻi's beaches and three others are more occasional visitors. All sea turtles are listed as threatened or endangered under the federal Endangered Species Act (ESA) of 1973, as amended. Federal- and state-listed species are discussed in Section 4.4.4.

Approximately 26 species of marine mammals, mostly cetaceans, are considered resident or occasional visitors to Hawaiʻi. These include the Humpback Whale or *koholā* (*Megaptera noveangliae*), which migrates during the winter months to Hawaiian waters to breed and give birth each year before returning to feed in Alaskan waters during spring and summer, False Killer Whale (*Pseudorca crassidens*), and the Spinner Dolphin (*Stenella longirostris*) and Bottlenose Dolphin (*Tursiops truncatus*). Humpback Whales and Hawaiian Monk Seals (*Monachus schauinslandi*) are common marine mammals in Hawaiʻi and are listed as endangered under the ESA (DLNR 2015). All marine mammals are protected by the Marine Mammal Protection Act. Many of the resident whales and dolphins feed on fishes and squids that occur in the moderately deep waters off Hawaiʻi's coasts.

Approximately 4,100 species of marine invertebrates are known from Hawai'i. Marine invertebrates collected under Aquarium Permits generally include those species that are colorful or aesthetically pleasing. Between 2000 and 2017 over 93% (2,066,025 individuals) of all invertebrates collected under Aquarium Permits were collected from the island of O'ahu, based on data provided by the DAR (2014a). This is likely due to White List restrictions in West Hawai'i. In East Hawai'i, non-White List Species may be collected, and invertebrates made up approximately 58% of the total catch of White List and non-White List Species combined.

Of the approximately 249,000 invertebrates collected in East Hawai'i since 2000, over 73% (182,710 individuals) were Red Pond Shrimp (species not specified). Red Pond Shrimp (primarily *Halocaridina rubra*) also make up 42.5% of all species collected in East Hawai'i. Other common species of invertebrates captured in East Hawai'i include hermit crabs (species not specified), Feather Dusters Worms (*Sabellastarte spectabilis*), and Zebra Hermit Crabs (*Calcinus laevimanus*).

4.4.2.1 Red Pond Shrimp

This group of species live in underground (hypogeal) environments and in anchialine ponds (landlocked ponds with a mix of freshwater and seawater through underground connections to the sea). Of the eight

known species to occur in Hawai'i, all are endemic to the Hawaiian Archipelago (including Johnston Atoll) except *Antecaridina lauensis*, *Calliasmata pholidota*, and *Metabetaeus lohena* which are found throughout Hawai'i and also in Chile (US Fish and Wildlife Ecos Environmental Conservation 12/2015). *Halocaridina rubra* (*'Ōpae 'ula*, an endemic shrimp species known to be ideal *'ōpelu* bai) reaches 0.5 inch in length and is an herbivore that grazes on algal, bacterial, and diatom films growing on rocks and other hard substrates. They can also filter feed in mid-water and at the surface. The other species are all larger (up to two inches long) and some are predatory. All have red color and reduced appendages. *'Ōpae 'ula* carry about 12 fertilized eggs under their abdomen for a brood period of about 38 days. They reproduce 1-2 times per year. Lifespan of *'Ōpae 'ula* is long, up to 20 years in captivity. Less is known about the life history of the other species, but they are relatively long-lived for species in their taxa.

No population estimates are available for Red Pond Shrimp.

4.4.2.2 Hermit Crab (various species)

Because specific species of hermit crabs are not reported on Aquarium Permit reporting forms, it is not possible to know which species are collected, with the exception of zebra hermit crabs (Section 4.4.2.3). However, hermit crabs are one of the most common types of tide pool animals. They rely on empty snail shells for protection. Most species will scavenge the reefs consuming fish, other invertebrates, or algae. Some will display a variety of coloration and elaborate eye colors. Approximately 23 species of hermit crabs are known from Hawai'i shorelines.

No population estimates are available for hermit crabs.

4.4.2.3 Zebra Hermit Crab (*Calcinus laevimanus*)

This species of hermit crab is found in a large area of the Indo-Pacific, extending from Africa to Australia and Japan to Hawai'i. The common name comes from the coloration, black and white pincers, and white bands on dark legs. They also have orange and sky-blue eyestalks. They prefer to inhabit gastropod shells in intertidal flats, reef flats, and rock platforms, and may also be found in mangrove areas on sand mud bottoms and on rocky shores (Rahayu 2000).

No population estimates are available for Zebra Hermit Crabs.

4.4.3 Hawai'i Species of Greatest Conservation Need

Species of Greatest Conservation Need (SGCN) are identified in Hawai'i's State Wildlife Action Plan (SWAP) but are not threatened, endangered, or otherwise legislatively protected species. In fact, all three SGCN species noted below (and further discussed in Section 5.0) are listed as species of 'Least Concern' by the IUCN (2017). However, recognizing the need to act to protect endemic species, the DLNR identified Hawai'i's indigenous SGCN in Exhibit 1 of Hawai'i Administrative Rules Chapter 124. This list includes terrestrial mammals, marine mammals, and marine reptiles only. Additional native species were identified and added based on their presence on the following lists (DLNR 2018):

- The Federal list of threatened, endangered, candidate and concern species;

- Species protected by the U.S. Marine Mammal Protection Act;
- The State list of threatened and endangered species;
- The Checklist of the Birds of Hawai‘i; and
- Species identified as present in Hawai‘i by groups or organizations with significant experience or expertise (e.g., Audubon Watch List; national and regional Bird Plans, such as the U.S. Shorebird Conservation Plan, Waterbird Conservation for the Americas; Regional Seabird Conservation Plan).

In addition to the above lists, for any terrestrial indigenous species not represented by any of the lists, their status as indigenous automatically included them as Hawai‘i’s SGCN. For aquatic fishes and invertebrates, endemic species were added to the list (DLNR 2018). The DAR also included native species on the IUCN Threatened Red List, and the Convention on International Trade in Endangered Species list. A Statewide Aquatic Wildlife Conservation Strategy (SAWCS) Advisory Council was developed to advise on additional species that were at risk due to specific threats. The SAWCS Advisory Council is a panel with representatives from federal and state agencies, resource user groups, and non-profit organizations that helps the DAR develop its CWCS (DLNR 2018).

Additional species considered must meet one or more of the following biological criteria (DLNR 2018):

- Species with low or declining populations;
- Species indicative of the diversity and health of the state’s wildlife;
- Species with small, localized “at-risk” populations;
- Keystone species;
- Indicator species;
- Species with limited dispersal;
- Disjunct species;
- Vulnerable species;
- Species of conservation concern;
- “Responsibility” species, (i.e., species that have their center of range within a state); and,
- Species with fragmented or isolated populations.

Currently 25% of fish, 20% of mollusks, 18% of algae, and 20% of the corals are considered endemic to Hawai’i and listed as SGCN species (Randall 2007, DLNR 2015).

Based on these parameters, three White List Species occur on Hawai’i’s SGCN list:

1. Psychedelic Wrasse
2. Tinker's Butterflyfish
3. Fisher's Angelfish.

The DLNR SWAP (2015) addresses these species and identifies the following actions to ensure the species conservation and sustainability:

1. Conservation Actions: The goals of conservation actions are to not only protect current populations, but to also establish further populations to reduce the risk of extinction. Commercial licenses are required for aquarium collectors. In addition to common statewide and island conservation actions, specific actions include:
    - Restoration of habitat; and,
    - Maintaining healthy populations with appropriate fishing regulations and education.
2. Monitoring:
    - Continue to survey for populations and distribution in known and likely habitats.
3. Research Priorities:
    - Improve understanding of factors affecting the species population size and distribution; and,
    - Support aquaculture research to develop captive breeding for species used in the aquarium trade.

4.4.4 Threatened and Endangered Wildlife Species

A total of 8 federal and 10 state-listed threatened or endangered marine species, consisting of one seal, four whales, and five sea turtles, occur in Hawaiʻi (Table 4-5). Federal endangered species are those species that the US Fish and Wildlife Service (USFWS) define as being in danger of becoming extinct, while threatened species are those likely to become endangered in the foreseeable future. State endangered species are those defined by the DLNR as in danger of becoming extinct at a state level, while threatened species are those likely to become endangered in the foreseeable future at the state level. No species collected by aquarium fishers occur on the state or federal list of threatened and endangered species.

Table 4-5. Threatened and endangered marine species of Hawai'i.

Common Name	Scientific Name	State Status	Federal Status
Mammals			
Hawaiian Monk Seal	*Neomonachus schauinslandi*	E	E
Fin Whale	*Balaenoptera physalus*	E	NA
Humpback Whale	*Megaptera novaeangliae*	E	E
Sperm Whale	*Physeter catodon*	E	E
False Killer Whale	*Pseudorca crassidens*	E	NA
Reptiles			
Pacific Leatherback Sea Turtle	*Dermochelys coriacea schlegelii*	E	E
Pacific Hawksbill Sea Turtle	*Eretmochelys imbricata bissa*	E	E
Loggerhead Sea Turtle	*Caretta*	T	T
Green Sea Turtle	*Chelonia mydas*	T	T
Olive Ridley Sea Turtle	*Lepidochelys olivacea*	T	T

4.4.5 Reef Habitat

Stretching for more than 1,200 miles in the Central Pacific, Hawaiian coral reefs account for about 85% of all coral reefs in the United States. More than 500 species of algae also live in Hawai'i's coral reefs providing food for fish and oxygen for all marine life. The oceans' algae provide more oxygen than all land plants worldwide combined. There are 78 species of endemic marine algae, 24 species of endemic freshwater algae, and two aquatic plants included on Hawai'i's list of SGCN (DLNR 2015).

Hawai'i's reefs are unique among the world's reef ecosystems. Compared to coral reefs in the Indo-Pacific or Caribbean, Hawaiian reefs are relatively young. Hawai'i reefs are therefore dominated by hard corals (as opposed to sponges, tunicates, and soft corals) and are inhabited by distinctive reef fish and other marine life. Most stony corals grow very slowly. Hawai'i hosts about 40 species of hard, reef building corals (MRC 2017). Due to Hawai'i's extreme isolation, an estimated 25% of the coral reef species are found nowhere else.

Stony corals are defined by Hawai'i Administrative Rule 13-95 as any species belonging to the Order Scleractinia (marine corals which generate a hard skeleton). All reef corals, including mushroom corals, belong to this order (DAR 2014b). The animals which form stony corals belong to the same major group as jellyfish and anemones. Most of them are colonial, and all secrete a hard skeleton made of calcium carbonate. The animals themselves, called polyps, form the outer living layer of a coral colony. Each polyp sits in a cup-like depression called a calyx. Most stony corals grow very slowly and can take hundreds of years to recover from damage (DAR 2014b).

The characteristic color of many living corals is due to the presence of single-celled algae, called zooxanthellae, which live inside the coral polyp. The coral and algae have a symbiotic relationship. Most stony corals produce colonial forms that are attached to the substrate, but a few are solitary and unattached (DAR 2014b).

Ecosystem indicators related to benthic reef community integrity indicate a shift in West Hawai'i towards lowered reef accretion and reduced structural complexity. Hard coral cover, an indicator of reef topographic

complexity, habitat structure, and reef accretion, decreased from an average of 44% to 31% cover in the North from 2003 to 2014, a decline of roughly one-third in just 12 years (Gove et al. 2016). However, over the same time period, hard coral cover remained relatively constant in the South (Gove et al. 2016). The ratio between the cover of calcifying to non-calcifying organisms – an indicator of coral reef community dynamics and the extent to which a given system is dominated by organisms that contribute to coral reef development and persistence – declined across West Hawai‘i since 2003 (Gove et al. 2016). The North experienced the biggest change in this indicator, with the calcified: non-calcified ratio decreasing by approximately half to a present value of <1, indicating the benthic community is currently dominated by non-calcifying benthic organisms (Gove et al. 2016).

4.4.5.1 Corals Common to Hawai'i (DAR 2014b)

Rose or Cauliflower Coral (*Pocillopora meandrina*)

The most common *Pocillopora* in Hawai'i, this coral prefers wave-agitated environments, and is found at depths to about 150 feet. Commonly called "rose coral" or "cauliflower coral," the colonies form cauliflower-shaped heads about 10 to 20 inches in diameter. Branches are heavy and leaf-like and fork bluntly near the ends. All branches have wart-like projections called verrucae that are covered with calices. Color of living colonies ranges from brown to pink.

Lace Coral (*Pocillopora damicornis*)

This delicate and fragile coral forms small bushy clumps up to about 6 inches in diameter. Colonies consist of fine branches covered with calices. These branches range from long and slender in calm waters to more robust forms in areas of wave action. Sometimes the skeleton will create pocket formations around a crab that lives among the branches. Usually found in protected areas and inner portions of large reef flats, this species appears to strongly depend on sunlight, as it is rarely found below about 30 feet. Colonies range in color from light brown in shallow waters to dark brown in deeper waters.

Antler Coral (*Pocillopora eydouxi*)

Colonies consist of thick pipe-like branches that resemble moose antlers. This species also possesses verrucae and is usually found in depths of 35 to 150 feet. Live colonies are brown in color and usually darker than other Pocilloporid corals.

Lobe Coral (*Porites lobata*)

This coral produces many encrusting or massive forms on the reef from the intertidal zone to depths of over 180 feet. Long narrow cracks found on the coral heads are produced by a type of alpheid shrimp. Calices have a snowflake-like appearance and are shallow and flush to the surface. Living colonies range in color from yellowish-green to brown and sometimes blue.

Finger Coral (*Porites compressa*)

Distinguishing features are the finger-like branching and shallow snowflake-shaped calices. This species is most common in wave-protected areas like bays or deeper reef slopes to depths of about 150 feet. It has

many growth forms, but all of them show some sort of fingerlike branching. Color of live colonies ranges from light brown to light yellowish-green.

Rice Coral (*Montipora capitata*)

The most obvious characteristic of this coral is the nipple-like projections (papillae) that cover the surface. These papillae are smooth with no calices on them. Calices are found on the upper surface of the coral between the papillae. The image of the calices and papillae create a "rice & pepper" appearance. This species is found at depths up to about 150 feet. It has a number of growth forms ranging from plate-like to branchlike and encrusting types. Color of living colonies is usually brown. If the colony is growing in a plate form, the edges may be white.

Mushroom or Razor Coral (*Fungia scutaria*)

This solitary (single polyp), free-living (unattached) coral is most commonly found on reef flats, frequently between cracks and crevices. It has also been found at depths of over 75 feet. Its disk-like, elliptical shape resembles a mushroom cap and ranges from 1.5 to 7 inches in diameter. Some adults may form a high arch in the middle. Immature forms are attached to the substrate or an adult mushroom coral by a stalk. It grows into a disk and, when large enough, breaks off the stalk and becomes free-living. The color of live specimens ranges from pale brown in bright sunlight to dark brown in shady areas or deeper water.

Cup or Tube Coral (*Tubastraea coccinea*)

This is a common non-reef building coral found in shallow Hawaiian waters. This species forms large calices and occurs in clumps that are 2 to 4 inches in diameter. Living tissue is usually bright orange in color but may also appear pink or even black. The bright coloration is not produced by zooxanthellae. This coral is usually found on steep ledges, in caves and in shady tidepools.

4.4.6 Invasive Species

From *A Guidebook of Introduced Marine Species in Hawai'i* (DeFelice et al. 2001):

> *Through the Hawai'i Biological Survey at Bishop Museum, a count of the total number of species in the Hawai'i Archipelago has been compiled. In 1999, there were 23,150 known species of terrestrial and aquatic algae, plants, and animals, including 5,047 nonindigenous species (~ 20%). The total number of marine and brackish water alien species in the Hawaiian Islands was 343, including 287 invertebrates, 24 algae, 20 fish, and 12 flowering plants.*
>
> *The 287 alien marine invertebrate species make up about 7% of the known marine and brackish water invertebrate fauna in the Hawaiian Islands (4,099 species). Arthropods have been the most successful marine invaders, with 71 suspected alien crustacean species, while 53 alien mollusks have made it to Hawai'i. Limited information exists for these invasive species.*
>
> *The greatest number of introduced marine invertebrates have arrived to Hawai'i through hull fouling, but many have also arrived with solid ballast and in ballast water. DeFelice et al. (2001) considered 201 species (70%) to be introduced, and 86 species (30%) cryptogenic (not*

> *demonstratively native or introduced). Two hundred forty-eight (87%) have become established, 15 (5%) arrived but failed to become established, 6 (2%) were intercepted, and the population status of 18 species (6%) is unknown.*
>
> *The nonindigenous invertebrate species in the Hawaiian Islands are primarily of Indo-Pacific/Philippines Islands region origin. A surprising number of species from the tropical western Atlantic/Caribbean region have invaded Hawai'i as well.*

Invasive algae pose the largest threat to Hawai'i's reef ecosystem. The five most common algae species posing the largest threat include Smothering Seaweed (*Kappaphycus* and *Euchema* spp.), Gorilla Ogo (*Gracilaria salicornia*), Leather Mudweed (*Avrainvillea amadelpha*), Hook Weed (*Hypnea musciformis*), and Prickly Seaweed (*Acanthophora spicifera*). Marine debris arriving from other countries and regions and ballast water/biofouling are the primary threat for invasion in the Hawaiian Islands.

Invasive fish species of concern in Hawai'i include two White List Species, the Bluestripe Snapper (Taape), and Peacock Grouper (= Roi, Bluespot Peacock Grouper), and a non-White List Species, the Blacktail Snapper (*Lutjanus fulvus*). All three species were introduced between 1956-1961, mostly as game fish (IUCN 2017).

The Peacock Grouper (Section 4.4.1.34) is a known carrier of Ciguatera (a foodborne illness), which is well known by the local fishermen and therefore its use as a food fish is intentionally very limited (BIAAF, pers. comm., also reviewed in Appendix A). It has become a dominant predator species in the Main Hawaiian Islands and is known to have negative ecological impacts on other endemic and culturally valued species (Dierking 2007). In recent years, efforts to minimize populations of this species have led to statewide events often dubbed "roi round-ups," where local spear fishers are encouraged to catch and remove as many roi from the reefs as possible. However, a recently completed 5.5-year study found that removal of the Peacock Grouper did not translate into sustained increases in prey, nor to increases in total fish biomass (Giddens et al. 2017).

The Bluestripe Snapper (Section 4.4.1.33) and Peacock Grouper (Section 4.4.1.34) are well established in Hawai'i. The Blacktail Snapper occurs at low densities only in the lower Hawaiian Islands (Randall 1987, Gaither et al. 2010 as cited in IUCN 2017). From 2008 through 2014, regional estimates of the density of Blacktail Snapper ranged from 1.8 to 14.1 individuals per 2.5 acres over hard bottoms to 98.5 feet depth in Pacific coral reef areas surveyed by NOAA (NOAA unpublished data as described in Heenan et al. 2014 as cited in IUCN 2017). The highest recorded density was in the MHI region (0.3 to 45.1 individuals per 2.5 acres) as compared to the lowest in the Southern Mariana Islands region (0 to 4.3 individuals; IUCN 2017).

4.4.7 Aquarium Fish Population Estimate Data

4.4.7.1 West Hawai'i Aquarium Project (WHAP) Surveys

To monitor and gauge the effects of the aquarium fishing industry, the West Hawai'i Aquarium Project (WHAP) established 25 study sites (Figure 4) along the West Hawai'i coastline in early 1999 at 9 FRA sites, 10 Open Area sites (aquarium fish collection areas) and 6 previously established MPAs to collect baseline data both prior to and after the closure of the FRAs. The MPAs are MLCDs and FMAs, which have been

closed to aquarium collecting for at least 9 years and were presumed to have close to "natural" levels of aquarium fish abundances (DAR 2019a). They serve as a reference or 'control' to compare with the FRAs and Open Areas. It should be noted that after several years of study and observation, one of the MPA sites (Lapakahi MLCD – subzone B), was found not to be closed to aquarium collecting due to its remoteness and poorly defined seaward boundaries (i.e., 500 feet offshore). As such, the Lapakahi survey site was considered an Open Area for data analysis purposes (DAR 2014a, 2019a).

The overall goals of the WHAP were two-fold: 1) To evaluate the effectiveness of the FRA network by comparing targeted aquarium fishes in FRAs and Open Areas relative to adjacent control sites and, 2) To evaluate the impact of the FRA network on the commercial aquarium fishery (DAR 2019a).

Detailed explanations of the study sites and survey methods are found in Tissot et al. (2004) and Walsh (2013). To briefly summarize: Densities of all fish and selected invertebrate species were visually estimated along four 82x13 foot strip transects at each of 25 permanent sites located at depths between 30-60 feet in the three types of management areas. All survey divers either had extensive experience in conducting underwater fish surveys in Hawai'i or received training through the UH's Quantitative Underwater Ecological Survey Techniques (QUEST) training course prior to collecting data (Hallacher and Tissot 1999). In addition to the transect surveys, a 10 minute 'free-swim' survey is also conducted by two divers in the areas surrounding the actual transects. The purpose of this survey is to better census uncommon or rare species and species of particular ecological interest such as Bluestripe Snapper, Peacock Grouper, terminal phase parrotfish (Family Scaridae), cleaner wrasses (*Labroides* spp.) and Crown-of-Thorns Starfish (*Acanthaster solaris*). All sites are presently surveyed four times per year. Through 2018 (the most recent year for which data are available), a total of 8,712 transects had been completed (DAR 2019a). Six rounds were conducted prior to FRA closure in 1999 (DAR 2014a).

Table 4-6 provides population estimates for the Open Areas and for the WHRFMA as a whole for those species on the White List based on the WHAP data. It is important to note that the population estimates provided in the table and in the previous life histories sections (Section 4.4.1), only include West Hawai'i estimates of fish at depths of 30-60 feet (the depth at which WHAP surveys are conducted); thus, the actual population size of each species is likely greater due to individuals occurring at other depths, or in unsurveyed areas.

Table 4-6. West Hawai'i Open Area population estimates for all White List Species based on average WHAP data from 2012/2013 and 2017/2018 and percent of that population collected annually by aquarium fishers at the 30'-60' depth in 2017/2018 (DAR 2019a). Data in this table (recreated from 2019a) may differ from other publications due to the time of year data were analyzed, number of monthly reports available to the DAR at that time, and Hawai'i's confidentiality laws. Also included are 2017/2018 WHRFMA population estimates, including Open Areas, FRAs and MPAs (Dr. Bill Walsh, personal communication, 2020).

Common Name	2017-2018 Catch	2017-2018 30'- 60' Open Area Population	Catch as % of 30'-60' Open Area Population	30' – 60' WHRFMA Population (Open Areas, FRAs and MPAs)
Achilles Tang	5,437	13,796	39.67%	21,494
Bird Wrasse	265	66,581	0.40%	130,529
Black Durgon	11	92,354	0.01%	186,595
Black Surgeonfish (chevron tang)	3,878	98,067	3.95%	156,701
Blacklip Butterflyfish (Coral Butterflyfish)	81	39,734	0.20%	44,203
Blackside Hawkfish	30	23,625	0.13%	39,371
Bluestripe Snapper (Taape)	0	33,290	0.00%	79,907
Brown Surgeonfish (Lavender, Forktail Tang)	957	2,980,402	0.03%	4,140,802
Eightline Wrasse	97	187,930	0.05%	271,982
Eyestripe Surgeonfish (Palani)	0	N/A	N/A	1,185
Fisher's Angelfish	288	59,064	0.49%[3]	59,258
Flame Wrasse	0	N/A	N/A	NA
Forcepsfish	840	39,734	2.11%	81,490
Fourlined Wrasse	54	227,663	0.02%	348,400
Fourspot Butterflyfish	319	15,034	2.12%	18,932
Gilded Triggerfish (Blue-throat Triggerfish)	20	3,222	0.62%	8,895
Goldrim Tang	1,324	5,966	22.19%	13,832
Hawaiian Dascyllus (Domino)	89	63,359	0.14%	83,475
Hawaiian Whitespotted Toby (Puffer)	26	249,141	0.01%	328,806

Common Name	2017-2018 Catch	2017-2018 30'- 60' Open Area Population	Catch as % of 30'-60' Open Area Population	30' – 60' WHRFMA Population (Open Areas, FRAs and MPAs)
Kole (Goldring Surgeonfish, Yelloweye, Goldring)	30,901	5,312,745	0.58%	9,555,712
Lei Triggerfish	78	92,354	0.08%	142,699
Longfin Anthias	0	N/A	N/A	NA
Milletseed (Lemon) Butterflyfish	98	2,148	4.56%	2,259
Multiband (Pebbled) Butterflyfish	470	378,843	0.09%	810,451
Orangeband (Shoulder) Surgeonfish	1,293	53,694	2.41%	77,641
Orangespine Unicornfish (Clown Tang)	6,078	180,099	3.37%	266,945
Ornate Wrasse (Pinkface)	1,602	196,879	0.81%	254,626
Peacock Grouper (Roi, Bluespot Peacock Grouper)	0	51,546	0.00%	101,016
Pencil Wrasse	278	17,182	1.62%	27,016
Potter's Angelfish	2,245	265,488	0.85%	424,980
Psychedelic (Redtail) Wrasse	599	1,071	55.78%[3]	1,966
Pyramid Butterflyfish	42	37,586	0.11%	42,610
Redbarred Hawkfish	21	6,443	0.33%	8,902
Saddle Wrasse	538	140,947	0.10%	773,758
Shortnose (Geoffroy's) Wrasse	582	3,222	18.07%	4,669
Spotted Boxfish (Boxfish)	57	12,887	0.44%	19,468
Thompson's Surgeonfish	148	271,693	0.05%	380,593
Tinker's Butterflyfish	290	N/A	N/A	NA
Yellow Tang	264,870	2,867,048	9.24%	5,690,643
Yellowtail Coris (Clown Wrasse)	623	18,256	3.41%	34,322

A summary of the DAR 1999 to 2019 study findings is presented below (DAR 2019a):

- Of the 40 collected aquarium species, prior to the closure of aquarium collecting, Yellow Tang made up 81.6% of the total and Kole 9.5% (2017).
- In the 20 years since FRA establishment, the population of Yellow Tang has increased 165% in the FRAs, 74% in existing MRAs, and 101% in the Open Areas where fishing effort has been concentrated, with a current population estimate of approximately 5.7 million fish in the 30-60-foot depth range in the WHRFMA.
- Outward movement of adult Yellow Tang from protected areas into surrounding areas ('spillover') augments adult stocks in Open Areas up to a 0.6 mile or more away.
- Overall Kole abundance in the 30-60-foot depth range over the entire West Hawai'i coast increased by almost 5.2 million fish (118%) since FRA establishment (1999/2000), with a current population of about 9.6 million fish.
- Commercial aquarium landings of Achilles Tang have declined in West Hawai'i over the past two decades in association with a recent dramatic increase in its value (192% since 2008). This is strongly suggestive of declining availability (i.e., abundance). (Addressed in Section 5.4.1.3 – Achilles Tang).
- Achilles Tang have declined significantly in FRAs and Open Areas over the last 20 years. Open Area populations have usually been higher than FRA populations in the past decade. Achilles Tang has had low levels of recruitment over the past two decades, and because of its popularity as a food fish as well as an aquarium fish, this species is harvested both as juveniles and adults.
- Of the remaining 7 of the top 10 collected aquarium species, 1 species (Goldrim Surgeonfish) had no significant change in population, 6 species (Orangespine Unicornfish, Chevron Tang, Orangeband Surgeonfish, Brown Surgeonfish, and Potter's Angelfish) increased significantly in one or more of the management areas, and 1 species (Ornate Wrasse (Pinkface)) declined significantly in both FRA and Open areas. These results suggest that factors other than aquarium collecting are also affecting populations of these fish.
- For 26 other species on the White List, 10 showed a significant population increase in one or more of the management areas while 11 decreased. Of the species which declined (11), only a single one, Blackside Hawkfish, declined exclusively in the Open Areas, indicating that factors other than aquarium collecting were also affecting the populations of these species.
- For most of the species on the White List, collecting impact, in terms of the percentage of the population being removed annually, is relatively low with 9 species having single digit percent catch and 23 species having catch values <1%.
- Survey data are lacking for four species which typically occur in deep water (Tinker's Butterflyfish, Psychedelic Wrasse, Flame Wrasse and Hawai'i Longfin Anthias), as well as the Eyestripe Surgeonfish (which is typically found over sand during the day, a habitat not surveyed by WHAP).

- In terms of reef fish biomass caught by the different fisheries in West Hawai'i, considerably more biomass is taken by the combined recreational and commercial (non-aquarium) fisheries either including Yellow Tang (2.8 times) or excluding it (8.6 times). The total take of reef fish by commercial and non-commercial ('recreational') fishers on other Main Hawai'i Islands greatly exceeds the numbers and biomass of the fish collected by aquarium collectors.
- The 2010 and 2014 Hawai'i Island aquarium catch report validation did not indicate substantial underreporting of catch by aquarium collectors.

The Psychedelic Wrasse, Tinker's Butterflyfish, and Fisher's Angelfish are all listed as SGCN in Hawai'i (Section 4.4.3). They are not federal- or state-listed as threatened or endangered species (Section 4.4.4) and are not currently afforded any protection from collection. The Psychedelic Wrasse is endemic to the Hawaiian Islands and is found among seaweed coral reefs at depths from 40-450 feet (Lieske and Myers 1994) and are the most abundant on the Northwestern side of the island (BIAAF, pers. comm.); Tinker's Butterflyfish is found deeper than 100 feet on coral reef slopes (Pyle 2001); and, Fisher's Angelfish have been observed feeding on algae and small shrimp associated with coral along outer reef slopes at depths between 10 and 200 feet (Pyle and Myers 2010). Adequate population estimates based on WHAP data (30-60 feet depth) are not available to assess the impact of aquarium collection on these three species due to their deeper water habitats. However, based on deep diver observations, Tinker's Butterflyfish and Psychedelic Wrasse are substantially more common in the long term protected areas (MPAs; DAR 2019a). Commercial aquarium fishers generally do not fish in the deeper waters in which these species occur. In 2017, there were 599 Psychedelic Wrasse, approximately 290 Tinker's Butterflyfish (n.d. in East Hawai'i), and 288 Fisher's Angelfish collected by aquarium fishers on the island of Hawai'i (DAR 2018a).

4.4.7.2 NOAA Pacific Islands Fishers Science Center Ecosystem Sciences Division (PIFSC-ESD) Surveys (formerly Coral Reef Ecosystems Program or CREP)

The NOAA Pacific Islands Fishers Science Center (PIFSC) has been involved in a large-scale monitoring program that surveys coral reef fish assemblages and habitats, including White List Species, encompassing the bulk of the US-affiliated tropical Pacific. This effort, formerly known as the Coral Reef Ecosystem Program (CREP), is now known as the Ecosystem Sciences Division (ESD), and has included over 5,500 surveys around 39 islands, including the island of Hawai'i. The dataset was developed as a resource that could be used to understand how human, environmental, and oceanographic conditions influence coral reef fish community structure, providing a basis for research to support effective management outcomes (CREP 2018).

In 2010, the Pacific Reef Assessment and Monitoring Program developed and implemented a standardized survey methodology focusing on reef fish and paired benthic habitat-monitoring using monitoring methods specified in the National Coral Reef Monitoring Plan. The aim of the current systematic sampling design is to maximize survey site replication, while the overarching goal was to generate data representative of coral reef hardbottom substrate at the islands-scale (CREP 2018).

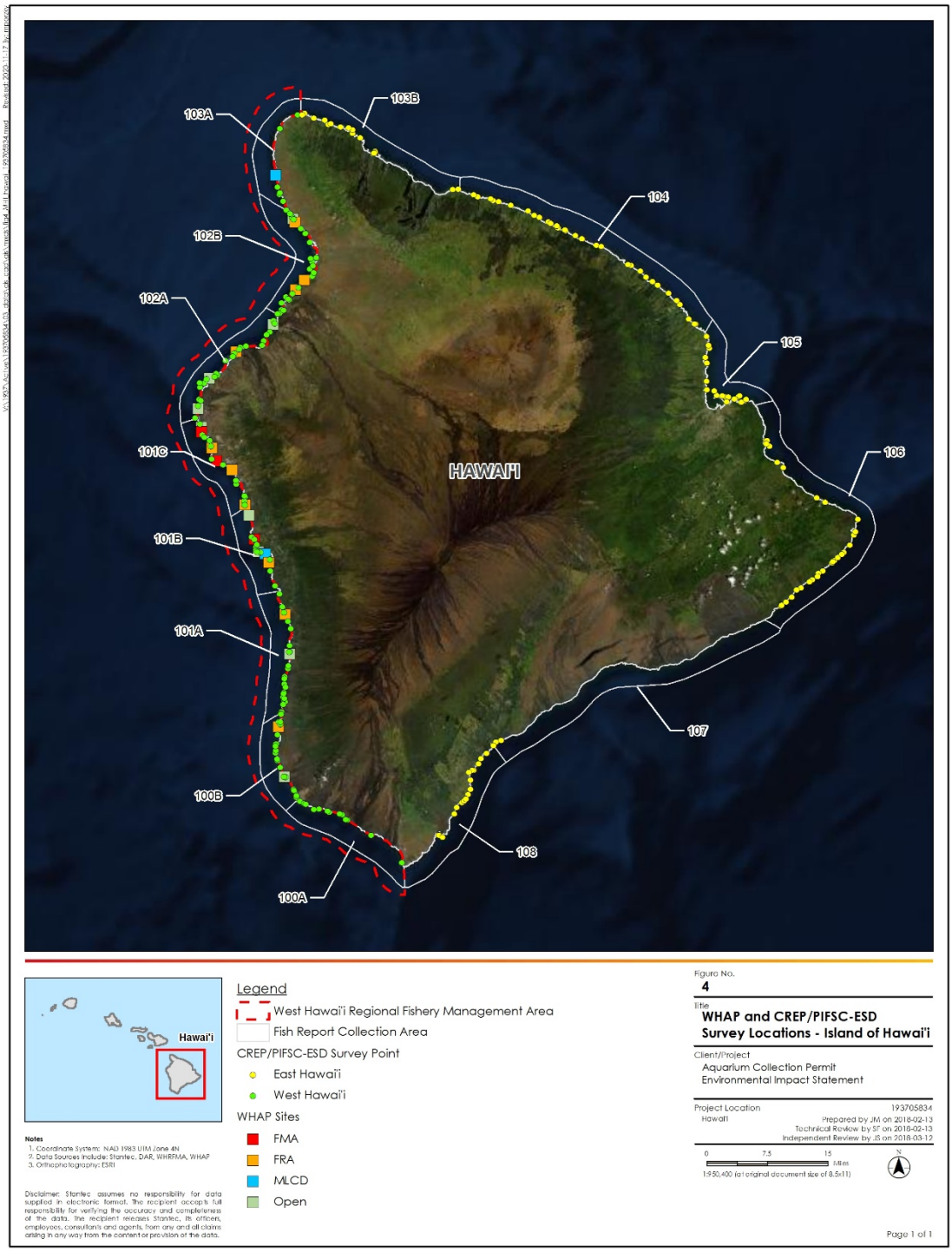


Figure 4. WHAP and PIFSC-ESD (formerly CREP) survey locations – Island of Hawai'i.

Surveys are conducted around the island of Hawai'i at 257 stationary point count locations (Figure 4) with a randomized depth-stratified design, at depths from 0-98 feet (approximately 0-30 meters). At each point count location, divers conducted fish counts, estimated benthic cover, and habitat structural complexity. Typically, 3–5 days were spent at each island during each visit (generally once every 3 years), conducting 30–50 fish surveys during that time. Detailed explanations of the study sites and survey methods are found in Heenan et. al (2017). To establish survey points, an approximately 98-foot (30-meter) transect is measured out along the substrate. For each point count, a pair of divers conducts simultaneous counts in adjacent 49.2 foot (15 meter) cylindrical plots along the transect (i.e., diver 1 surveys from the 7.5 meter mark along the transect and diver 2 surveys from the 22.5 meter mark) extending from the substrate to the limits of vertical visibility (Heenan et. al 2017).

Each fish count consists of two parts, a 5-minute species enumeration in which divers generate a list of taxa observed within their cylinder to species when possible; and, a tally portion in which divers systematically work through their species list recording the number and estimated size of fish present within the cylinder. Tallying is done by conducting a series of rapid visual sweeps of the plot with one species-group (e.g., mid-water, surgeonfish, benthic butterflyfish) counted per sweep. At the end of the sweeps, divers carefully search for small, site-attached, and semi-cryptic species. Surveys were not conducted if horizontal visibility was <25 feet (Heenan et. al 2017).

To facilitate analysis in this Revised FEIS, PIFSC-ESD provided the Applicant with the estimated population size for each White List Species for the island of Hawai'i by converting survey counts to abundance per unit area, and then multiplying by the estimated area of hardbottom habitat in <30 meters of water (8,995 Ha in East Hawai'i and 5,727 Ha in the WHRFMA). Approximate confidence intervals (95%) were estimated using two times the standard error of the estimated population size, as provided by PIFSC-ESD, with the lower bound set to zero when needed since populations cannot be negative.

Although PIFSC-ESD data are the most comprehensive data publicly available for the island of Hawai'i, certain limitations of the surveys may lead to an underestimate of some populations of aquarium fish. Specifically, surveys are concentrated into a short period of survey effort (about one month each year) located in different locations from one year to the next, allowing for a larger coverage of the entire island. Also, population estimates may be an underestimate for certain species as surveys were only conducted at depths <30 meters (approximately 98 feet) in areas of hardbottom habitat. No data were collected from softbottom habitat, as these tend to not be important habitats for most aquarium species, but certain species may utilize these areas, and therefore are not represented in the population estimate. No data were collected from depths greater than 30 meters (approximately 98 feet), but certain species may utilize these areas as well, and are therefore not represented in the population estimate. In addition, divers are trained in the identification of aquarium fish; however, certain species may be cryptic, skittish, or difficult to identify in the field, which may lead to underestimates of the population of those species. All data collection methods have a range of variation, or uncertainty. For the PIFSC-ESD data, this results in a mean estimate, as well as a high and low range for the mean population estimates (Table 5-16). For the purposes of this Revised FEIS, the mean was used to assess impacts.

4.4.7.3 WHAP and PIFSC-ESD Survey Comparison

Both the WHAP and PIFSC-ESD collect data on fish populations in nearshore waters of the island of Hawai'i that are available and appropriate for estimating population size, within the limitations of each survey (e.g., spatial coverage, depth range), and for analysis of the impact of fish collection under Aquarium Permits. In addition, both surveys collect data on the physical conditions at each survey site. The following provides a side by side comparison of some of the parameters of each survey method.

WHAP	PIFSC-ESD
• 25 survey sites with 4 transects (82x13 foot long) each (100 transects total), in specific areas (FRAs, MPAs, Open Areas) along west coast of Hawai'i	• 257 point counts covering entire island of Hawai'i except collection zone 107
• 30-60-foot depth survey area	• 0-98-foot depth survey area
• 4-6 survey rounds per year	• 30-50 surveys at least once every 3 years
• 8,712 transects completed (1999-2018)	• Surveys conducted in 2010, 2013, 2014, 2015, 2016, and 2019
• Visually estimated fish density, benthic cover, and habitat structural complexity	• Fish counts, estimated benthic cover, and habitat structural complexity

The WHAP data are collected from 25 transect survey sites located within the WHRFMA (Figure 4) and are designed to estimate fish densities over time within the WHRFMA between depths of 30-60 feet. By design, the WHAP focuses on the WHRFMA and does not have full spatial coverage of the island of Hawai'i; therefore, data generated by the WHAP cannot be used to develop population estimates for East Hawai'i. In addition, because WHAP estimates population size at depths from 30-60 feet, shallow- and deep-water species (or life phases of species) that spend time outside the 30-60-foot depth range are not adequately surveyed by WHAP transects.

The PIFSC-ESD data are collected on all reef fish species for the Pacific islands, including from 257 stationary point count locations located around the island of Hawai'i, with the exception of collection zone 107 (Figure 4), from depths of 0-98 feet, providing an assessment of fish populations in both shallow and some deep-water habitats. Deep-water species (or life phases of species) that spend time below the 98-foot depth range are not adequately surveyed by PIFSC-ESD.

Differences in study design between the two surveys result in differences in how data are collected and analyzed. However, when PIFSC-ESD data collected at a similar depth as those collected by the WHAP are compared, the population estimates collected by the two surveys are more similar. Both data sets are presented and analyzed in this Revised FEIS. However, due to the larger spatial coverage and greater range of depths surveyed by the PIFSC-ESD, PIFSC-ESD data were considered to be a better estimator of island-wide fish populations (and provide the only population estimates for East Hawai'i), and therefore

serve as the primary basis for the impact analysis found in Section 5.0. Additionally, while collection in the WHRFMA would occur only within the Open Areas of the WHRFMA, there is evidence for connectivity between FRAs and Open Areas (Christie et al. 2010), therefore, analyzing the impacts on just the Open Area populations is not representative of the impact. As such, analysis of impacts based on the WHAP Open Area and WHRFMA population estimates is provided for comparison purposes in Section 5.0.

5.0 ENVIRONMENTAL CONSEQUENCES

This section discusses the impacts of implementing the No Action Alternative, the CML-only Alternative, the Pre-Aquarium Collection Ban Alternative, the WHRFMA-only Programmatic Permit Alternative, the Achilles Tang Conservation Alternative, the Limited Permit Issuance Alternative, and the Revised White List and Limited Permit Issuance Alternative on resources retained for further analysis. Aspects of the environment that may be affected by the alternatives are discussed to the level of detail commensurate with the potential effect. Those aspects of the environment that would not be affected are discussed briefly. The content, intensity, and likelihood of the impact were taken into consideration in the making of these ratings.

Direct, indirect, and cumulative impacts are evaluated for each resource. The temporal scope of the impacts analysis is five years, because the WHRFMA management plan is reviewed every five years by the DLNR in cooperation with the University of Hawai'i (DAR 2019a). Reviews have been completed for the 2010, 2015, and 2020 Legislatures (DAR 2019c), and the next review will occur for the 2025 Legislature.

The HEPA does not specifically define direct and indirect impacts. As such, for the purposes of this Revised FEIS, the National Environmental Policy Act (NEPA) definitions are used. The NEPA defines direct effects as those effects that are caused by the action and occur at the same time and place (40 Code of Federal Regulations [CFR] § 1508.8(a)). Indirect effects include effects later in time or farther removed in distance but are still reasonably foreseeable (40 CFR § 1508.8(b)). Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems (40 CFR § 1508.8).

The HEPA Guide (OEQC 2014) indicates that an EIS needs to consider all mitigation measures to avoid, minimize, rectify, or reduce adverse impacts. Therefore, mitigation is only considered for alternatives with a significant adverse impact.

The HEPA defines cumulative impacts as the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (HAR Section 11-200-2).

Cumulative impacts were analyzed according to a tiered approach, which allows for a resource-specific analysis of regional and local actions and narrows the focus to those impacts with direct influence on the proposed action and agency decision-making. Following this approach, the cumulative impacts analysis

focused on potential impacts to White List Species, non-White List Species, SGCN, and reef habitat as these are the resources with the potential for on-going impacts due to commercial aquarium fish collection. The spatial analysis area for cumulative impacts is the nearshore waters of the island of Hawai'i down to 600 feet (100 fathoms), with emphasis on the WHRFMA. As stated in Section 4.4, there is evidence that reef fish around the island of Hawai'i are genetically separated from the rest of the MHI, therefore, the spatial extent of cumulative impacts was limited to the island of Hawai'i.

5.1 HRS §189-3 AND DATA ANALYSIS

HRS §189-3 states:

> *(a) Upon the demand of the department, every commercial marine licensee shall furnish to the department a report or reports with respect to the marine life taken and any other information the department may require for the purposes of this section.*
>
> *(b), "Any information submitted to the department by any person in compliance with any requirement under this section shall be confidential and shall not be disclosed, except when required under court order or pursuant to subpoena issued by the department of the attorney general, or with the prior written consent of the person submitting the information, or under cooperative agreements with government agencies of the United States for exchange and use of the information specifically to manage marine life. The department, by rule, may establish procedures necessary to preserve the confidentiality, except that the department may release or make public any of the information in the aggregate or summary form which does not directly or indirectly disclose the identity of any person who submits information."*

The DAR complies with this statute by keeping confidential any catch data when less than three collectors report from an individual collection zone (Figure 1). Collection zones depicted in Figure 1 correspond to areas defined by the monthly report fishers are required to provide to DAR. Confidential data are identified as *n.d.* (not disclosed) in the tables in Section 5.0. The impact of this statute on data analysis is minimal but can cause confusion when numbers in the text or in the tables do not exactly match up, or do not match previously published reports for which the *n.d.* data were available (i.e., DAR reports). Although it is possible for 1-2 aquarium fishers to collect large numbers of fish and skew the data, this concern was minimized by the manner in which data were analyzed. Data provided by the DAR for this Revised FEIS were evaluated using many parameters, thereby minimizing bias due to confidentiality. The data were also viewed in aggregate and over extended time periods (i.e., 2000-2017) to further minimize confidentiality issues. Additionally, the 10 fishers who would receive Aquarium Permits under the Limited Permit Issuance Alternative, including the 7 fishers who would receive permits under the Proposed Action, waived their right to confidentiality, so all data from these 10 fishers were released for analysis in the EIS for the WHRFMA and East Hawai'i from 2000 through 2017. These historic data are presented for the 10 fishers combined, as needed for the analysis of the Limited Permit Issuance Alternative but are not provided separately for the 7 fishers as their impacts would be limited by the individual catch quotas.

5.2 SOCIOECONOMIC RESOURCES

The No Action Alternative would not involve any aquarium collection. Socioeconomic impacts are calculated based on historic trends for the CML-only Alternative, Pre-Aquarium Collection Ban Alternative, WHRFMA-only Alternative, Achilles Tang Conservation Alternative, and the Limited Permit Issuance Alternative. Socioeconomic impacts are calculated based on the individual catch quotas (Section 3.7.1) for the Revised White List and Limited Permit Issuance Alternative. Therefore, historic trend data are provided for the entire fishery and for the 10 fishers who would be issued permits under the Limited Permit Issuance Alternative but are not applicable for the 7 fishers who would be issued permits under the Revised White List and Limited Permit Issuance Alternative. Table 5-1 summarizes how impacts are calculated by alternative for the WHRFMA and East Hawai'i.

Table 5-1. Summary of socioeconomic impact analysis by alternative.

Alternative	WHRFMA	East Hawai'i
No Action	None (no collection)	None (no collection)
CML-Only	None (no collection)	Follow 2018-2019 collection trends
Pre-Aquarium Collection Ban	Follow historic (2000-2017) trends	Follow historic (2000-2017) trends
WHRFMA-Only Programmatic Issuance of Aquarium Permits	Follow historic (2000-2017) trends	Follow historic (2000-2017) trends
Achilles Tang Conservation	Follow historic (2000-2017) trends, with a small decrease due to decreased catch of Achilles Tang	Follow historic (2000-2017) trends
Limited Permit Issuance	Follow historic (2000-2017) trends of the 10 fishers who would be issued permits	None (no collection)
Revised White List and Limited Permit Issuance (Preferred) Alternative	Based on individual catch quotas, issuance of 7 permits, and historic price per fish for the 8 species on Revised White List	None (no collection)

5.2.1 Direct Impacts

As noted in Section 4.1.1, the East Hawai'i aquarium fishery represents only a small portion (4.5%) of the overall value of the fishery on the island of Hawai'i and an even smaller portion of the overall value of the fishery in the state of Hawai'i. Table 4-2 (Section 4.1.1) shows the annual average of the East Hawai'i fishery for the period from 2000-2017 was approximately $73,067 (inflation-adjusted 2020 dollars), as compared to the $1.5 million (inflation-adjusted 2020 dollars) of the WHRFMA. Since the closure of the WHRFMA to commercial aquarium collection in October 2017, data disclosed from fishers in East Hawai'i reported sales of $366,434 of finfish during the 2018 calendar year (DAR 2019b), which is 5 times the historic average value and 2.6 times the maximum reported value from 2000 to 2017 (Table 5-2). Therefore, while the focus of this section is on the WHRFMA and its socioeconomic impacts, East Hawai'i data are

included due to their importance for the CML-only Alternative, under which no commercial aquarium collection would be allowed to occur within the WHRFMA, as well as other alternatives which would include collection in East Hawai'i either with or without the use of fine mesh nets.

Total ex-vessel value (i.e., price received by a fisher for the catch) for the 10 fishers in the WHRFMA ranged from a low of $14,492 in 2001 to a high of $670,546 in 2010, with an average of $328,192 (inflation-adjusted 2020 dollars; Table 5-2). During the period from 2000 – 2017, the 10 fishers made up from 2.0% to 38.6% of the total economic value of the WHRFMA aquarium fishery (Table 5-2). Total ex-vessel value for all aquarium collectors in the WHRFMA ranged from a low of $735,821 in 2000 to a high of $1,872,346 in 2010, with an average of $1,425,034 (inflation-adjusted 2020 dollars; Table 5-2). Total ex-vessel value for the state of Hawai'i ranged from a low of $1,340,774 in 2002 to a high of $2,723,388 in 2015, with an average of $2,183,880 (inflation-adjusted 2020 dollars) (Table 5-2). The 2017 ex-vessel inflation-adjusted value for the 10 fishers within the WHRFMA was $524,168; all aquarium fish collection in the WHRFMA was $1,357,962; and aquarium fish collection in the state of Hawai'i was $2,034,076 (Table 4-1 and Table 4-2).

Table 5-2. Minimum, maximum and average market values of the commercial aquarium fishery from 2000 through 2017 (inflation-adjusted 2020 values). See Table 4-2 for additional data by year. These data are applicable to the analysis of the No Action, CML-only, Pre-Aquarium Collection Ban, WHRFMA-only Programmatic Issuance of Aquarium Permits, Achilles Tang Conservation, and Limited Permit Issuance alternatives.

		Minimum	Maximum	Average
East Hawai'i	All Fishers	$17,725	$142,844	$63,708
WHRFMA	All Fishers	$735,821	$1,872,346	$1,193,656
	10 Fishers	$14,492	$670,546	$328,192
State of Hawai'i	All Fishers	$1,340,774	$2,723,388	$2,183,880

It should be noted that the dollar value of these fisheries represents only the ex-vessel value, what the fishers are paid for their catch, and does not include the value which would be generated by additional dealer and retail sales. The actual economic value of the catch is thus substantially greater than the ex-vessel value and is discussed in further detail in the indirect impacts section below.

According to data presented in DAR (2019a), the market value of the WHRFMA has increased by 143% between 2000 and 2017, growing from a value of $530,842 in 2000 to a value of $1,290,316 in 2017 (DAR 2019a)[11],representing a 5.36% annual growth rate[12].

All commercial aquarium collectors must obtain a state Aquarium Permit and a CML, which allows them to offer the fish for sale. The Aquarium Fish Catch Report requirement is triggered by the CML. In the past, some collectors participated in a dive team. To avoid duplicate fish catch reporting, only a principal diver

[11] This value does not match that reported in this EIS from 2000, likely due to confidentiality rules (see Section 5.1).

[12] $Annual\ Percent\ Growth = \left[\frac{2017\ value}{2000\ Value}^{1/17} - 1\right] * 100$

was required to report the catch and effort for the dive team (DAR, pers. comm., 2018). This process ensures that reported catch data are not duplicated in the State's system. However, this reporting mechanism can lead to confusion by outside observers, as the total number of permit holders is higher than the number of permit holders reporting data (Table 4-1), giving the appearance of under reporting. Analysis by the DAR (2014a) has shown that actual underreporting of catch is small, with a 3.5% difference between the number of animals reported caught and sold in 2010 and a 0.4% difference in 2014, which likely represent live releases and mortality. For the period 2000 to 2017, the total number of permit holders for the WHRFMA ranged from 24 to 63 (average = 46), while the number of permit holders reporting ranged from 19 to 42 (average = 28). In 2017, it is estimated that up to 57 individuals were directly employed in the commercial aquarium fishery in the WHRFMA (up to 226 employed in the state of Hawai'i).

5.2.1.1 No Action Alternative

Under the No Action Alternative, commercial collection of aquarium fish would not occur in the WHRFMA or in East Hawai'i. This represents a loss of approximately 57 jobs and $1.67 million annually from the state of Hawai'i's economy compared to the Pre-Aquarium Collection Ban Alternative, which is less than 0.02% of the $8.6 billion ocean economy in Hawai'i, and even less of Hawai'i's economy overall.

5.2.1.2 CML-only Alternative

Under the CML-only Alternative, commercial collection of aquarium fish would not occur in the WHRFMA. In East Hawai'i, an unlimited number of CMLs for commercial aquarium collection would be issued, and aquarium collection using legal gear or methods other than fine-mesh nets would occur. Commercial aquarium fishers may no longer find it feasible to target aquarium fish and may begin to participate in other fisheries, but this is not possible to quantify at this time.

Under the CML-only Alternative, some aquarium collection is anticipated to occur using legal gear or methods other than fine mesh nets. After the closure of the WHRFMA to commercial aquarium collection in October 2017, based on data disclosed by the DAR, East Hawai'i reported sales of $366,434 during the 2018 calendar year (DAR 2019b), which is 5 times the historic average value and 2.6 times the maximum reported from 2000 to 2017 (Table 5-2).

In East Hawai'i, under the CML-only Alternative, it is estimated that the commercial aquarium fishery would add approximately $366,434 to the state of Hawai'i's economy in the first year of the 5-year analysis period based on what occurred in 2018 (DAR 2019b). Assuming a 5.36% annual growth rate, this would total approximately $2 million over the 5-year analysis period (average of $407,878 per year) and an unknown number of jobs (assumed to be <57) under the CML-only Alternative. This would represent an increase in East Hawai'i of over $1.6 million compared to the Pre-Aquarium Collection Ban Alternative, though there would also be a loss of approximately $7.9 million in the WHRFMA when compared to the Pre-Aquarium Collection Ban Alternative.

An increase in the East Hawai'i commercial aquarium fishery value may offset some of the loss from the WHRFMA fishery under the CML-only Alternative, but the fishery as a whole would still add approximately $6.3 million less to the economy over the 5-year analysis period than under the Pre-Aquarium Collection Ban Alternative, or $1,259,660 less per year (on average). This represents an annual loss of approximately

0.01% of the $8.6 billion ocean economy in Hawai'i, and an even lesser percentage of the overall Hawai'i economy.

5.2.1.3 Pre-Aquarium Collection Ban Alternative

Under the Pre-Aquarium Collection Ban Alternative, an unlimited number of Aquarium Permits would be issued for the use of fine-mesh nets within the WHRFMA and East Hawai'i, and it is assumed for this analysis that fishing trends, including the value and sales of fish, would follow historic trends (see Table 4-2). Based on historic data collected prior to the October 2017 ban on commercial aquarium collection, under the Pre-Aquarium Collection Ban Alternative the commercial aquarium fishery is estimated to create approximately 57 jobs, and add an average of approximately $1,498,101 (inflation-adjusted 2020 dollars, based on $1,425,034 from the WHRFMA and $73,067 from East Hawai'i) to the state of Hawai'i's economy during the first year of the 5-year analysis period. Assuming an annual growth rate of 5.36%, this would total over $8.3 million over the 5-year analysis period (average of $1.67 million per year). This represents less than 0.02% of the $8.6 billion ocean economy in Hawai'i, and even less of Hawai'i's economy overall.

5.2.1.4 WHRFMA-only Programmatic Issuance of Aquarium Permits Alternative

Under the WHRFMA-only Programmatic Issuance of Aquarium Permits Alternative, an unlimited number of Aquarium Permits would be issued for the use of fine-mesh nets within the WHRFMA, but fine-mesh nets would not be allowed in East Hawai'i. The impact on socioeconomics within the WHRFMA would be creation of an estimated 57 jobs, as well as the addition of approximately $1,425,034 (inflation-adjusted 2020 dollars) to the state of Hawai'i's economy during the first year of the 5-year analysis period. This value would likely grow by approximately 5.36% each year, for a total value of $7.9 million over the 5-year analysis period (average of $1,586,208 per year).

In East Hawai'i, given that the WHRFMA would be open to fishing with the use of fine mesh nets, impacts to the economy would be anticipated to be similar to the Pre-Aquarium Collection Ban Alternative, or even potentially decrease since fishing in the WHRFMA may provide more favorable given the use of fine mesh nets. Therefore, it is anticipated that aquarium fish collection in East Hawai'i would add, at most, $73,067 in the first year, and given an annual growth rate of 5.36%, a total of $406,655 over the 5-year analysis period (average of $81,331 per year), or less. Thus, this alternative overall would add $7.9 to $8.3 million to the economy over the 5-year analysis period.

Assuming an average of $1,586,208 per year from the WHRFMA, and $81,331 per year from East Hawai'i, the total of $1.67 million represents less than 0.02% of the $8.6 billion ocean economy in Hawai'i, and even less of Hawai'i economy overall.

5.2.1.5 Achilles Tang Conservation Alternative

The Achilles Tang Conservation Alternative would include issuance of an unlimited number of Aquarium Permits for the WHRFMA and East Hawai'i, and implementation of a bag limit of 5 Achilles Tang per day, resulting in an estimated 50% reduction in the number of Achilles Tang collected by the commercial aquarium fishery (due to a 50% reduction in the current bag limit of 10 Achilles Tang). Estimated value of the Achilles Tang catch in the WHRFMA since the 2014 bag limit was imposed has been $135,627 (2015),

$129,876 (2016), and $130,853 (2017). The worst-case scenario under the Achilles Tang Conservation Alternative would be that the income from Achilles Tang would be cut in approximately half (average of $66,059 decrease in income based upon the past three years). This represents approximately 4.6% of the average economic value of the WHRFMA ($1,425,034 per year).

This impact may be buffered however, as the cost per fish may increase as the supply of Achilles Tang decreases, negating any socioeconomic impact to the fishers. If this were to be case, the socioeconomic impact of the bag limit would be seen on the consumer side (i.e., those purchasing aquarium fish, who would have to pay a higher premium due to decreased supply).

However, assuming that the impact is $60,059 of the WHRFMA value, the Achilles Tang Conservation Alternative would add approximately $1,364,975 in the first year of analysis, and assuming an annual growth rate of approximately 5.36%, the WHRFMA would add approximately $7.6 million over the 5-year analysis period (average of $1,519,356 per year).

Impacts in East Hawai'i would remain the same as the Pre-Aquarium Collection Ban Alternative (as no bag limit would be implemented there), for a total of $406,655 over the 5-year analysis period (average of $81,331 per year). Combined, the WHRFMA and East Hawai'i would add approximately $8 million to the economy over the 5-year analysis period (average of $1,600,687 per year). The represents less than 0.02% of the $8.6 billion ocean economy in Hawai'i, and even less of Hawai'i economy overall.

5.2.1.6 Limited Permit Issuance Alternative

Under the Limited Permit Issuance Alternative, Aquarium Permits would be issued to 10 fishers for the use of fine-mesh nets within the WHRFMA, as well as corresponding CMLs. No commercial aquarium fish collection would be allowed in East Hawai'i. This would create a minimum of 10 jobs for the 10 fishers who would have permits.

The 10 fishers who would receive permits averaged $328,192 per year in the WHRFMA between 2000 and 2017, up to a maximum of $670,546 (based on the maximum from 2010) (inflation-adjusted 2020 dollars; see Table 4-2). Assuming that the first year of the 5-year analysis period would have a market value of $328,192 to $670,546, and applying a 5.36% annual growth rate, the Limited Permit Issuance (Preferred) Alternative would add from $1.8 to $3.7 million over the 5-year analysis period (average of $365,311 to $746,386 per year). Therefore, under this alternative, the commercial aquarium fishery would represent less than 0.01% of the $8.6 billion ocean economy in Hawai'i, and an even smaller percentage of the overall economy in the State (see Section 4.1).

5.2.1.7 Revised White List and Limited Permit Issuance (Preferred) Alternative

Under the Revised White List and Limited Permit Issuance (Preferred) Alternative, Aquarium Permits would be issued to 7 fishers for the use of fine-mesh nets in the WHRFMA, as well as corresponding CMLs. No commercial aquarium collection would be allowed in East Hawai'i. This would create a minimum of 7 jobs for the 7 fishers who would have permits.

These 7 fishers would each be allowed to collect and sell a limited number of each of the 8 species on the proposed Revised White List (see Section 3.7.1). Based on the average, minimum and maximum per-fish

sale values from 2017 (see Section 4.1.1), and assuming that each fisher reached their individual catch quota for each species, the Revised White List and Limited Permit Issuance (Preferred) Alternative would add an average of $1,059,640 to the economy each year, ranging from a minimum of $499,416 to a maximum of $2,022,686 (Table 5-3).Annual growth, if it did occur, would not be the result of increased collection since the total allowable catch would not change. Growth could occur based on an increase in the market value of the species on the proposed Revised White List, but what that growth might be cannot be estimated at this time.

Table 5-3. Predicted gross annual sales based on average, minimum and maximum per fish values (see Section 4.1.1) from 2017 and assuming the entire individual catch quota for each species for each fisher.

Species	Total Potential Catch (7 fishers combined)	Projected Average Annual Sales (minimum to maximum)
Yellow Tang	200,000	$858,000 ($400,000-$1,608,000)
Black Surgeonfish	3,152	$47,280 ($15,760-$94,816)
Orangespine Unicornfish	5,872	$23,488 ($11,744-$63,944)
Kole	30,000	$90,000 ($60,000-$180,000)
Bird Wrasse	344	$1,032 ($344-$3,440)
Potter's Angelfish	4,376	$35,008 ($8,752-$65,640)
Thompson's Surgeonfish	2,016	$4,032 ($2,016-$6,048)
Brown Surgeonfish	800	$800 ($800-$800)
Total WHRFMA Fishery (all 7 fishers)	**n/a**	**$1,059,640 ($499,416-$2,022,686)**

Therefore, over the 5-year analysis period, the Revised White List and Limited Permit Issuance (Preferred) Alternative would add an estimated $499,416 to $2,022,686 per year, for a total of $2.5 to $10.1 million. Therefore, under this alternative, the commercial aquarium fishery in the WHRFMA would represent up to approximately 0.02% of the $8.6 billion ocean economy in Hawai'i, and an even smaller percentage of the overall economy in the State (see Section 4.1).

5.2.2 Indirect Impacts

Indirect socioeconomic impacts of the commercial aquarium fishery would primarily involve the additional profits from the aquarium fish market (including freight and packaging), as well as other tourist businesses such as snorkel and dive operations that rely on seeing and interacting with a healthy reef ecosystem. The presence of a healthy reef ecosystem may also impact overall land/home values on the island of Hawai'i.

As described in Section 4.1.1, the total sales of the Hawaiian aquarium fishery (including freight and packaging) is nearly six times the ex-vessel value (Walsh et al. 2003). Therefore, it is estimated that the

commercial aquarium fishery indirectly adds approximately five times the direct socioeconomic costs described in Section 5.2.1 to the economy.

5.2.2.1 No Action Alternative

Under the No Action Alternative, no commercial aquarium fishing would occur in the WHRFMA or in East Hawai'i, and the direct economic impacts include a loss of approximately $8.3 million over the 5-year analysis period when compared with the Pre-aquarium Collection Ban Alternative. A direct loss of $8.3 million would represent an indirect loss of approximately $41.5 million over the 5-year analysis period, or an average of $8.3 million per year, representing less than 0.01% of the annual $84.9 billion gross domestic product of Hawai'i.

Under the No Action Alternative, no interaction between other tourist operations and commercial aquarium fishers would occur in the WHRFMA or in East Hawai'i. No scientific data exist to suggest that in the absence of aquarium fishers an increase in other tourist operations would occur.

5.2.2.2 CML-only Alternative

Under the CML-only Alternative, no commercial aquarium fishing would occur in the WHRFMA, but aquarium fishing in East Hawai'i would occur using methods other than fine-mesh nets.

The commercial aquarium industry in East Hawai'i is expected to add approximately $2 million over the 5-year analysis period to the economy under the CML-only Alternative, for an indirect economic benefit of approximately $10 million over the 5-year analysis period, or an average of $2 million per year, representing <0.01% of the annual $84.9 billion gross domestic product of Hawai'i.

Based on the direct economic loss of approximately $6.3 million over the 5-year analysis period under the CML-only Alternative when compared to the Pre-Aquarium Collection Ban Alternative (this loss is described in Section 5.2.1.2), approximately $31 million in indirect economic benefits of this fishery would not occur over the 5-year analysis period, or an average of $6.3 million per year, representing <0.01% of the annual $84.9 billion gross domestic product of Hawai'i.

Under the CML-only Alternative, no interaction between other tourist operations and commercial aquarium fishers would occur in the WHRFMA; however, interactions in East Hawai'i would occur and may increase over historic levels due to increased use of the area by aquarium fishers.

No scientific data exist to suggest that in the absence of aquarium fishers an increase in other tourist operations would occur.

5.2.2.3 Pre-Aquarium Collection Ban Alternative

Under the Pre-Aquarium Collection Ban Alternative, commercial aquarium fishing would occur in the WHRFMA and East Hawai'i using fine mesh nets, and it is assumed for this analysis that fishing trends, including the value and sales of fish, would follow those prior to the October 2017 commercial aquarium collection ban (see Table 4-2). Based on the direct economic value of $8.3 million over the 5-year analysis period, the commercial aquarium fishery would indirectly add an additional $41.7 million under the Pre-

Aquarium Collection Ban Alternative to the economy of Hawai'i, or an average of $8.3 million per year, representing <0.01% of the annual $84.9 billion gross domestic product of Hawai'i.

Indirect socioeconomic impacts between commercial aquarium fishers, dive tour operators and subsistence/cultural fishers are possible if the commercial aquarium fishing leads to a decrease in demand for snorkel and scuba tours or a decrease in availability of species of fish targeted for subsistence/cultural fishing activities. As the number of commercial aquarium collectors in West Hawai'i began to rise in the 1980s conflicts between dive tour operators and commercial aquarium collectors began to increase. A short-lived informal "Gentleperson's Agreement" was reached in 1987 whereby aquarium collectors agreed to refrain from collecting in certain areas. In return, charter operators agreed not to initiate legislation opposing collecting and to cease harassment. In 1991, four of the areas from the Gentleperson's Agreement were established as the Kona Coast Fisheries Management Area (FMA) within which aquarium collecting is prohibited (Walsh et al. 2003; HAR §13-58). This, in part, led to the development of the WHRFWG and the WHRFMA, minimizing indirect impacts to other, tourist related industries (e.g., dive and snorkel operations), and subsistence and/or cultural fishing. In addition, the average collection of 30 of the 36 White List Species with available population estimates is below 1% of their estimated PIFSC-ESD WHRFMA populations and collection of 5 of the remaining three species would be less than 5% of their PIFSC-ESD population estimate (Section 5.4.1.3). The Achilles Tang is the only species projected to be collected at more than 5% of the estimated population, though average collection is still below 25%. The small percentage of fish collected over multiple areas would be imperceptible to the average observer.

Available data do not suggest that the Pre-Aquarium Collection Ban Alternative has impacted the tourism industry or land values in Hawai'i. Hawai'i's tourism industry achieved new records in total visitor spending and visitor arrivals in 2017, marking the sixth consecutive year of record growth in both categories. Total spending by visitors to the Hawaiian Islands increased 5.6% to a new high of $16.81 billion (HTA 2018). When adjusted for inflation, total visitor spending was up 3.5% from 2016 (Figure 3). A total of 9,404,346 visitors came by air or by cruise ship to the state, up 5.3% from the previous record of 8,934,277 visitors in 2016. Total visitor days rose 4.8% compared to 2016. The average spending per day by these visitors ($198 per person) was also higher than 2016 ($197 per person; HTA 2018).

Despite the housing crisis and recent recession, the average sale price of homes steadily increased in Hawai'i from 2011 to 2014 after a few years of year-to-year fluctuation. The average sale price of homes in 2014 was $594,440, which was 26.4% higher than the average sale price in 2011. A rapid price increase was observed particularly in 2013 and 2014. The average sale price in 2013 and 2014 was about 10%higher than the price in the prior year. In 2015, the total number of home sales increased by 9.3%, but the average sale price was 0.3% lower than the previous year (HDBEDT 2016). These price increases occurred while commercial aquarium collection was also occurring, suggesting that collection is not impacting home values.

Under the Pre-Aquarium Collection Ban Alternative, a portion of the direct and indirect income from this fishery (total of $50 million over the 5-year analysis period) would be put back into Hawai'i's economy through re-investment efforts in terms of equipment, maintenance, supplies, and personnel.

In addition, while the aquarium fishery directly employs permitted collectors, these collectors hire staff/assistants, sell their catch to wholesalers, who in turn get the fish to the market, which includes pet

stores and their customers (Dierking 2002). This economic value is represented in the $41.7 million indirect economic benefit, but there are also jobs, which cannot be quantified at this time.

5.2.2.4 WHRFMA-only Programmatic Issuance of Aquarium Permits Alternative

Under the WHRFMA-only Programmatic Issuance of Aquarium Permits Alternative, it is assumed that the indirect socioeconomic impacts in the WHRFMA would be similar to the Pre-Aquarium Collection Ban Alternative (Section 5.2.2.3). In East Hawai'i, the impacts may be similar to the CML-only Alternative, though with the WHRFMA open to fishing with the use of fine mesh nets, aquarium fish collection in East Hawai'i may return to levels seen under the Pre-Aquarium Collection Ban Alternative, or even decrease since fishing in the WHRFMA may prove more favorable given the use of fine mesh nets. Based on the $7.9 to $8.3 million in direct economic benefits under the WRFMA-only Programmatic Issuance of Aquarium Permits Alternative, the indirect economic benefits would range from $39.7 to $41.7 million ($7.9 to $8.3 million per year), representing <0.01% of the annual $84.9 billion gross domestic product of Hawai'i.

5.2.2.5 Achilles Tang Conservation Alternative

The indirect impacts of the Achilles Tang Conservation Alternative would be similar to those of the Pre-Aquarium Collection Ban Alternative (Section 5.2.2.3), though the indirect economic benefits may decrease to $40 million in line with the direct economic decrease, representing <0.01% of the $84.9 billion annual gross domestic product of Hawai'i. The reduction in the Achilles Tang bag limit may make the species more visible to divers and snorkelers.

5.2.2.6 Limited Permit Issuance Alternative

Under the Limited Permit Issuance Alternative, Aquarium Permits and CMLs would be issued for 10 fishers for the use of fine-mesh nets within the WHRFMA. Based on the direct economic benefit of $1.8 to $3.7 million over the 5-year analysis period, an indirect economic benefit of $9.1 to $18.7 million would be added to the economy, representing <0.01% of the $84.9 billion annual gross domestic product of Hawai'i.

Other indirect impacts of the Limited Permit Issuance Alternative would be similar to those of the Pre-Aquarium Collection Ban Alternative (Section 5.2.2.3). No commercial aquarium collection would occur within East Hawai'i.

5.2.2.7 Revised White List and Limited Permit Issuance (Preferred) Alternative

Under the Revised White List and Limited Permit Issuance (Preferred) Alternative, Aquarium Permits and CMLs would be issued for 7 fishers for the use of fine-mesh nets within the WHRFMA, and catch would be limited to the 8 species on the proposed Revised White List and to the individual catch quotas set for each species. Based on the direct economic benefit of $2.5 to $10.1 million over the 5-year analysis period, an indirect economic benefit of $12.5 to $50.5 million would be added to the economy, representing approximately 0.06% of the $84.9 billion annual gross domestic product of Hawai'i.

Other indirect impacts of the Limited Permit Issuance Alternative would be similar to those of the Pre-Aquarium Collection Ban Alternative (Section 5.2.2.3), though collection of 32 of the 40 White List Species would not occur, including the Achilles Tang, and no impacts would occur in East Hawai'i.

5.2.3 Cumulative Impacts

For the period 2000 to 2017, the commercial aquarium fishery within the WHRFMA added an average of $1,425,034 (inflation-adjusted 2020 dollars) annually to the state of Hawai'i's economy, while the overall aquarium fishery within the state of Hawai'i added an average of $2,183,880 (inflation-adjusted 2020 dollars) (Table 4-2). Thus, the WHRFMA aquarium fishery accounts for approximately 65% of the overall aquarium fishery within Hawai'i. In 2016, the overall Gross Domestic Product (GDP) of Hawai'i was $84.9 billion, of which, the commercial aquarium fishery contributed $2,257,021 (0.003%), of which $1,582,011 was from the WHRFMA. Over the 5-year analysis period, it is estimated that the aquarium fishery on Hawai'i would directly add $2 million (under the CML-only Alternative) to $8.3 million (under the Pre-Aquarium Collection Ban Alternative or the WHRFMA-only Alternative) to the state's economy. No contribution to the state's economy would occur under the No Action Alternative since no collection would occur.

All action alternatives under consideration would have a minimal, but beneficial cumulative impact on Hawai'i's overall and ocean socioeconomic resources. The reduction in Achilles Tang bag limit under the Achilles Tang Conservation Alternative and the Limited Permit Issuance Alternative (or their removal from the White List under the Preferred Alternative) may have an effect on the non-aquarium commercial fishery; however, the known catch of Achilles Tang made up approximately 5.5% of the White List Species collected by commercial fishers on the island of Hawai'i, and averages only 454 per year on the Island (see Section 5.4.3.2, Table 5-18). Similarly, the exclusion of 32 species from the White List and introduction of individual catch quotas for the remaining 8 species may have a minimal effect on the non-aquarium commercial fishery. Of the 32 species excluded from the proposed Revised White List, commercial fishing has reported catch of the Achilles Tang (average of 454 per year on the island of Hawai'i), Milletseed Butterflyfish (average of less than 1 per year on the island of Hawai'i), Brown Surgeonfish (average of 8 per year on the island of Hawai'i), Peacock Grouper (average of 72 per year on the island of Hawai'i), Eyestripe Surgeonfish (average of 480 per year on the island of Hawai'i), Orangeband Surgeonfish (average of 157 per year on the island of Hawai'i), and Bluestripe Snapper (average of 4,568 per year; see Section 5.4.3.2). However, most of 32 species excluded from the White List are not collected by commercial fishers on the island of Hawai'i. Of the 8 species on the proposed Revised White List, commercial fishing has reported catch of the Kole (average of 2,093 per year on the island of Hawai'i), Yellow Tang (average of less than 1 per year on the island of Hawai'i), Orangespine Unicornfish (average of 194 per year on the island of Hawai'i), and Black Surgeonfish (average of 82 per year on the island of Hawai'i).

5.3 CULTURAL RESOURCES

5.3.1 Direct and Indirect Impacts

Local fishing for food species in Hawai'i is generally considered a vital social and cultural process, and many local residents in Hawai'i hold a negative view of the aquarium fishery, which is not considered a cultural right that needs to be protected (Rossiter and Levine 2013). Rossiter and Levine (2013) state that this is likely because aquarium fish are not fished for consumption, and the catch does not provide wider benefits to the local community in terms of food or cultural compensation, as well as because the economic benefits are realized only by a very small and often non-indigenous subset of the local population.

A full analysis of the cultural impacts of commercial aquarium collection is found in the Cultural Impact Assessment (CIA) located in Appendix A. As part of the CIA, extensive oral interviews were conducted with numerous individuals from multiple user groups (including cultural practitioners, aquarium collectors, subsistence and commercial fishers, charter boat operators, and researchers) who represent various communities within the WHRFMA. While some of the consulted individuals expressed specific cultural concerns with respect to the White List Species, others stressed the ecological importance of the fish, and the need for them to live out their life cycles in their natural habitats. As evident in the statements made by multiple individuals, the take of fishes for commercial aquarium purposes within the WHRFMA has a long and contentious history, and it remains a point of conflict. As discussed in Section 4.2, detailed in the CIA, and mentioned by commenters during the comment periods of the previous EA and FEIS, many of the 40 White List Species have a cultural significance in Hawai'i, and there are distinct differences between the traditional Native Hawaiian approach to fish harvest and management and the western model approach.

As concluded in the CIA, cultural impacts would occur if issuance of Aquarium Permits under an alternative would cause a significant decline in the population of a White List Species considered to be a cultural resource, either directly through the collection of fish or indirectly through habitat impacts. However, some interviewees expressed the belief that collection for aquarium purposes, regardless of impact or sustainability, is a violation of traditional beliefs (see Appendix A), including traditional and customary practices. Table 4-4 lists the 40 White List Species, and Section 4.4 includes a brief summary of known cultural significance by species. While not all species have a known Hawaiian cultural significance, for this analysis, it was assumed that the 33 species on the White List identified as having a cultural use for food, medicinal, religious or ceremonial purposes could have a negative cultural impact if populations of those species were impacted.

As detailed in Section 5.4, populations of the 40 White List Species are not anticipated to significantly decline under any of the 7 alternatives under consideration. However, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, all six action alternatives may negatively impact cultural practices. No negative cultural impacts would occur under the No Action Alternative. Under the CML-only Alternative, no negative impacts to cultural resources would occur in the WHRFMA, but still may occur in East Hawai'i. Under the Limited Permit Issuance Alternative and the Preferred Alternative, no negative impacts to cultural resources would occur in East Hawai'i but may still occur in the WHRFMA. Under the Preferred Alternative, negative impacts in the WHRFMA would be the least when compared to the other action alternatives due to implementation of the Revised White List (32 species would not be collected at all in the WHRFMA) and individual catch quotas for the remaining 8 on the proposed Revised White List species.

5.3.2 Cumulative Impacts

It is acknowledged that cultural resources, including traditional practices specific to both species and places, have been impacted by past and current actions, and will continue to be impacted by reasonably foreseeable future actions. The cumulative impacts of the seven alternatives under consideration are addressed in this section.

It is not possible to fully quantify the cumulative effects of past and ongoing actions on cultural practices and beliefs. Many users and user groups have collected fish in the waters around the island of Hawai'i for various purposes for centuries. The commercial aquarium fishery has existed in Hawai'i since the late 1940s and in the past the fishery has impacted cultural resources by virtue of the fact that commercial aquarium collection occurs in a culturally significant area (the ocean), and in some instances involves culturally significant species. However, commercial aquarium collection is not the only fishery occurring in the ocean and affecting some of the White List Species, including those with cultural significance (e.g., Achilles Tang) (see Section 5.4.3). Harvest of some of the White List Species by other non-regulated users (e.g., subsistence fishers, non-aquarium commercial and recreational fishers) occurs and is anticipated to continue under any of the seven alternatives under consideration. In addition, other ocean users may indirectly affect reef fish and the reefs they depend on, such as beachgoers using sunscreen, scuba divers and snorkelers affecting fish behavior, and boaters anchoring on top of reefs (see Section 5.4.3.4). Beach and shoreline development may also have effects on reefs and reef fish. In addition to effects on culturally significant White List Species by the various user groups discussed above, climate change resulting in warming ocean temperatures and habitat loss due coral bleaching also affects reef fishes and their populations (see Section 5.4.3.5) including those with cultural significance.

As concluded in the CIA (Appendix A), cultural impacts would occur if a significant decline in the population of a White List Species considered to be a cultural resource occurs. The DAR (2019a) has noted significantly declining populations in one or more management area for 12 of the White List Species, and cumulatively, all of the factors discussed above likely contribute to the declines. Therefore, cumulative cultural resource impacts to these 12 White List Species would occur under any of the four alternatives which include collection of these species in the WHRFMA. No cumulative cultural resource impacts to the remaining 28 White List Species are anticipated, given that populations have remained stable or increased for 24 of those species, and population trend data is not available for the other four species[13]. However, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, any aquarium collection could have a cumulative impact, though that impact cannot be quantified at this time.

As noted above and in Section 5.4.3, the declines for the 12 species are occurring in both areas open and closed to commercial aquarium fishing for all but one species, indicating that aquarium collection is not driving the decline (DAR 2019a). Because these declines are occurring in FRAs and/or MPAs as well (i.e., areas not open to commercial aquarium collection) it is reasonable to assume that banning commercial aquarium collection would not halt the declines. In addition, for the 12 species that have shown a significant decline in population size in one or more management area since establishment of the WHRFMA in 1999, commercial aquarium collection under any of the four alternatives which include collection of these species in the WHRFMA would collect less than 1% of the PIFSC-ESD WHRFMA estimates for 10 of the species (Table 5-21), 2.0%-20.44% for the Achilles Tang, and no population estimate is available for the Pyramid Butterflyfish.

[13] Species not adequately surveyed by WHAP include Tinker's Butterflyfish, Longfin Anthias, Flame Wrasse, and Eyestripe Surgeonfish.

Under the Preferred Alternative, collection of the 12 species showing significantly declining populations would not occur, and therefore while cultural resource impacts may still occur to these species as a result of collection by other user groups and factors such a climate change, commercial aquarium collection would not contribute cumulatively to future declines of these species.

Measures included in the Limited Permit Issuance Alternative (e.g., limited permit issuance, reduced Achilles Tang bag limit) may mitigate potential impacts to cultural resources by limiting the number of Aquarium Permits issued as well as the number of Achilles Tang that can be collected by commercial aquarium collectors each day. These measures may increase the number of Achilles Tang available for cultural practices and traditional subsistence fishers, and potentially decrease user conflict between commercial collectors and subsistence fishers or cultural practitioners.

Measures included in the Preferred Alternative (e.g., limited permit issuance, Revised White List, and implementation of individual catch quotas) will mitigate potential impacts to cultural resources by halting collection of 32 species in the WHRFMA, and by limiting the number of the remaining 8 species which can be collected by any fisher in a given year. These measures may increase the number of White List Species available for cultural practices and traditional subsistence fishers, and potentially decrease user conflict between commercial aquarium collectors and subsistence fishers or cultural practitioners, though conflicts with other user groups may still remain. Although cumulative cultural resource impacts would be lower under the Preferred Alternative, the Applicant acknowledges that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices.

5.4 BIOLOGICAL RESOURCES

The No Action Alternative would not involve any aquarium collection. Biological impacts are calculated based on historic trends for the CML-only Alternative, Pre-Aquarium Collection Ban Alternative, WHRFMA-only Alternative and the Limited Permit Issuance Alternative. Biological impacts are calculated based on the individual catch quotas (Section 3.7.1) for the Revised White List and Limited Permit Issuance Alternative. Therefore, historic trend data are provided for the entire fishery and for the 10 fishers who would be issued permits under the Limited Permit Issuance Alternative but are not applicable for the 7 fishers who would be issued permits under the Revised White List and Limited Permit Issuance Alternative. Table 5-4 summarizes how impacts are calculated by alternative for the WHRFMA and East Hawai'i.

Table 5-4. Summary of biological impact analysis by alternative.

Alternative	WHRFMA	East Hawai'i
No Action	None (no collection)	None (no collection)
CML-Only	None (no collection)	Follow 2018-2019 collection trends
Pre-Aquarium Collection Ban	Follow historic (2000-2017) trends	Follow historic (2000-2017) trends
WHRFMA-Only Programmatic Issuance of Aquarium Permits	Follow historic (2000-2017) trends	Follow historic (2000-2017) trends

Alternative	WHRFMA	East Hawai'i
Achilles Tang Conservation	Follow historic (2000-2017) trends, with a small decrease due to decreased catch of Achilles Tang	Follow historic (2000-2017) trends
Limited Permit Issuance	Follow historic (2000-2017) trends of the 10 fishers who would be issued permits	None (no collection)
Revised White List and Limited Permit Issuance (Preferred) Alternative	Based on individual catch quotas and the issuance of 7 permits	None (no collection)

5.4.1 Direct Impacts

According to data presented in DAR (2019a), the number of collected fish in the WHRFMA has increased by 29% between 2000 and 2017, growing from a collection of 252,290 in 2000 to a collection of 324,565 in 2017 (DAR 2019a)[14], representing an annual growth rate of 1.49%[15].

Table 5-5 summarizes the historic collection data for East Hawai'i and the WHRFMA by year for all commercial aquarium collectors, as well as for the 10 fishers who would receive Aquarium Permits under the Limited Permit Issuance Alternative (includes the 7 fishers who would receive permits under the Preferred Alternative).

Table 5-5. Total fish and invertebrates collected under Aquarium Permits from East Hawai'i and total White List Species collected from the WHRFMA annually from 2000-2017 (DAR 2018a). Also included for comparison are data from collection of fish within East Hawai'i in 2018. These data are applicable to the analysis of the No Action, CML-only, Pre-Aquarium Collection Ban, WHRFMA-only Programmatic Issuance of Aquarium Permits, Achilles Tang Conservation, and Limited Permit Issuance alternatives.

Fiscal Year	East Hawai'i		WHRFMA			Combined	
	10 fishers	All fishers (White List Species in parenthesis)	10 fishers	All fishers	Percent contribution of 10 fishers	10 fishers	All fishers
2000	0	6,685 (6,673)	16,893	241,070	7.0%	16,893	247,755
2001	0	*n.d.*	4,405	243,085	1.8%	4,405	243,085
2002	0	*n.d.*	9,917	192,102	5.2%	9,917	192,102
2003	0	*n.d.*	29,449	233,930	12.6%	29,449	233,930
2004	0	*n.d.*	88,176	336,436	26.2%	88,176	336,436
2005	0	7,942 (7,807)	78,657	433,270	18.2%	78,657	441,212
2006	0	22,371 (21,613)	73,310	478,122	15.3%	73,310	500,493

[14] The numbers in 2000 do not match the number presented elsewhere in the text, likely due to confidentiality of data (Section 5.1).

[15] $Annual\ Percent\ Growth = \left[\frac{2017\ value}{2000\ Value}^{1/17} - 1\right] * 100$

Fiscal Year	East Hawai'i		WHRFMA			Combined	
	10 fishers	All fishers (White List Species in parenthesis)	10 fishers	All fishers	Percent contribution of 10 fishers	10 fishers	All fishers
2007	0	11,036 (10,893)	56,636	337,287	16.8%	56,636	348,323
2008	29	36,924 (35,946)	85,737	342,954	25.0%	85,766	379,878
2009	0	21,494 (20,819)	105,112	284,537	36.9%	105,112	306,031
2010	0	9,232 (8,074)	155,729	377,805	41.2%	155,729	387,037
2011	0	39,058 (5,462)	93,200	361,452	25.8%	93,200	400,510
2012	1,047	104,670 (5,763)	86,399	349,971	24.7%	87,446	454,641
2013	0	55,945 (3,389)	85,150	362,444	23.5%	85,150	418,389
2014	446	52,799 (16,946)	115,867	338,848	34.2%	116,313	391,647
2015	0	25,272 (0)	125,657	358,671	35.0%	125,657	383,943
2016	0	15,504 (0)	160,832	377,479	42.6%	160,832	392,983
2017	3,771	22,002 (16,887)	150,500	324,565	46.4%	154,271	346,567
2018[1]	26,013	55,815 (unknown, data not provided)	N/A, aquarium fishing closed as of October 2017			26,013	55,815
Total (2000-2017)	**5,293**	**430,934 (160,272)**	**1,521,626**	**5,974,028**	**25.5%**	**1,526,919**	**6,404,962**
Average (2000-2017)	**294**	**30,781 (10,017)**	**84,535**	**331,890**	**25.5%**	**84,829**	**355,831**

[1]Data from 2018 were provided for the calendar year for all fishers, and for the fiscal year for the 10 fishers. However, both datasets contain 12 calendar months, and are considered comparable for analysis.

5.4.1.1 No Action Alternative

Under the No Action Alternative issuance of Aquarium Permits and CMLs for aquarium collection would not occur and commercial aquarium fishing would not be permitted in the WHRFMA or East Hawai'i. Therefore, collection would be zero, and reef habitat would not be affected by aquarium collection.

It is anticipated that population trends of the 40 White List Species in the WHRFMA would follow trends shown in the FRAs (Table 5-7 and Table 5-11). This includes 17 species with stable populations, 13 species with increasing populations, and 6 species with decreasing populations (DAR 2019a).

5.4.1.2 CML-only Alternative

Under the CML-only Alternative issuance of Aquarium Permits would not occur and commercial aquarium fishing would not be permitted in the WHRFMA. Therefore, collection of all White List Species in the WHRFMA would be zero and reef habitat would not be affected.

It is anticipated that population trends of the 40 White List Species in the WHRFMA would follow trends shown in the FRAs (Table 5-7 and Table 5-11). This includes 17 species with stable populations, 13 species with increasing populations, and 6 species with decreasing populations (DAR 2019a).

In East Hawai'i, an unlimited number of CMLs for commercial aquarium collection would be issued, and aquarium collection using legal gear or methods other than fine-mesh nets would occur. It is assumed that collection trends would follow what occurred after closure of the WHRFMA to commercial aquarium collection in October 2017, which increased collection in East Hawai'i. After the closure of the WHRFMA to commercial aquarium collection in October 2017, commercial aquarium collectors in East Hawai'i collected 55,815 fish in the 2018 calendar year (based on data provided by the DAR), and an additional 32,331 fish through October 2019 (data provided on October 21, 2019, DAR 2019b). Assuming 55,815 fish are collected in the first year of the 5-year analysis period, and an annual growth rate of 1.49% in collection, a total of 287,516 fish would be collected over the 5-year analysis period (average of 57,503 per year).

Of the 88,146 fish collected in East Hawai'i in 2018 and 2019, nearly 86% were Yellow Tang (Table 5-6). Due to confidentiality laws (Section 5.1), information on species collected is limited, however the species composition for 93% of all collection is provided in Table 5-6. Assuming that similar collection would occur annually over the 5-year analysis period under the CML-only Alternative, collection of each species would result in impacts to 1.40% or less of the estimated population per year for all species except Yellow Tang, which has an estimated collection of 14.95% of the estimated population.

Population trend data for East Hawai'i are not available. Ochavillo and Hodgson (2006) suggest collection of between 5% and 25% is sustainable for various reef species in the Philippines that are similar to those on the White List (e.g., tang, wrasse, butterflyfish, angelfish, triggerfish), and collection of all 7 species collected in East Hawai'i falls within or below the lower end of this threshold. Similarly, a study in the Caribbean found that the maximum sustainable yield of parrotfish is 40% of the biomass, but that limiting harvest to less than 10% increases reef resilience (Bozec et al. 2016). Similar data for the White List Species are not available to determine species-specific sustainable thresholds; therefore, this research represents the best available science, and we conservatively apply the lower end of the 5% to 25% threshold throughout this EIS. See "Impact of Collection on White List Species Populations" in Section 5.4.1.3 for a further discussion on population impacts. It is also important to note that East Hawai'i is not isolated, Christie et al. (2010) documented connectivity between adjacent reefs of up to 114 miles. Therefore, the impact of collection in East Hawai'i may be lower than predicted due to the additional populations present in West Hawai'i.

No collection data for invertebrates was provided for 2018 or 2019 from East Hawai'i, though this could be due to Hawai'i confidentiality laws (see Section 5.1). Therefore, we assume that the collection of invertebrates would follow historic trends from 2000-2017, and would not increase under the CML-only Alternative, as collection of invertebrates has not and would not be allowed in the WHRFMA (i.e., there has

been no change in laws/regulations regarding invertebrate collection on the island of Hawai'i). The only invertebrate with catch data provided from 2000-2017 was the Red Pond Shrimp, which had an average collection of 20,301 individuals per year, and a maximum of 97,730 in 2012 (DAR 2018a). Therefore, while still applying a 1.49% annual growth rate for collection, it is anticipated that 20,301 to 97,730 invertebrates (mainly Red Pond Shrimp) would be collected during the first year of the 5-year analysis period, and a total of 104,575 to 503,430 would be collected over the 5-year analysis period (average of 20,915 to 100,686 per year).

Table 5-6. Projected annual and total collection of fish species collected in East Hawai'i over the 5-year analysis period, based on an average collection of 57,503/year total fish, and impact on the 2019 PIFSC-ESD (2020) population estimates.

Species	2019 East Hawai'i PIFSC-ESD (2020) Population Estimates (lower-upper estimate limit)	% of total catch in East Hawai'i (2018-2019)	Projected Average Annual Collection Under CML-only Alternative	% of the PIFSC-ESD population collected annually
Yellow Tang	329,557 (153,969-505,145)	85.7%	49,280	14.95%
Achilles Tang	185,259 (72,966-297,552)	4.5%	2,588	1.40%
Kole, Goldring Surgeonfish	1,331,404 (785,880-7,876,927)	2.0%	1,150	0.09%
Black Surgeonfish (Chevron Tang)	110,361 (0-230,830)	0.3%	173	0.16%
Tinker's Butterflyfish	N/A	0.3%	173	NA
Orangespine Unicornfish	478,551 (319,899-637,204)	0.2%	115	0.02%
Goldrim Tang	21,495 (0-64,464)	<0.1%	58	0.27%
All Others (White List and non-White List)	NA	7.0%	4,025	NA

Without the use of fine mesh nets, the size class of fish collected may increase over that which is caught with fine mesh nets (i.e., the smaller fish would escape the larger mesh), but again this impact cannot be quantified at this time. Multiple other methods are allowed to capture fish in East Hawai'i, so all sizes can be captured, but quantities and effectiveness differ from the use of fine mesh nets.

5.4.1.3 Pre-Aquarium Collection Ban Alternative

Under the Pre-Aquarium Collection Ban Alternative issuance of an unlimited number of Aquarium Permits would occur and commercial aquarium fishing would take place in both the WHRFMA and East Hawai'i. Based on historic trends, it is assumed that between 113 and 226 Aquarium Permits would be issued in the State of Hawai'i (minimum and maximum of the last 18 years, Table 4-1), and between 24 and 60 Aquarium

Permits would be issued for fishers in the WHRFMA (Table 4-2). Impacts to invertebrates, including the Red Pond Shrimp, would be similar to the CML-only Alternative, with a total of 104,575 to 503,430 invertebrates (mostly Red Pond Shrimp) collected over the 5-year analysis period (average of 20,915 to 100,686 per year).

It is likely that fishing pressure on the species collected in the past would remain relatively the same as what occurred prior to the October 2017 ban on commercial aquarium collection, resulting in an estimated 331,890 (18-year average) individual fish collected from the WHRFMA. Prior to October 2017, an average of 30,781 fish and invertebrates were collected from East Hawai'i (Table 5-5). Based on data provided, 42.4% were Red Pond Shrimp, while the rest were fish species or other invertebrates (DAR 2018a). However, no other invertebrate species' catch data were provided due to confidentiality, and therefore, we conservatively assume that the remaining 57.6% of the catch was fish. Therefore, of the 30,781 fish and invertebrates collected in an average year, it is assumed that 57.6% of those are fish (17,730). Assuming a 1.49% annual growth rate on the average collection from the WHRFMA (331,890 per year) and East Hawai'i (17,730 per year), a total of 1.8 million fish would be collected from the Island of Hawai'i over the 5-year analysis period, with 1.7 million of those collected in the WHRFMA and 91,000 from East Hawai'i (average of 341,929 and 18,266 per year).

White List Species

WHRFMA (Only White List Species Collected)

The top 10 collected species in the WHRFMA made up 98.2% of all fishes collected in fiscal year 2017 (DAR 2019a):

- Yellow Tang (81.6% of the total catch)
- Goldring Surgeonfish, Kole (9.5% of the total catch)
- Orangespine Unicornfish (1.9% of the total catch)
- Achilles Tang (1.7% of the total catch)
- Black Surgeonfish (1.2% of the total catch)
- Potter's Angelfish (0.7% of the total catch)
- Ornate Wrasse (0.5% of the total catch)
- Goldrim Surgeonfish (0.4% of the total catch)
- Orangeband Surgeonfish (0.4% of the total catch)
- Brown Surgeonfish (0.3% of the total catch)

The remaining 30 White List Species made up the remaining 1.8% of collected fish (DAR 2019a). Total abundance of nearshore fishes has had a significant positive trend in all management areas (Open Areas, FRAs and MPAs) since 2003 (DAR 2019a).

WHAP data indicate that establishment of the FRAs has had a significantly positive impact on Yellow Tang and Kole populations in the WHRFMA (DAR 2019a; Table 5-7). Achilles Tang have decreased in both FRAs and Open Areas, suggesting that factors other than aquarium collection are also affecting their population (DAR 2019a; Table 5-7). Of the remaining 7 of the top 10 collected aquarium species, 1 species (Goldrim Surgeonfish) had no significant change in population since establishment of the FRAs in 1999, 6 species (Orangespine Unicornfish, Black Surgeonfish, Orangeband Surgeonfish, Brown Surgeonfish, and Potter's

Angelfish) increased significantly in one or more of the management areas, and 1 species (Ornate Wrasse [Pinkface]) declined significantly in both FRAs and Open Areas, suggesting that factors other than aquarium collecting were also affecting the Ornate Wrasse population. It is acknowledged that, in addition to the number of fish collected, incidental mortality may occur in fish that are released. However, while there are no data available to analyze these impacts, it is assumed that the magnitude of these impacts would not change from what has historically occurred, and thus these impacts are already accounted for in the analysis of population trend data.

Additionally, a comparison of West Hawai'i with Maui using 2002-2010 WHAP data and PIFSC-ESD data found that for the 10 most collected species in the WHRFMA (not the same 10 species listed above, as this list can vary by year), all were more abundant within the Open Areas of the WHRFMA (where aquarium collection occurs) than in the Maui MPA closed areas, and five of the species were significantly more abundant (DAR 2019a).

Table 5-7. Change in density of the top 10 collected species in the WHRFMA based on WHAP data. 'Before' = Mean of 1999-2000; 'After' = Mean 2017-2018. Young-of-year (YOY) not included. Bold = statistically significant t-test (DAR 2019a).

COMMON NAME	AREA	MEAN DENSITY (NO./100M^2)		OVERALL% CHANGE IN DENSITY	ρ
		Before	After		
Yellow Tang	**FRA**	**12.73**	**33.79**	**+165.4%**	**<0.001**
	Open	**10.24**	**20.53**	**+100.6%**	**<0.001**
	MPA	**23.08**	**40.07**	**+73.6%**	**<0.001**
Kole (Goldring Surgeonfish, Yelloweye, Goldring)	**FRA**	**28.38**	**52.60**	**+85.4%**	**<0.001**
	Open	**21.18**	**41.65**	**+96.6%**	**<0.001**
	MPA	**28.53**	**62.64**	**+119.6%**	**<0.001**
Orangespine Unicornfish	FRA	0.81	0.67	-16.8%	0.26
	Open	**1.12**	**1.59**	**+42.6%**	**<0.001**
	MPA	**1.59**	**2.88**	**+81.4%**	**<0.001**
Achilles Tang	**FRA**	**0.26**	**0.05**	**-82.7%**	**<0.001**
	Open	**0.31**	**0.09**	**-70.5%**	**<0.001**
	MPA	0.42	0.22	-48.3%	0.05
Black Surgeonfish	**FRA**	**0.18**	**0.76**	**+319.2%**	**<0.001**
	Open	**0.17**	**0.84**	**+402.1%**	**<0.001**
	MPA	**0.53**	**0.98**	**+83.7%**	**<0.001**
Potter's Angelfish	**FRA**	**1.38**	**2.28**	**+66.0%**	**<0.001**
	Open	**1.65**	**2.47**	**+49.9%**	**<0.001**
	MPA	**1.54**	**2.39**	**+55.4%**	**<0.001**
Ornate Wrasse	**FRA**	**0.94**	**0.66**	**-30.1%**	**<0.001**
	Open	**2.20**	**1.83**	**-16.6%**	**<0.001**
	MPA	**1.24**	**1.59**	**+28.5%**	**<0.05**
Goldrim Surgeonfish	FRA	0.04	0.09	+156.6%	0.46
	Open	0.01	0.06	+605.9%	0.42
	MPA	0.11	0.21	+102.4%	0.45

Orangeband Surgeonfish	FRA	0.13	0.22	+73.9%	0.24
	Open	**0.31**	**0.50**	**+60.0%**	**<0.01**
	MPA	**0.56**	**0.87**	**+56.3%**	**<0.05**
Brown Surgeonfish	**FRA**	**8.57**	**13.90**	**+62.1%**	**<0.001**
	Open	**11.20**	**25.77**	**+130.1%**	**<0.001**
	MPA	**7.68**	**22.21**	**+189.3%**	**<0.001**

YELLOW TANG

The Yellow Tang has been the most collected species every year since 1976 (DAR 2018a). Since 2000, 5,972,413 individuals of all White List Species have been collected in the WHRFMA; 4,885,736 (81.8%) of those were Yellow Tang. The average number of Yellow Tang captured each year since 2000 was 271,430 individuals, ranging between a minimum catch of 152,047 individuals (2002) and maximum of 386,767 (2006). Under the Pre-Aquarium Collection Ban Alternative, it is anticipated that between 152,047 and 387,767 Yellow Tang would be collected each year, for a total of approximately 760,000 to 1.9 million Yellow Tang over the 5-year analysis period.

Based on data collected in 2019 by the PIFSC-ESD (2020), the WHRFMA Yellow Tang population is estimated at 6,087,924 individuals (Table 5-8). The WHAP estimates the 2017/2018 Open Area Yellow Tang population in the WHRFMA at 2,867,048 at the 30'-60' depth, an increase of over 1.2 million fish since 2012/2013. Collection of Yellow Tang between 152,047 and 386,767 individuals would remove approximately 2.50% to 6.35% of the current PIFSC-ESD estimated population for the WHRFMA, 2.67% to 6.80% of the WHAP estimated population for the WHRFMA, and between 5.30% and 13.49% of the estimated WHRFMA Open Area population (Table 5-8). While this collection would occur only within the Open Areas of the WHRFMA, there is evidence for connectivity between FRAs and Open Areas (Christie et al. 2010), therefore, analyzing the impacts on just the Open Area populations is not representative of the impact, nevertheless, that analysis is provided for comparison purposes in Table 5-8. See "Impact of Collection on White List Species Populations" below.

Table 5-8. 2019 PIFSC-ESD (2020) estimated population of Yellow Tang for the WHRFMA and 2017/2018 WHAP Open Area and WHRFMA (Open Area, MPA and FRA) population estimates and percentage of population collected by commercial aquarium fishers in the WHRFMA (DAR 2018a).

Population Estimate Source	Population Estimate	Minimum WHRFMA Collection per Year[2]	Maximum WHRFMA Collection per Year[2]	Minimum % of Population	Maximum % of Population
PIFSC-ESD 2019 WHRFMA	6,087,924	152,047	386,767	2.50%	6.35%
WHAP 2017/2018 WHRFMA Open Areas (30'-60')[1]	2,867,048			5.30%	13.49%
WHAP 2017/2018 WHRFMA Total	5,690,643			2.67%	6.80%

(30'-60'; Open Areas, MPAs and FRAs)[1]					

[1]Include both adults and young-of-the-year. Data for 2012/2013 are from DAR 2014a. Data for 2016/2017 are from DAR 2019a.
[2]From 2000 – 2017

The DAR (2019a), stated:

- Since the FRAs were established, the population of Yellow Tang has increased 165% in the FRAs and 101% in the Open Areas (areas fished by commercial aquarium fishers), compared to 74% in the MPAs. Overall Yellow Tang abundance in the 30-60-foot depth range over the entire West Hawai'i coast had increased 150% (over 3.4 million fish) from 1999/2000 to 2017/2018 to a population of approximately 5.7 million fish.

- There were no significant differences in the abundance of adult Yellow Tang in open vs. closed areas in shallow water (10-20-foot depths). Total estimated coastwise population of adult Yellow Tang in this depth range was estimated to be >2.5 million individuals. West Hawai'i had a significantly greater percent change in Yellow Tang density within its planned networked MPAs (and Open Areas) as compared to two non-networked sites on Maui.

Figure 5 illustrates the population trends for Yellow Tang since the FRAs were established, illustrating the upward trend in all areas, even with commercial aquarium collection of 4,885,736 Yellow Tang between 2000 and 2017 in the WHRFMA.

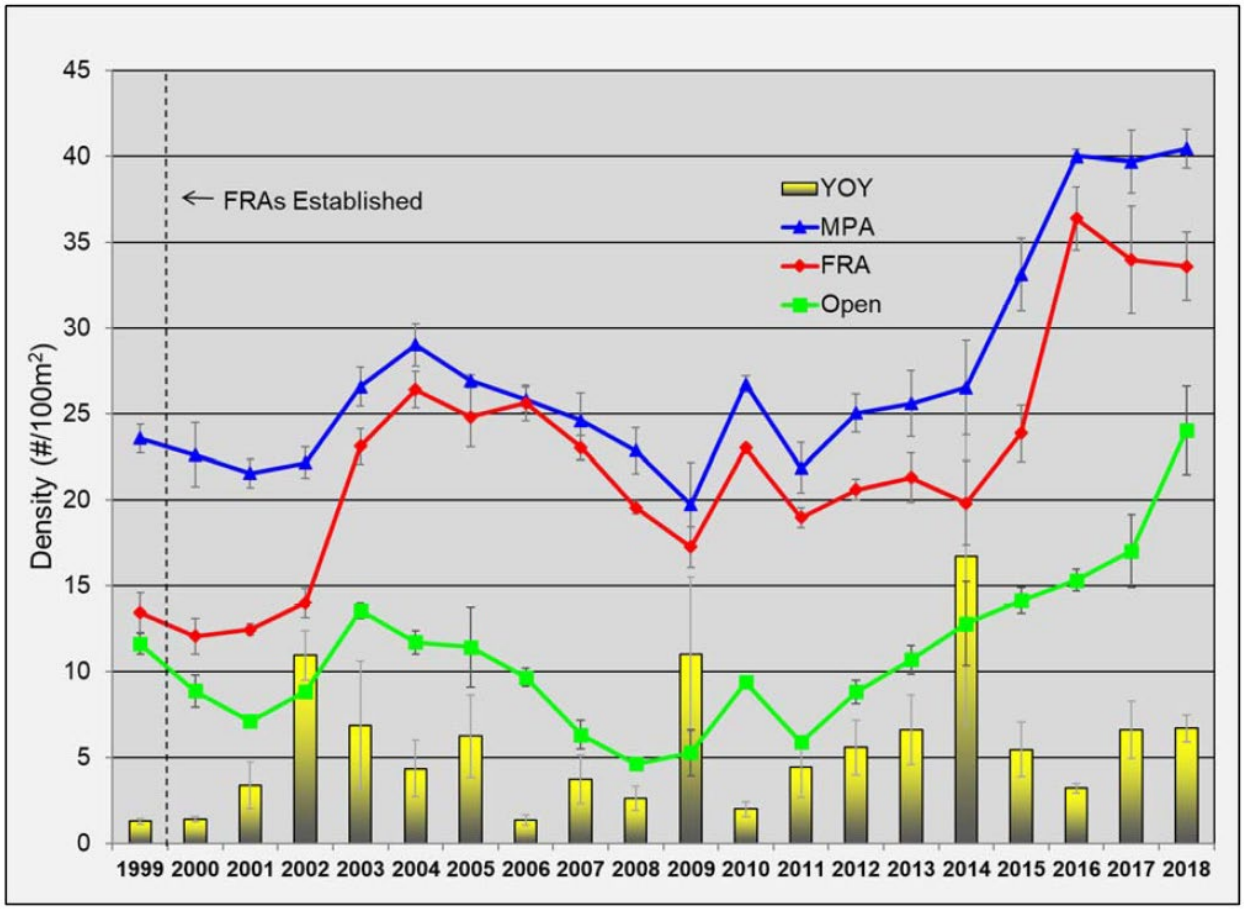


Figure 5. Overall changes in Yellow Tang density (Mean ± SE) in FRAs, MPAs, and Open Areas, 1999-2018. Yellow vertical bars indicate mean density (MAY-NOV) of Yellow Tang YOY. YOY are not included in trend line data (DAR 2019a).

It is important to note that the Yellow Tang breeding population (larger, adult fish), reflected in the trend lines in Figure 5, is not collected by commercial aquarium fishers, nor is this age/size class desired as a food fish. The brood stock is therefore protected and not significantly reduced as a result of aquarium fish collection. The vertical bars (YOY = young of the year) essentially represent the replacement/recruitment rate of the species (i.e., when juvenile fish survive to be added to a population). It is these juveniles up to several years of age that are targeted by the aquarium fishery, as there is no market for the larger fish.

Even with the targeting the smaller fish by the commercial aquarium collectors, juvenile Yellow Tang densities have significantly increased by 60.8% within Open Areas between 2003 and 2017 (DAR 2019a, Gove et al. 2019). It is noted that despite this increase in Open Areas, MPAs and FRAs still had significantly higher densities of juvenile Yellow Tang in 2017 when compared to Open Areas (Gove et al. 2019).

GOLDRING SURGEONFISH, KOLE

The Kole has been the second most collected species every year since 1976 (DAR 2018a). Since 2000, 5,972,413 individuals of all White List Species have been collected in the WHRFMA; 552,603 (9.3%) of those were Kole. The average number of Kole captured each year since 2000 was 30,700 individuals, ranging between a minimum catch of 15,961 (2001) and maximum of 42,112 (2006). Under the Pre-Aquarium Collection Ban Alternative, it is anticipated that between 15,961 and 42,112 Kole would be collected each year, for a total of approximately 80,000 to 210,500 over the 5-year analysis period.

Based on data collected in 2019 by the PIFSC-ESD (2020), the WHRFMA Kole population is estimated at 6,655,072 individuals (Table 5-9). The WHAP estimates the 2017/2018 Open Area Kole population in WHRFMA at 5,312,745 at the 30-60-foot depth, an increase of nearly 1.7 million fish since 2012/2013. Collection of between 15,961 and 42,112 Kole individuals would remove less than 0.7% of the current PIFSC-ESD WHRFMA population estimate, less than 0.5% of the WHAP estimated population for the WHRFMA, and less than 0.8% of the estimated Open Areas population (Table 5-9). While this collection would occur only within the Open Areas of the WHRFMA, there is evidence for connectivity between FRAs and Open Areas (Christie et al. 2010), therefore, analyzing the impacts on just the Open Area populations is not representative of the impact; nevertheless, that analysis is provided for comparison purposes in Table 5-9. See “Impact of Collection on White List Species Populations” below.

Table 5-9. 2019 PIFSC-ESD (2020) estimated population of Kole for the WHRFMA and 2017/2018 WHAP Open Area population estimate and percentage of population collected by commercial aquarium fishers in the WHRFMA (DAR 2018b).

Population Estimate Source	Population Estimate	Minimum WHRFMA Collection per Year[2]	Maximum WHRFMA Collection per Year[2]	Minimum % of Population	Maximum % of Population
PIFSC-ESD 2019 WHRFMA	6,655,072	15,961	42,112	0.24%	0.63%
WHAP 2017/2018 WHRFMA Open Areas (30’-60’)[1]	5,312,745			0.30%	0.79%
WHAP 2017/2018 WHRFMA Total (30’-60’; Open Areas, MPAs and FRAs)[1]	9,555,712			0.17%	0.44%

[1]Includes both adults and young-of-the-year
[2]From 2000-2017

The DAR(2019), stated:

- The FRAs have also been very successful in increasing Kole populations. The number of Kole increased significantly in all management areas, including Open Areas, from 1999/2000 to 2012/2013. Overall Kole abundance in 30-60-foot depth range over the entire West Hawai′i coast increased 118% (nearly 5.2 million fish) during this time period with a population of about 9.6 million fish in 2019.

- Long-term West Hawai′i studies have found Kole populations had decreased 14% in South Kona and 71% in South Kohala. Given the length of protection at these sites and the overall decline in

habitat quality and fish populations in South Kohala, it seems unlikely that the declines are due primarily to aquarium collecting. Comparative surveys utilizing DAR and NOAA data indicate Kole are substantially more abundant in West Hawai'i over most size ranges than in any of the other islands in the MHI or the Northwestern Hawaiian Islands.

Figure 6 illustrates the population trends for Kole since the FRAs were established, illustrating the upward trend in all areas, even with commercial aquarium collection of 552,603 Kole between 2000 and 2017 in the WHRFMA.

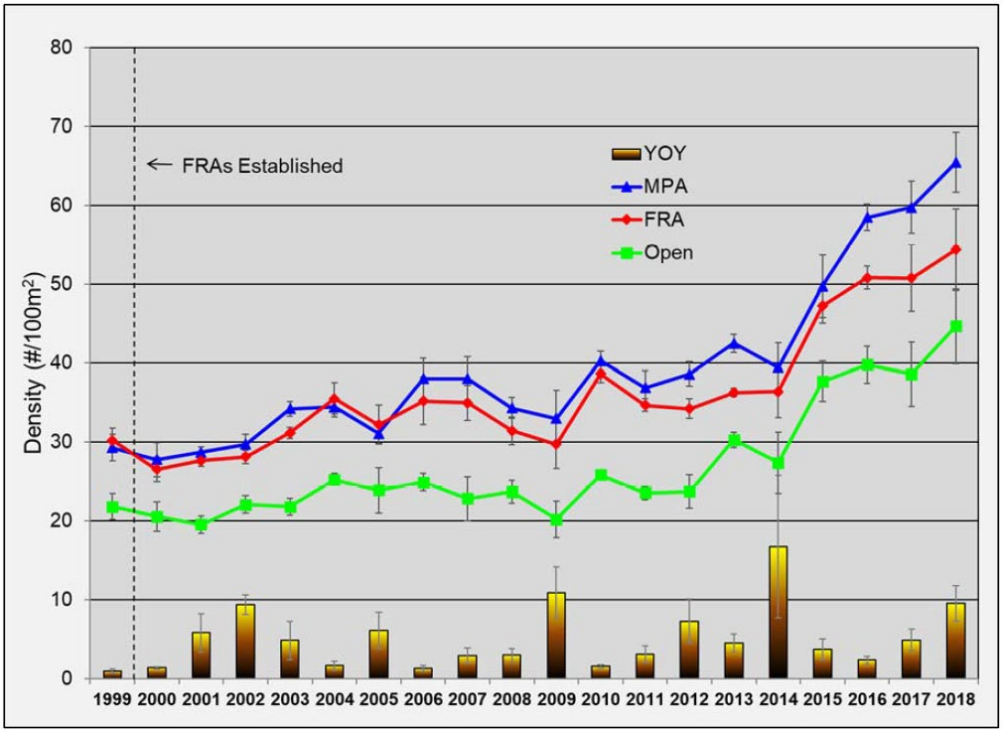


Figure 6. Overall changes in Kole density (Mean ± SE) in FRAs, MPAs, and Open Areas, 1999-2018. Vertical bars indicate mean density (JUN-NOV) of Kole YOY. YOY are not included in trend line data (DAR 2019a).

Trend lines in Figure 6 reflect Kole brood stock, i.e., large sized fish not collected by commercial aquarium fishers. The brood stock is therefore protected and not significantly reduced as a result of aquarium fish collection. The vertical bars (YOY = young of the year) essentially represent the replacement/recruitment rate of the species (i.e., when juvenile fish survive to be added to a population). It is these juveniles up to several years of age that are targeted by the aquarium fishery, as there is no market for the larger fish.

OTHER TOP 10 WHITE LIST SPECIES (CATCH RANKED 3-10)

These 8 species (Orangespine Unicornfish, Achilles Tang, Black Surgeonfish, Potter's Angelfish, Ornate Wrasse, Goldrim Surgeonfish, Orangeband Surgeonfish, and Brown Surgeonfish) made up 7.1% of the catch in fiscal year 2017. When abundances of these eight collected species are combined, they have

increased in all management areas since the FRAs were established (Figure 7). Abundances have been consistently higher in Open Areas for five of these species, and no consistent pattern was observed for the other three species (Table 5-7).

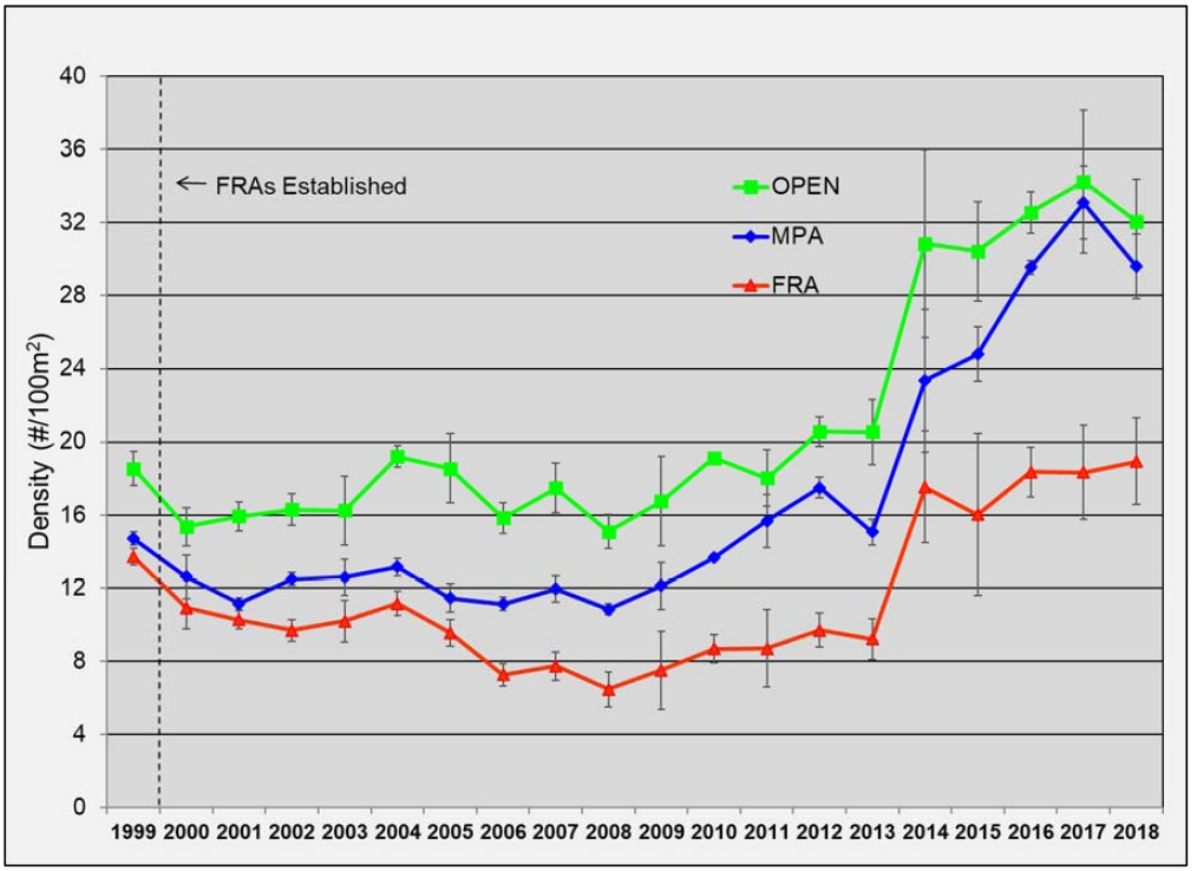


Figure 7. Overall changes in density (Mean ± SE) for the top 3-10 collected aquarium species combined in FRAs, MPAs, and Open Areas, 1999-2018. YOY are not included in trend line data (DAR 2019a).

Six of these species had long-term population increases in one or more of the management areas (Table 5-7). For the other two species, the Ornate Wrasse and the Achilles Tang, there were long-term population declines in both FRAs and Open Areas, with larger declines seen in FRAs than in Open Areas (Table 5-7), suggesting that some factor other than commercial aquarium collection was driving the decline. The Achilles Tang is discussed in more detail below.

ACHILLES TANG

The Achilles Tang has generally been the third most collected species every year since 1976, with a few exceptions (4th most captured fish from 2008-2009 and again 2015-2017; DAR 2018a). Since 2000, 5,972,413 individuals of all White List Species have been collected in the WHRFMA; 132,775 (2.2%) of those were Achilles Tang. The average number of Achilles Tang captured each year since 2014 (when the

current bag limit of 10 was implemented) was 5,600 individuals, ranging between a minimum catch of 5,568 (2015) and maximum of 5,757 (2016). Under the Pre-Aquarium Collection Ban Alternative, it is anticipated that approximately 5,600 Achilles Tang would be collected each year.

Based on data collected in 2019 during PIFSC-ESD (2020) surveys, the Achilles Tang population in the WHRFMA is estimated at 27,392 individuals (Table 5-10). The WHAP estimates the 2017/2018 Open Area Achilles Tang population in WHRFMA at 13,796 at the 30-60-foot depth, a decrease of 7,831 since 2012/2013 (Table 5-10). Collection of 5,600 Achilles Tang would remove approximately 20.44% of its current PIFSC-ESD estimated population for the WHRFMA, 26.05% of the WHAP estimated population for the WHRFMA, and 40.59% of the population in the WHRFMA Open Areas (Table 5-10). While this collection would occur only within the Open Areas of the WHRFMA, there is evidence for connectivity between FRAs and Open Areas (Christie et al. 2010), therefore, analyzing the impacts on just the Open Area populations is not representative of the impact; nevertheless, that analysis is provided for comparison purposes in Table 5-10. See "Impact of Collection on White List Species Populations" below. In addition, as noted below in this section, the WHAP surveys underestimate Achilles Tang population size for a variety of reasons.

Table 5-10. 2019 PIFSC-ESD (2020) estimated population of Achilles Tang for the WHRFMA and 2017/2018 WHAP Open Area population estimate and percentage of population collected by commercial aquarium fishers in the WHRFMA (DAR 2018a).

Population Estimate Source	Population Estimate	Average WHRFMA Collection per Year[2]	Average % of Population
PIFSC-ESD 2019 WHRFMA	27,392	5,600	20.44%
WHAP 2017/2018 WHRFMA Open Areas (30'-60')[1]	13,796		40.59%
WHAP 2017/2018 WHRFMA Total (30'-60'; Open Areas, MPAs and FRAs)[1]	21,494		26.05%

[1]Inlcudes both adults and young-of-the-year. See discussion below.
[2]From 2015-2017, after the daily bag limit of 10 Achilles Tang was implemented. This data ranges from 5,473 to 5,757, with an average of 5,600. Due to the small range, the average was used.

The DAR (2019a) stated:

- Commercial aquarium landings of Achilles Tang have declined in West Hawai'i over the past two decades in association with a 192% increase in its value since 2008. This is suggestive of declining availability (i.e., abundance). Achilles Tang has declined in FRAs and Open Areas over the last 20 years but have generally been more abundant in Open Areas than protected FRAs. Achilles Tang has had low levels of recruitment over the past two decades (mean Yellow Tang recruitment has been 57 times greater, and Kole recruitment has been 54 times greater).

- An important caveat is that the reef areas where the WHAP transects are located are not the prime habitat for adults of this species. As such the bulk of the population is not adequately surveyed by WHAP monitoring.
- Results from the WHAP monitoring program and long-term studies suggest there should be concern for the sustained abundance of this species. Achilles Tang are a very popular food fish as well as an aquarium fish and thus are being harvested both as juveniles and adults. Low levels of recruitment over the past 11 years appear insufficient to compensate for the existing levels of harvest. In order to address concerns regarding aquarium impacts on this species, the new West Hawai′i Regional Fishery Management Area Rule (HAR § 13-60.4) includes an Achilles Tang bag limit of 10 fish/person/day which applies only to aquarium collectors (2014). (Addressed below in this section).

Although the most recent DAR report (2019a) suggests there should be concern for the sustained abundance of Achilles Tang in the WHRFMA, the report concedes that WHAP transects are not located in prime habitat for adult Achilles Tang (i.e., high energy shallower surge zones), and therefore the bulk of the Achilles Tang population is not adequately surveyed by WHAP monitoring (DAR 2019a). In addition, WHAP transects are not located in all collection zones found within the WHRFMA (Figure 4), including the two zones (100A and 108) with the highest percentage of the Achilles Tang collection, suggesting that the population of Achilles Tang in the WHRFMA is likely higher than estimated by the WHAP.

The island of Hawai'i is divided into 14 collection zones for reporting purposes (Zones 100-108; Figure 4). The WHAP has survey transects only on the west side of the island as far south as collection zone 100B, but no transects within collection zones 100A and 108 located on the southwest and southeast portions of the island, respectively (Figure 4). Since 2000, 56% of all Achilles Tang catch data provided were from collection zones 100 and 108, and since 2012 when collection zone 100 was subdivided into 100A and 100B, 51% of all Achilles Tang catch data provided have been from collection zones 100A and 108 (DAR 2018a). Since 2000, less than two fishers have reported catch of Achilles Tang in collection zones 104, 105, and 106 (all n.d. data), and only in one year did more than two commercial aquarium fishers report Achilles Tang collection from zone 107 (DAR 2018a).

Because WHAP transects are not located in prime habitat, and no transects are located in areas where the majority of Achilles Tang collection occurs and over 40% of the population occurs, Achilles Tang population estimates based on WHAP data are likely underestimated (this is supported by the DAR [2019a] report), which thus results in the impact of the collection being overestimated when based solely on WHAP data. These issues related to the WHAP data support the use of the PIFSC-ESD population estimate for evaluating the impact of the collection (Table 5-10), as PIFSC-ESD surveys have good spatial coverage in all West Hawai'i collection zones and in the shallower water zones occupied by Achilles Tang. Nevertheless, an analysis of collection based on the WHAP Open Area and WHAP WHRMFA population estimates is provided for comparison purposes in Table 5-10.

The most recent DAR report (2019a) states that commercial aquarium landings of Achilles Tang have declined in West Hawai′i over the past two decades in association with a dramatic increase in its value (DAR 2019a). The results presented by Stevenson et al. (2013) suggest the MPA network significantly displaced fishing effort from the central to the northern and southern coastal regions of the island of Hawai'i

farther from ports of entry, and that estimated catch revenues and experimental catch per unit effort were statistically greater as distance from port of entry increased. These findings suggest that commercial aquarium fishers are traveling farther to reach suitable habitat areas open to Achilles Tang collection (e.g., Collection Zones 100A and 108), resulting in increased collection costs due to increased fuel consumption, equipment wear and tear, business expenses, time, etc., which is then passed on to wholesalers (i.e., increased cost per fish). At the same time, the bag limit on Achilles Tang implemented in 2014 has resulted in reduced Achilles Tang catch (average of 5,600 per year since 2014, down from 7,740 in 2014), affecting the number of fish brought to market (i.e., supply), which may also raise the price per fish. Therefore, the conservation measures that have been implemented to manage aquarium fish harvest (i.e., establishment of MPA network, bag limits) are more likely the cause of lower catch and increased value of Achilles Tang than declining availability.

Figure 8 illustrates the population trends for Achilles Tang since the FRAs were established, illustrating the downward trend in all areas. This downward trend has also been document by the Shallow Water Resource Fish Surveys (SWRF), which survey the shallower reef areas utilized by this species and have indicated a significant (90%) decline in Achilles Tang biomass in their primary adult habitat since 2008 (DAR 2019a). However, unlike aquarium collectors in West Hawai'i, there has never been a bag limit on this species for other fisheries. It is also important to note that these surveys only count Achilles Tang larger than 10 cm in size[16].

[16] https://nmspapahanaumokuakea.blob.core.windows.net/papahanaumokuakea-prod/media/archive/council/meetings/2018/rac-dar-report-07-19-18.pdf

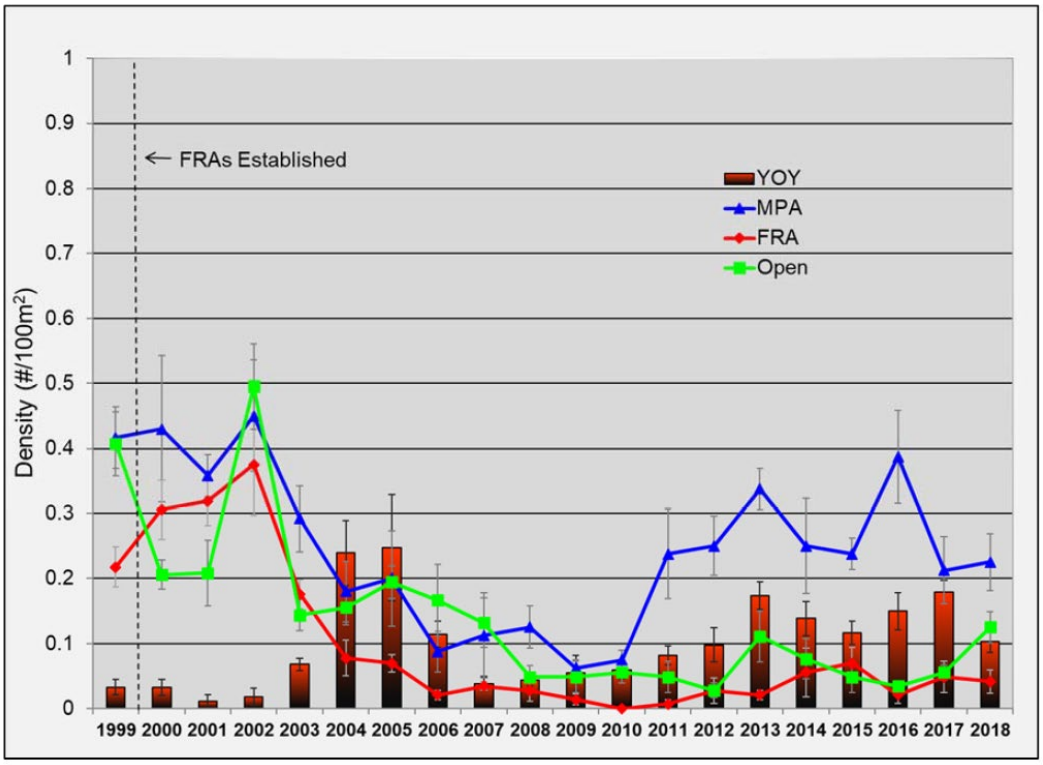


Figure 8. Overall changes in Achilles Tang density in FRAs, MPAs, and Open Areas, 1990-2018. Vertical bars indicate mean density (JUN-NOV) of Achilles Tang YOY. YOY are not included in trend line data (DAR 2019a).

The catch of Achilles Tang decreased from 7,740 in 2014 to an average of 5,600 per year from 2015-2017. It is important to note that the Achilles Tang bag limit of 10 fish per day began in 2014, which likely accounts for the reduced catch after 2014. Additionally, unlike the Yellow Tang and Kole, Achilles Tang have generally been more abundant over the past decade in Open Areas compared to the protected FRAs, which may reflect habitat differences or differential non-aquarium fishing pressure in various areas (DAR 2019a).

As discussed above, due to WHAP survey locations, Figure 8 is likely an underestimate of the overall WHRFMA Achilles Tang population (DAR 2019a), as it represents only those Achilles Tang observed at a depth of 30-60 feet (not prime adult habitat) and does not include areas where most Achilles Tang are collected (Collection Zones 100A and 108; prime habitat for all sizes, Figure 4).

OTHER 30 WHITE LIST SPECIES

The top 10 collected species made up 98.2% of the collected fish in the WHRFMA in 2017, and the remaining 30 White List Species made up the remaining 1.8% of collected fish.

These each made up less than 1% of the overall catch in the WHRFMA since 2000. Of these species, four do not have WHAP data due to occurring in deeper habitats not surveyed by WHAP (Tinker's Butterflyfish, Hawaiian Longfin Anthias, Flame Wrasse) or being found in different habitat during the daytime which is

not surveyed (Eyestripe Surgeonfish). Two additional species, the Psychedelic Wrasse and the Fisher's Angelfish, tend to be in deeper waters, but are also recorded in WHAP transects (though these estimates are considered to be substantially lower than their actual abundances; DAR 2019a).

Thus, there are good long-term survey data for an additional 26 White List Species (Table 5-11). Of these, 10 showed a significant increase in population size in one or more management area, while 9 showed a decrease, though only one of the decreases was exclusively in the Open Areas, and 1 species had both an increase and a decrease in different management areas. Six species had no significant changes in population in any of the areas. Aquarium collection of the one species that declined exclusively in the Open Areas, the Blackside Hawkfish, is low, and is only 0.13% of the Open Area Population, making it unlikely that aquarium collecting alone is the cause of this species decline in Open Areas (DAR 2019a). In addition, the Open Area population increased from 20,508 in 2012-2013 (DAR 2014a) to 23,625 in 2017-2018 (DAR 2019a), indicating that recruitment of this species is occurring even in the presence of commercial aquarium collection, given that the population estimates include young-of-year, compared to the density estimates which do not. It is acknowledged that, in addition to the number of fish collected, incidental mortality may occur with fish that are released. However, while there are no data available to analyze these impacts, it is assumed that the magnitude of these impacts would not change from what has historically occurred, and thus these impacts are already accounted for in the analysis of population trend data.

Table 5-11. Change in density of 26 additional White List Species in the WHRFMA based on WHAP data. 'Before' = Mean of 1999-2000; 'After' = Mean 2017-2018. Young-of-year (YOY) not included. Bold = statistically significant t-test (DAR 2019a).

COMMON NAME	AREA	MEAN DENSITY (NO./100M^2)		OVERALL CHANGE IN DENSITY	ρ
		Before	After		
Forcepsfish	**FRA**	**0.41**	**0.59**	**+0.19**	**<0.05**
	Open	0.41	0.37	-0.04	0.58
	MPA	0.84	0.79	-0.05	0.71
Yellowtail Coris	FRA	0.17	0.20	+0.02	0.61
	Open	0.13	0.17	+0.04	0.53
	MPA	0.30	0.44	+0.14	0.24
Psychedelic Wrasse	FRA	0.01	0.01	0.00	1.00
	Open	0.01	0.01	0.00	1.00
	MPA	0.01	0.03	+0.02	0.63
Shortnose Wrasse	FRA	0.02	0.01	-0.01	0.73
	Open	0.02	0.03	+0.01	0.77
	MPA	0.01	0.08	+0.06	0.31
Saddle Wrasse	**FRA**	**3.66**	**2.91**	**-0.74**	**<0.001**
	Open	**5.93**	**4.23**	**-1.70**	**<0.001**
	MPA	4.39	3.93	-0.46	0.17
Multiband Butterflyfish	**FRA**	**5.20**	**2.69**	**-2.51**	**<0.001**
	Open	**4.00**	**3.28**	**-0.17**	**<0.001**

Common name	Area	Mean density (No./100m²)		Overall change in density	ρ
		Before	After		
	MPA	**4.94**	**3.19**	**-1.75**	**<0.001**
Fourspot Butterflyfish	FRA	0.05	0.03	-0.02	0.65
	Open	**0.54**	**0.14**	**-0.40**	**<0.001**
	MPA	**0.43**	**0.20**	**-0.23**	**<0.05**
Fisher's Angelfish	FRA	0.00	0.00	0.00	1.00
	Open	**0.00**	**0.55**	**+0.54**	**<0.001**
	MPA	0.00	0.00	0.00	1.00
Pencil Wrasse	FRA	0.14	0.16	+0.02	0.78
	Open	**0.05**	**0.16**	**+0.11**	**<0.05**
	MPA	0.04	0.08	+0.03	0.82
Bird Wrasse	**FRA**	**0.67**	**0.84**	**+0.17**	**<0.05**
	Open	0.64	0.62	-0.01	0.82
	MPA	**1.04**	**1.53**	**+0.48**	**<0.01**
Thompson's Surgeonfish	**FRA**	**0.72**	**1.64**	**+0.92**	**<0.001**
	Open	**0.69**	**2.53**	**+1.84**	**<0.001**
	MPA	**0.66**	**1.55**	**+0.89**	**<0.01**
Milletseed Butterflyfish	FRA	0.00	0.00	0.00	1.00
	Open	0.04	0.02	-0.02	0.57
	MPA	**0.44**	**0.01**	**-0.43**	**<0.001**
Eightline Wrasse	**FRA**	**2.20**	**1.14**	**-1.05**	**<0.001**
	Open	**3.31**	**1.75**	**-1.56**	**<0.001**
	MPA	**3.17**	**1.83**	**-1.34**	**<0.001**
Hawaiian Dascyllus	**FRA**	**0.02**	**0.33**	**+0.31**	**<0.001**
	Open	0.51	0.59	+0.08	0.41
	MPA	0.12	0.15	+0.04	0.70
Blacklip Butterflyfish	**FRA**	**0.00**	**0.07**	**+0.07**	**<0.05**
	Open	**0.00**	**0.29**	**+0.29**	**<0.001**
	MPA	0.02	0.04	+0.02	0.68
Lei Triggerfish	FRA	0.53	0.69	+0.16	0.07
	Open	0.75	0.86	+0.11	0.24
	MPA	**0.57**	**1.06**	**+0.50**	**<0.001**
Spotted Boxfish	FRA	0.05	0.08	+0.03	0.49
	Open	0.10	0.12	+0.02	0.73
	MPA	0.10	0.19	+0.08	0.25
Fourline Wrasse	**FRA**	**1.36**	**1.81**	**+0.45**	**<0.01**
	Open	**1.66**	**2.12**	**+0.46**	**<0.01**
	MPA	**2.95**	**1.76**	**-1.19**	**<0.001**
Pyramid Butterflyfish	FRA	0.02	0.07	+0.04	0.37
	Open	**0.66**	**0.35**	**-0.31**	**<0.01**
	MPA	**0.59**	**0.10**	**-0.49**	**<0.05**
	FRA	0.34	0.23	-0.11	0.08

Common Name	Area	Mean Density (No./100m²)		Overall Change in Density	ρ
		Before	After		
Blackside Hawkfish	**Open**	**0.41**	**0.22**	**-0.19**	**<0.01**
	MPA	0.26	0.26	0.00	1.00
Hawaiian Whitespotted Toby	FRA	1.13	1.00	-0.13	0.34
	Open	**3.48**	**2.32**	**-1.16**	**<0.001**
	MPA	**2.87**	**2.14**	**-0.73**	**<0.01**
Redbarred Hawkfish	FRA	0.03	0.04	+0.01	0.84
	Open	0.16	0.06	-0.09	0.63
	MPA	0.06	0.02	-0.04	0.49
Gilded Triggerfish	**FRA**	**0.14**	**0.03**	**-0.11**	**<0.05**
	Open	**0.31**	**0.03**	**-0.27**	**<0.001**
	MPA	**1.26**	**0.36**	**-0.90**	**<0.001**
Black Durgon	**FRA**	**0.53**	**0.82**	**+0.29**	**<0.05**
	Open	**0.43**	**0.86**	**+0.42**	**<0.01**
	MPA	**2.21**	**4.36**	**+2.14**	**<0.001**
Bluestripe Snapper	**FRA**	**0.07**	**0.80**	**+0.73**	**<0.001**
	Open	**0.12**	**0.31**	**+0.18**	**<0.01**
	MPA	0.19	0.17	-0.02	0.83
Peacock Grouper	FRA	0.57	0.72	+0.16	0.09
	Open	0.57	0.48	-0.09	0.28
	MPA	0.89	0.83	-0.06	0.72

Capture data from 2000-2017 (DAR 2018a), 2019 PIFSC-ESD (2020) population estimates, 2017-2018 WHAP population estimates, and estimated catch percentages for all White List Species in both West and East Hawai'i can be found in Section 5.4.1.3.

East Hawai'i

Commercial aquarium fish collection in East Hawai'i is significantly less than in the WHRFMA, in both level of effort and number of individuals kept. Between 2000 and 2017, approximately 160,272 White List Species were collected from East Hawai'i (DAR 2018a), compared to the 5,972,413 fish collected in the WHRFMA. The number of commercial aquarium fishers reporting catch is also significantly lower in East Hawai'i with an average of 5 permitted fishers reporting each year since 2000, compared to an average of 28 permitted fishers reporting from the WHRFMA over the same time period (this number does not include any permit reports that fall under the *n.d.* category).

Of the approximately 160,272 White List Species fish collected in East Hawai'i over the past 18 years, approximately 75% (119,959) were Yellow Tang. Seventy-seven percent (77%) of the Yellow Tang were captured from 2000- 2011. From 2011-2014 (the last year for which data are available due to data confidentiality), the average catch of Yellow Tang was 6,836 per year ranging between a minimum of 2,774 (2013) and a maximum of 14,269 (2014) individuals. Kole and Achilles Tang captures in East Hawai'i since 2000 have averaged 1,047 and 703 individuals per year, respectively.

The East Hawai'i population estimates for Yellow Tang, Kole, and Achilles Tang based on data collected in 2019 during PIFSC-ESD (2020) surveys are shown in Table 5-12. Based on these estimates, and the minimum and maximum collection of each species over an 18-year period, the proportion of the overall population removed by the East Hawai'i fishery is less than 5% for each species.

Table 5-12. 2019 PIFSC-ESD (2020) estimated populations of Yellow Tang, Kole, and Achilles Tang for East Hawai'i and percentage of population collected by commercial aquarium fishers in East Hawai'i (DAR 2018a).

Species	East Hawai'i Pop (PIFSC-ESD 2020)	East Hawai'i (DAR2018a)			
		Minimum Collection per Year[1]	Maximum Collection per Year[1]	Minimum % of Population	Maximum % of Population
Yellow Tang	**329,557**	2,774	14,269	0.84%	4.33%
Kole	**1,331,404**	76	3,601	<0.01%	0.27%
Achilles Tang	**185,259**	525	1,525	0.28%	0.82%

[1]From 2000-2017

Of the remaining fish species collected in East Hawai'i, none averaged more than 53 individuals collected per year since 2000; most averaged less than 25 individuals per year. Under the Pre-Aquarium Collection Ban Alternative, it is anticipated that the collection of White List Species in any year of the 5-year analysis period would be similar to the 18-year annual average.

Capture data from 2000-2017 (DAR 2018a), 2019 PIFSC-ESD (2020) population estimates, and estimated catch percentages for all White List Species in both East and West Hawai'i can be found in Section 5.4.1.3.

Non-White List Species

WHRFMA

Only White List Species are allowed to be collected from the WHRFMA and any non-target, non-White List Species captured incidentally during fishing activities are to be immediately released at the capture site (Act 306; Section 1.2.4.1). Incidental captures are limited due to the capture methods implemented by the fishers, which focus on target species. Any incidental captures would therefore be negligible.

East Hawai'i

East Hawai'i is not restricted to the White List Species and many additional forms of aquatic life can be collected. Based on collection data between 2000 and 2017, a single invertebrate species, Red Pond Shrimp (unidentified species), made up the majority of the catch (DAR 2018a). Of the 249,007 non-White List aquatic animals collected in East Hawai'i over the past 18 years, approximately 73% (182,710 individuals) of the provided catch data were Red Pond Shrimp (this value is likely even higher, given the large number of years that could not disclose Red Pond Shrimp numbers due to data confidentiality, and Red Pond Shrimp made up over 99% of the collection when looking only at disclosed data). On average, more than 20,000 Red Pond Shrimp are collected annually from East Hawai'i (DAR 2018a). All remaining 79 non-White List Species collected in East Hawai'i averaged three or less individuals collected per year since 2000 based on the data reviewed. Under the Pre-Aquarium Collection Ban Alternative, it is anticipated

that annual collection of non-White List Species over the 5-year analysis period would be similar to the catch from 2000 to 2017.

Hawai'i Species of Greatest Conservation Need

WHRFMA

Although listed as a Hawaiian SGCN, the IUCN (2017) provides this assessment of the Psychedelic Wrasse:

> *This species has a relatively restricted distribution in the east-central and north-western Pacific Ocean, being found only around the Hawaiian Islands Chain. Although there is no evidence for any population declines, the species is taken in the marine aquarium fish trade. However, more than two thirds of its range are enclosed by the Papahanaumokuakea Marine National Monument. This species is therefore listed as Least Concern.*

A total of 4,931 Psychedelic Wrasse were collected in the WHRFMA from 2000 to 2017 (DAR 2018a), representing 0.08% of the total White List Species collected over that same period. The average number of Psychedelic Wrasse captured each year since 2000 was 274 individuals, ranging between 97 (2003) and 599 (2017) individuals collected (Table 5-13). Under the Pre-Aquarium Collection Ban Alternative, it is anticipated that between 100 and 600 Psychedelic Wrasse would be collected annually. The population of Psychedelic Wrasse in the WHRFMA has remained relatively stable between 1999/2000 and 2017/2018 (Table 5-11), with no statistically significant changes in either the Open Areas or protected areas.

Although listed as a Hawaiian SGCN, the IUCN (2017) provides this assessment of the Tinker's Butterflyfish:

> *The species is common and fairly widespread. Although it is occasionally collected for the aquarium trade, its deep-water habitat likely prevents the harvest of many specimens. Therefore, harvesting does not appear to be a major threat and there are no signs of significant decline. It is listed as Least Concern.*

A total of 5,561 Tinker's Butterflyfish were collected in the WHRFMA from 2000 to 2017 (DAR 2018a), representing 0.09% of the total White List Species collected over the same period. The average number of Tinker's Butterflyfish captured each year since 2000 was 309 individuals, ranging between 166 (2013) and 586 (2015) individuals collected (Table 5-13). Under the Pre-Aquarium Collection Ban Alternative, it is anticipated that between 170 and 590 Tinker's Butterflyfish would be collected annually over the 5-year analysis period.

Although listed as a Hawaiian SGCN, the IUCN (2017) provides this assessment of the Fisher's Angelfish:

> *Listed as Least Concern in view of its wide distribution, large overall population, relatively limited collection for the aquarium fish trade, no substantial habitat loss, and no major threats overall.*

A total of 1,538 Fisher's Angelfish were collected in the WHRFMA from 2002 to 2017 (DAR 2018a)[17], representing 0.03% of the total White List Species collected over the same period. The average number of Fisher's Angelfish captured each year since 2000 was 96 individuals, ranging between 22 (2004) and 288 (2017) individuals collected (Table 5-13). Under the Pre-Aquarium Collection Ban Alternative, it is anticipated that between 20 and 290 Fisher's Angelfish would be collected annually. Fisher's Angelfish have shown a significant increase in population within the Open Areas (Table 5-11), though it should be noted that this species tends to be a deeper water species, and the population estimates for WHAP are considered to be substantial underestimates (DAR 2019a).

WHRFMA population estimates for Psychedelic Wrasse and Fisher's Angelfish based on data collected in 2019 by the PIFSC-ESD (PIFSC 2020) and 2017/2018 WHAP WHRFMA and Open Area population estimates are shown in Table 5-13. No population estimate is available for the Tinker's Butterflyfish. Based on these estimates, and the minimum and maximum catch for each species over an 18-year period (all within the WHRFMA; fewer than three collectors reported these species in any given year in East Hawai'i, therefore, data were not disclosed[18]), the proportion of the WHRFMA population removed by the fishery ranges from less than 1% for Fisher's Angelfish to 10.30% to 30.47% for Psychedelic Wrasse (note that 30.47% is for a smaller depth range), and the proportion of the Open Area population ranges from less than 1% for the Fisher's Angelfish to 55.93% for the Psychedelic Wrasse.

However, Kane and Tissot (2017) demonstrate that densities of all three species are greater at depths below the 98-foot survey depth of the PIFSC-ESD surveys, suggesting that the actual populations of all two species with population estimates available are higher than those reported by the PIFSC-ESD and WHAP surveys, and the actual impact of commercial aquarium collection is lower than reported in Table 5-13. Also, even at these historic levels of collection, the Psychedelic Wrasse Open Area population has remained stable, and the Fisher's Angelfish Open Area population has significantly increased, as described above, suggesting sustainable levels of collection (WHAP does not provide population trend data on Tinker's Butterflyfish).

[17] Data not available for 2000 and 2001.
[18] Some collection data in East Hawai'i were disclosed by the 10 fishers (see Section 5.1), these data and the impacts on the population are provided in Table 5-15.

Table 5-13. 2019 PIFSC-ESD (2020) estimated populations of Psychedelic Wrasse, Tinker's Butterflyfish, and Fisher's Angelfish for the WHRFMA and 2017/2018 WHAP open area and WHRFMA population estimates (DAR 2019a, Dr. Bill Walsh personal communication, 2020) and percentage of populations collected by commercial aquarium fishers in the WHRFMA (DAR 2018a).

Species	0 - 98' WHRFMA Population (2019)[1]	30' -60' Open Area Population (2017/2018)[2]	30 - 60' WHRFMA Population (2017/2018)[2]	Minimum Collection per Year[3]	Maximum Collection per Year[3]	% of 0 - 98' WHRFMA Population	% of 30 - 60' Open Area Population	% of 30 - 60' WHRFMA Population
Psychedelic Wrasse	**5,813**	1,071	1,966	97	599	1.67%-10.30%	9.06%-55.93%	4.93%-30.47%
Tinker's Butterflyfish	**N/A**	N/A	NA	166	586	N/A	N/A	N/A
Fisher's Angelfish	**268,363**	59,064	59,258	22	288	<0.01%-0.11%	0.04%-0.49%	0.04%-0.49%

[1]All species population estimates are likely low due to the depths at which they occur.
[2]Pschedelic Wrasse and Fisher's Angelfish are only occasionally recorded on surveys, so these population estimates are underestimated. Tinker's Butterflyfish generally occurs in deeper habitats not adequately surveyed by transects.
[3]From 2000-2017

Based on deep diver observations, Tinker's Butterflyfish and Psychedelic Wrasse are substantially more common in the long term protected areas (MPAs) (DAR 2019a). Tinker's Butterflyfish is observed more often in Open Areas when compared to FRAs, while Psychedelic Wrasse observations are equivalent between these two areas (DAR 2019a).

East Hawai'i

Due to the low number of individual Aquarium Permits and low number of areas fished in East Hawai'i, reliable catch numbers are not available for the Psychedelic Wrasse, Fisher's Angelfish or Tinker's Butterflyfish in East Hawai'i. However, no Psychedelic Wrasse have been collected from East Hawai'i in 9 of the 18 years between 2000 and 2017 (DAR 2018a), and for the other 9 years, data were not disclosed (see Section 5.1). It is likely that Psychedelic Wrasse are primarily collected as a result of opportunistic collection by fishers while targeting other species. For the 10 fishers who disclosed their catch data (see Section 5.1), no collection of Psychedelic Wrasse occurred between 2000 and 2017 (see Table 5-15).

The same data limitations apply to the Tinker's Butterflyfish in East Hawai'i, though data from two years between 2000 and 2017 were disclosed (DAR 2018a). Collection of Tinker's Butterflyfish for these two years averaged 36 individuals per year collected in East Hawai'i, with a maximum of 38 individuals. Additional data disclosed by the 10 fishers (see Section 5.1) have collection of Tinker's Butterflyfish in East Hawai'i averaging 1 individual per year, with a maximum collection of 1 individual. No population estimate is available for the Tinker's Butterflyfish for East Hawai'i.

No Fisher's Angelfish have been reported as collected from East Hawai'i during the period 2000-2017.

Under the Pre-Aquarium Collection Ban Alternative, it is anticipated that annual collection of SGCN species over the 5-year analysis period would be similar to the catch from 2000 to 2017.

Reef Habitat

Herbivory

Multiple studies have documented the importance of the protection of herbivorous fish for reef recovery (e.g., Bellwood et al. 2004, Mumby and Steneck 2008, Hughes et al. 2010). Herbivores, which feed on marine algae, and especially coral scraping herbivores such as parrotfish (Scaridae), are widely considered to play a key role in the overall health and subsequent recovery of coral reefs after disturbances such as bleaching. The primary diet of the 40 White List Species is summarized in Table 5-14.

Table 5-14. White List Species and primary diet (Hoover 2008, Dr. Bill Walsh personal communication, 2020). Species proposed for the Revised White List are shown in bold.

Common Name(s)	Scientific Name	Diet
Blackside Hawkfish	*Paracirrhites forsteri*	Carnivore – small reef fishes and benthic invertebrates
Achilles Tang	*Acanthurus achilles*	Herbivore
Bird Wrasse	***Gomphosus varius***	**Carnivore – benthic invertebrates and small reef fish**
Black Durgon	*Melichthys niger*	Omnivore – algae and planton
Black Surgeonfish (Chevron Tang)	***Ctenochaetus hawaiiensis***	**Herbivore - primarily detritus**
Blacklip Butterflyfish (Coral Butterflyfish)	*Chaetodon kleinii*	Omnivore – soft corals, planton and algae
Bluestripe Snapper (Taape)	*Lutjanus kasmira*	Carnivore – benthic invertebrates and small fishes
Brown Surgeonfish (Lavender, Forktail Tang)	***Acanthurus nigrofuscus***	**Herbivore**
Eightline Wrasse	*Pseudocheilinus octotaenia*	Carnivore – benthic invertebrates and small reef fishes
Eyestripe Surgeonfish (Palani)	*Acanthurus dussumieri*	Herbivore - algae and detritus
Fisher's Angelfish	*Centropyge fisheri*	Omnivore – algae and benthic invertebrates
Flame Wrasse	*Cirrhilabrus jordani*	Planktivore
Forcepsfish	*Forcipiger flavissimus*	Carnivore - benthic invertebrates
Fourlined Wrasse	*Pseudocheilinus tetrataenia*	Carnivore – plankton, benthic invertebrates and fish eggs
Fourspot Butterflyfish	*Chaetodon quadrimaculatus*	Omnivore –benthic invertebrates, algae and coral
Gilded Triggerfish (Blue-throat Triggerfish)	*Xanthichthys auromarginatus*	Planktivore
Goldrim Tang	*Acanthurus nigricans*	Herbivore
Hawaiian Dascyllus (Domino)	*Dascyllus albisella*	Planktivore
Hawaiian Whitespotted Toby (Puffer)	*Canthigaster jactator*	Omnivore – benthic invertebrates, algae and detritus

Common Name(s)	Scientific Name	Diet
Kole (Goldring Surgeonfish, Yelloweye, Goldring)	***Ctenochaetus strigosus***	**Herbivore - primarily detritus**
Lei Triggerfish	*Sufflamen bursa*	Omnivore – algae, detritus, benthic invertebrates, and fish eggs
Longfin Anthias	*Pseudanthias hawaiiensis*	Planktivore
Milletseed (Lemon) Butterflyfish	*Chaetodon miliaris*	Carnivore – plankton and benthic invertebrates
Multiband (Pebbled) Butterflyfish	*Chaetodon multicinctus*	Omnivore – corals, benthic invertebrates and algae
Orangeband (Shoulder) Surgeonfish	*Acanthurus olivaceus*	Herbivore
Orangespine Unicornfish (Clown Tang, Naso Tang)	***Naso lituratus***	**Herbivore – leafy seaweeds**
Ornate Wrasse (Pinkface)	*Halichoeres ornatissimus*	Carnivore –benthic invertebrates
Peacock Grouper (Roi, bluespot Peacock Grouper)	*Cephalopholis argus*	Carnivore – small reef fishes and benthic invertebrates
Pencil Wrasse	*Pseudojuloides cerasinus*	Carnivore or planktivore
Potter's Angelfish	***Centropyge potteri***	**Herbivore – detritus and algae**
Psychedelic Wrasse	*Anampses chrysocephalus*	Carnivore/Planktivore
Pyramid Butterflyfish	*Hemitaurichthys polylepis*	Planktivore
Redbarred Hawkfish	*Cirrhitops fasciatus*	Carnivore – benthic invertebrates
Saddle Wrasse	*Thalassoma duperrey*	Carnivore – benthic invertebrates and planktivore
Shortnose (Geoffroy's) Wrasse	*Macropharyngodon geoffroy*	Carnivore – marine snails
Spotted Boxfish (Boxfish)	*Ostracion meleagris*	Omnivore – benthic invertebrates and algae
Thompson's Surgeonfish	***Acanthurus thompsoni***	**Planktivore**
Tinker's Butterflyfish	*Chaetodon tinkeri*	Carnivore – benthic invertebrates and plankton
Yellow Tang	***Zebrasoma flavescens***	**Herbivore**
Yellowtail Coris (Clown Wrasse)	*Coris gaimard*	Carnivore - invertebrates

Bellwood et al. (2004) noted that three types of herbivores – bioeroders, scrapers and grazers, work together to enable the recovery of coral reefs. Bioeroders remove dead corals, scrapers directly remove algae and sediment, and grazers remove seaweed. These actions expose the reef matrix for settlement, facilitate settlement, growth and survival, and reduce overgrowth and shading by macro-algae (Bellwood et al. 2004). Possessing these functional groups is central to a reef's capacity to resist phase shifts, regenerate, and retain critical functions in the face of disturbance (Bellwood et al. 2004).

Herbivores are key to maintaining low algal abundance (e.g., Mumby and Steneck 2008). As described in Hughes et al. (2010), depletion of herbivores can result in dense stands of macroalgae, preventing the return of corals by shading, destabilizing microbial communities, and promoting coral disease.

Mumby and Steneck (2008) defined an unhealthy reef as one lacking the resilience needed for natural recovery, which can be caused by overharvesting of herbivores. Furthermore, top-down control of algal blooms (compared to bottom-up or nutrient-controlled causes) exerts the dominant influence (Mumby and Steneck 2008). However, algal blooms are reversible if higher abundance of herbivorous fish can be achieved (Hughes et al. 2010).

Despite the overwhelming evidence of the importance of herbivores, the scientific evidence is not always clear that increasing herbivore populations will necessarily enhance coral reef recovery. While a number of field and experimental studies have found such a relationship (e.g. Hughes et al. 2007, Mumby and Harborne 2010, Burkepile and Hay 2010, Rasher et al. 2010) other studies have not (e.g. Carassou et al. 2013, McClanahan 2008, Graham et al. 2008, Kramer and Heck 2007, Mora 2008).

Herbivorous fish constitute roughly 50% of total fish biomass in West Hawai'i (DAR 2019a, Gove et al. 2019). The four largest groups of herbivorous coral reef fishes are the parrotfishes, damselfishes (Pomacentridae), rabbitfishes (Siganidae), and surgeonfishes (Acanthuridae). No parrotfishes or rabbitfishes (none present in Hawai'i) are included on the White List, and therefore cannot be collected by commercial aquarium fishers in the WHRFMA. Only one damselfish, the Hawaiian Dascyllus (Section 4.4.1.26), is included on the White List and can be collected. However, Hawaiian Dascyllus are not herbivores and the average number collected per year since 2000 is 1 in East Hawai'i and 119 in the WHRFMA (Table 5-15 and 5-16). Therefore, the herbivorous fish collected by aquarium fishers are predominantly surgeonfishes.

Foo et al. (2021) found that surgeonfish biomass declines are linked most strongly to changes in reef rugosity (a metric of reef topography). Regarding fishing pressure, they found that MPAs that prohibited a combination of lay nets, aquarium collection, and spear fishing were most effective in maintaining and/or increasing fish biomass across all functional groups; however, the study did not look at the impact of banning just aquarium fishing. The study did find that, for all groups, there biomass was significantly greater in areas that banned spear fishing compared to areas that did not ban spear fishing. Jouffray et al. (2015) found that throughout the Hawaiian archipelago, there was a positive relationship between scraper herbivore (i.e., parrotfish) biomass and structurally complex coral and crustose coralline algae dominated sites, compared to sites that were predominately grazers (e.g., surgeonfishes), where the probability of turf algae dominance increases. Foo et al. (2021) found that commercial fishing has led to decreases in parrotfish biomass in the WHRFMA, where current commercial fishing levels are negatively affecting scraper populations. As noted above, the herbivorous fish collected by aquarium fishers are predominantly surgeonfishes, and no parrotfish can be collected by commercial aquarium collectors in the WHRFMA.

Kelly et al. (2017) examined the role of herbivores in an herbivore management area off Maui, where take of herbivores is prohibited. The study found that larger size classes of "scraper/excavator" herbivorous fish contributed more to consumption as time progressed from when the area was established. All herbivorous fish observed off Maui predominately fed off turf algae, including the Orangeband Surgeonfish, Brown

Surgeonfish, Kole, Yellow Tang and Orangespine Unicornfish, which are all on the White List (Kelly et al. 2016).

Herbivores collected by the aquarium fishery typically consist of the smaller size classes, either by regulation (e.g., HAR 13-60.4 prohibits the collection of more than 5 Yellow Tang/day larger than 4.5 inches) or by market demand (i.e., minimal market for large adult fish in the aquarium trade). It is noted that small grazers can be important for turf algae and macroalgal removal (Kelly et al. 2017). In addition, bag limits are in place for the three White List Species (5 Yellow Tang >4.5" and 5 fish <2"; 5 Kole >4" [AQ fishers only] ; and Achilles Tang [10 fish/day]) that have made up 93.3% of all individuals collected by commercial aquarium fishers in the WHRFMA since 2000 (Section 5.4.1.3). Even with making up the highest proportion of the catch, WHAP data indicate populations of Yellow Tang and Kole continue to increase (Section 5.4.1.3).

Additionally, DAR (2019a) reported that herbivore biomass has not changed since 2003 in the Open Areas or FRAs and has increased by 30.8% in the MPAs. While there has been no significant change in Open Areas or FRAs, there has still been an increasing trend, with a 14.4% increase in herbivore biomass in FRAs and a 26.0% increase in herbivore biomass in Open Areas between 2003 and 2017 (DAR 2019a, Gove et al. 2019). This occurred even with the pressures from commercial aquarium collection, which was occurring during this time. Furthermore, the marked increase in herbivore biomass in more restrictive MPAs, and the fact that there is no significant difference between Open Areas and FRAs, indicates that any declining trends or differences in herbivore biomass are not due to aquarium collection, but rather due to other types of fishing (i.e., food fishing).

Given the conflicting data on the role of herbivores on reef recovery, Adam et al. (2015) provided the following recommendations:

1. Local management efforts should focus on minimizing direct sources of coral mortality (e.g., sedimentation and pollution), as well as restoring ecological processes (e.g., herbivory). Reducing nutrient inputs may mitigate negative impacts of ocean warming, and may also reduce algal productivity, facilitating the control of algae by herbivores.

2. Maintaining healthy herbivore populations, especially parrotfishes, can mitigate the negative impacts of ocean warming since abundant herbivores can control algae that inhibit coral recovery following coral decline.

3. Implementation of marine protected areas or other spatial restrictions on herbivore harvest will only be effective if also sustainably managing herbivore populations outside of the protected areas.

Under the Pre-Aquarium Collection Ban Alternative, these three recommendations would be met as follows:

1. No direct sources of coral mortality would be added to the environment.

2. Parrotfish cannot be collected in the WHRFMA, and therefore no impacts to parrotfish populations are anticipated. Other herbivorous fish collected would not change from historic trends. While there has been no significant change in Open Areas or FRAs, there has still been an increasing trend,

with a 14.4% increase in herbivore biomass in FRAs and a 26.0% increase in herbivore biomass in Open Areas between 2003 and 2017 (DAR 2019a, Gove et al. 2019).

3. Existing protected areas in the WHRFMA would remain. DAR (2019a) reported that herbivore biomass has not changed since 2003 in the Open Areas or FRAs and has increased by 30.8% in the MPAs. Based on the lack of decrease in both FRAs and Open Areas, this indicates that historic aquarium collection is sustainable.

Coral Damage and Overall Coral Cover

Similar to any other boat user group, it is possible that coral could be inadvertently damaged by an anchor. In addition, similar to other user groups who interact with the reefs, the activities of aquarium collectors could inadvertently damage coral. However, in a study analyzing the effects of aquarium collectors on coral reefs in Kona, Hawai'i, Tissot and Hallacher (2003) concluded that there were no significant differences in damaged coral between control and collected sites (i.e., sites where aquarium collection occurs) to indicate the presence of destructive fishing practices. In addition, they found no increases in the abundance of macroalgae where the abundance of herbivores was reduced by aquarium collecting, though as noted above, turf algae is the primary food of herbivores, and thus healthy herbivore populations are critical for healthy coral populations. It is also noted that this study took place prior to the 2014/2015 bleaching events.

The DAR has been conducting related observations since 2003 (DAR 2018c). Monitoring of coral reef benthic cover is conducted approximately every 4 years at 25 permanent monitoring sites, though it was not designed to score acute coral damage at fine scales. Monitoring is conducted more frequently if substantial benthic change occurs between regular sampling years (e.g. after a coral bleaching event). The analysis compares the presence or absence of commercial aquarium collecting in West Hawai'i relative to overall coral cover and changes in coral cover. Major results of the study are presented below:

- Coral cover was slightly higher within areas closed to the commercial aquarium fishery compared to Open Areas, but the difference was not statistically significant for any year of monitoring (2003: $p = 0.276$; 2007: $p = 0.275$; 2011: $p = 0.496$; 2014: $p = 0.554$; 2016: $p = 0.673$; 2017: $p = 0.782$). Additionally, there was no apparent trend of declining coral cover in the Open Areas over time.

- From 2003 to 2017, overall mean coral cover declined less within Open Areas compared to areas closed to commercial aquarium collection (Closed areas: -22.5% ± 3.4%; Open Areas: -15.5% ± 2.3%), but this difference in change in coral cover was not significant ($p = 0.093$).

- From 2014 to 2016, West Hawai'i experienced a severe coral bleaching and mortality event, which peaked in the fall of 2015. Over this time-period, overall mean coral cover decline was slightly less in the areas open to commercial aquarium collection, but again, the difference was not significant (Closed areas: -19.6 % ± 6.0 %; Open Areas: -17.6 % ± 1.3 %; $p = 0.605$).

- From 2016 to 2017, approximately one year after coral post-bleaching mortality subsided, minimal change in coral cover was documented within areas open to commercial aquarium collection (Open Areas: 0.07 % ± 2.1 %), compared to a slight decline in mean coral cover in areas closed to collection (Closed: -1.94 % ± 2.3 %), and this difference was statistically significant ($p = 0.038$).

While these two studies do not indicate significant differences between fished and unfished areas, that does not mean that no damage occurs. However, until further studies are conducted, they provide the best available science on the direct effects of commercial aquarium collection on coral.

Impact of Collection on White List Species Populations

Populations that have remained stable or increased between 2000-2017 when aquarium collection was occurring would be anticipated to continue to remain stable or increase with continued collection. Declines are harder to evaluate, as aquarium collection is not the only stressor on these populations (see Section 5.4.3 for a discussion on cumulative impacts), and as noted by the DAR (2019a), the 12 species on the White List with declining populations are declining in both areas open and closed to commercial aquarium fishing for all but one species, indicating that aquarium collection is not driving the decline. Nonetheless, it is anticipated that these 12 species would continue to decline under the Pre-Aquarium Collection Ban Alternative, and that the 11 species declining in multiple management areas would continue to decline under any of the alternatives under consideration.

This Section summarizes the White List Species collection data under the Pre-Aquarium Collection Ban Alternative, as well as population estimates, into tabular format (Table 5-15 and Table 5-16). The primary purpose of the data analysis in regard to White List Species was to estimate, as accurately as possible, what the current populations of White List Species are in East Hawai'i (Table 5-15) and the WHRFMA (Table 5-16), what level of collection was occurring in those populations prior to the 2017 ban on aquarium collection, and the average and maximum proportion of the population collected annually for the period 2000-2017 for each species. It should be noted that the average is based only on years with reported catch, and therefore results in potentially high estimates due to excluding years in which zero were caught. The 2019 PIFSC-ESD (PIFSC 2020) data provided by the NOAA are comprehensive in both scope and

Table 5-15. Summary of 2019 PIFSC-ESD (2020) population estimates, disclosed catch data from East and West Hawai'i since 2000 (DAR 2018a), and the impact of average (including only years with reported catch) and maximum annual collection by species for the 40 White List Species. n.d. = Not Disclosed (Section 5.1); NA = Insufficient data available. Historic collection data applies to the CML-only Alternative, Pre-Aquarium Collection Ban Alternative, WHRFMA-only Programmatic Issuance of Aquarium Permits Alternative, Achilles Tang Conservation Alternative, and the Limited Permit Issuance Alternative. Historic collection data does not apply to the Revised White List and Limited Permit Issuance Alternative since collection will be limited by the individual catch quotas.

Common Name	East Hawai'i Pop. Mean (lower-upper estimate limit) (PIFSC-ESD 2020)	East Hawai'i (DAR 2018a) (numbers from 10 fishers in parenthesis; DAR 2019b)			
		Average Catch per year	Maximum Catch per Year	Average Percent of Hawai'i Pop.	Max Percent of Hawai'i Pop.
Achilles Tang	185,259 (72,966-297,552)	703 (52)	1,525 (142)	0.38% (0.03%)	0.82% (0.08%)
Bird Wrasse	196,231 (72,296-320,166)	n.d. (0)	n.d. (0)	NA (0.00%)	NA (0.00%)
Black Durgon	514,378 (201,856-826,900)	n.d. (0)	n.d. (0)	NA (0.00%)	NA (0.00%)
Black Surgeonfish	110,361 (0-230,830)	n.d. (9)	n.d. (15)	NA (<0.01%)	NA (0.01%)
Blacklip Butterflyfish	387,141 (0-1,053,257)	n.d. (0)	n.d. (0)	NA (0.00%)	NA (0.00%)
Blackside Hawkfish	149,287 (55,951-242,623)	n.d. (0)	n.d. (0)	NA (0.00%)	NA (0.00%)
Bluestripe Snapper - Taape	1,525,714 (801,353-2,250,076)	0 (0)	0 (0)	0.00% (0.00%)	0.00% (0.00%)
Brown Surgeonfish	3,777,626 (2,645,288-4,909,965)	n.d. (0)	n.d. (0)	NA (0.00%)	NA (0.00%)
Eightline Wrasse	127,551 (32,482-222,620)	n.d. (0)	n.d. (0)	NA (0.00%)	NA (0.00%)
Eyestripe Surgeonfish	365,994 (215,909-516,079)	n.d. (0)	n.d. (0)	NA (0.00%)	NA (0.00%)
Fisher's Angelfish	11,697 (0-35,075)	0 (0)	0 (0)	0.00% (0.00%)	0.00% (0.00%)
Flame Wrasse	NA	n.d. (0)	n.d. (0)	NA	NA
Forcepsfish	251,206 (127,813-374,599)	21 (0)	27 (0)	<0.01% (0.00%)	0.01% (0.00%)
Fourline Wrasse	114,627 (5,683-223,616)	n.d. (0)	n.d. (0)	NA (0.00%)	NA (0.00%)

Common Name	East Hawai'i Pop. Mean (lower-upper estimate limit) (PIFSC-ESD 2020)	East Hawai'i (DAR 2018a) (numbers from 10 fishers in parenthesis; DAR 2019b)			
		Average Catch per year	Maximum Catch per Year	Average Percent of Hawai'i Pop.	Max Percent of Hawai'i Pop.
Fourspot Butterflyfish	378,603 (250,718-506,487)	30 (1)	30 (1)	<0.01% (<0.01%)	<0.01% (<0.01%)
Gilded Triggerfish	NA	n.d. (0)	n.d. (0)	NA	NA
Goldrim Tang	21,495 (0-64,464)	27 (2)	55 (2)	0.13% (<0.01%)	0.26% (<0.01%)
Kole	1,331,404 (785,880-1,876,927)	1,047 (21)	3,601 (27)	0.08% (<0.01%)	0.27% (<0.01%)
Hawaiian Dascyllus	22,690 (0-68,050)	12 (0)	12 (0)	0.05% (0.00%)	0.05% (0.00%)
Hawaiian Whitespotted Toby	443,961 (304,578-583,345)	n.d. (0)	n.d. (0)	NA (0.00%)	NA (0.00%)
Lei Triggerfish	685,297 (549,748-820,846)	n.d. (0)	n.d. (0)	NA (0.00%)	NA (0.00%)
Longfin Anthias	NA	n.d. (0)	n.d. (0)	NA	NA
Milletseed Butterflyfish	493,360 (0-1,199,830)	n.d. (1)	n.d. (1)	NA (<0.01%)	NA (<0.01%)
Multiband Butterflyfish	320,777 (166,458-475,095)	n.d. (0)	n.d. (0)	NA (0.00%)	NA (0.00%)
Orangeband Surgeonfish	885,926 (518,461-1,253,391)	16 (0)	16 (0)	<0.01% (0.00%)	<0.01% (0.00%)
Orangespine Unicornfish	478,551 (319,899-637,204)	36 (8)	59 (8)	<0.01% (<0.01%)	0.01% (<0.01%)
Ornate Wrasse	898,641 (569,991-1,227,290)	15 (1)	15 (1)	<0.01% (<0.01%)	<0.01% (<0.01%)
Peacock Grouper - Roi	172,341 (100,630-244,052)	n.d. (0)	n.d. (0)	NA (0.00%)	NA (0.00%)
Pencil Wrasse	14,314 (0-34,554)	n.d. (0)	n.d. (0)	NA (0.00%)	NA (0.00%)
Potter's Angelfish	236,771 (89,929-383,613)	n.d. (0)	n.d. (0)	NA (0.00%)	NA (0.00%)
Psychedelic Wrasse	6,976 (0-20,921)	n.d. (0)	n.d. (0)	NA (0.00%)	NA (0.00%)
Pyramid Butterflyfish	NA	n.d. (0)	n.d. (0)	NA	NA
Redbarred Hawkfish	162,539 (66,624-258,454)	n.d. (0)	n.d. (0)	NA (0.00%)	NA (0.00%)

Common Name	East Hawai'i Pop. Mean (lower-upper estimate limit) (PIFSC-ESD 2020)	East Hawai'i (DAR 2018a) (numbers from 10 fishers in parenthesis; DAR 2019b)			
		Average Catch per year	Maximum Catch per Year	Average Percent of Hawai'i Pop.	Max Percent of Hawai'i Pop.
Saddle Wrasse	3,319,375 (2,522,299-4,116,450)	9 (0)	9 (0)	<0.01% (0.00%)	<0.01% (0.00%)
Shortnose Wrasse	44,480 (473-88,487)	9 (0)	9 (0)	0.02% (0.00%)	0.02% (0.00%)
Spotted Boxfish	51,632 (11,233-92,031)	n.d. (0)	n.d. (0)	NA (0.00%)	NA (0.00%)
Thompson's Surgeonfish	302,538 (0-907,330)	n.d. (0)	n.d. (0)	NA (0.00%)	NA (0.00%)
Tinker's Butterflyfish	NA	36 (1)	38 (1)	NA	NA
Yellow Tang	329,557 (153,969-505,145)	11,996 (1,251)	33,809 (3,629)	3.64% (0.38%)	10.26% (1.10%)
Yellowtail Coris	118,139 (25,419-210,860)	17 (0)	18 (0)	0.01% (0.00%)	0.02% (0.00%)

[1]In some instances, the maximum catch of the 10 fishers who disclosed their data is greater than the maximum catch previously reported. This is likely due to data that had previously not been disclosed (see Section 5.1).
[2]Based on the sums of the average or maximum from East Hawai'i and the average or maximum from West Hawai'i.

Table 5-16. Summary of 2019 PIFSC-ESD (2020) population estimates, 2017/2018 WHAP population estimates (DAR 2019a, Dr. Bill Walsh personal communication, 2020), disclosed catch data from the WHRFMA since 2000 (DAR 2018a), and the impact of average (including only years with reported catch) and maximum annual collection by species for the 40 White List Species. n.d. = Not Disclosed (Section 5.1); NA = Insufficient data available. Historic collection data applies to the Pre-Aquarium Collection Ban Alternative, WHRFMA-only Programmatic Issuance of Aquarium Permits Alternative, Achilles Tang Conservation Alternative, and the Limited Permit Issuance Alternative. Historic collection data does not apply to the Revised White List and Limited Permit Issuance Alternative since collection will be limited by the individual catch quotas.

Common Name	WHRFMA (DAR 2018a) (numbers from 10 fishers in parenthesis; DAR 2019b)		2017/2018 WHAP Data (DAR 2019a, Dr. Bill Walsh personal comm., 2020)						2019 PIFSC-ESD Data (PIFSC-ESD 2020)		
	Average Catch per year	Maximum Catch per Year[1]	Open Area (30'-60') Population Estimate	Average Percent of Open Area Pop.	Max Percent of Open Area Pop.	WHRFMA (30'-60') Population Estimate (Open Areas, FRAs and MPAs)	Average Percent of WHRFMA Pop.	Max Percent of WHRFMA Pop.	WHRFMA Pop. Mean (lower-upper estimate limit)	Average Percent of WHRFMA Pop.	Max Percent of WHRFMA Pop.
Achilles Tang[3]	5,600 (1,809)	5,757 (2,157)	13,796	40.6% (13.1%)	41.7% (15.6%)	21,494	26.1% (8.4%)	26.8%	27,392 (0-62,341)	20.44% (6.60%)	21.02% (7.87%)
Bird Wrasse	345 (55)	624 (103)	66,581	<0.1% (<0.1%)	<0.1% (<0.1%)	130,529	0.3% (<0.1%)	0.5%	420,492 (236,468-604,517)	0.08% (0.01%)	0.15% (0.02%)
Black Durgon	64 (9)	143 (69)	92,354	<0.1% (<0.1%)	0.1% (<0.1%)	186,595	<0.1% (<0.1%)	0.1%	1,087,628 (189,402-1,985,853)	<0.01% (<0.01%)	0.01% (<0.01%)
Black Surgeonfish	3,535 (619)	8,598 (1,813)	98,067	3.6% (0.6%)	8.8% (1.8%)	156,701	2.3% (0.4%)	5.5%	315,065 (168,732-461,398)	1.12% (0.20%)	2.73% (0.58%)
Blacklip Butterflyfish	72 (22)	129 (64)	39,734	0.2% (<0.1%)	0.3% (0.2%)	44,203	0.2% (<0.1%)	0.3%	43,768 (0-131,261)	0.10% (0.05%)	0.29% (0.15%)
Blackside Hawkfish	42 (14)	85 (43)	23,625	0.2% (<0.1%)	0.4% (0.2%)	39,371	0.1% (<0.1%)	0.2%	77,476 (26,047-128,905)	0.05% (0.02%)	0.11% (0.06%)
Bluestripe Snapper - Taape	43 (19)	98 (52)	33,290	0.1% (<0.1%)	0.3% (0.2%)	79,907	0.1% (<0.1%)	0.1%	174,851 (71,232-278,470)	0.02% (0.01%)	0.06% (0.03%)
Brown Surgeonfish	891 (243)	2,476 (600)	2,980,402	<0.1% (<0.1%)	<0.1% (<0.1%)	4,140,802	<0.1% (<0.1%)	0.1%	4,336,269 (2,788,493-5,884,044)	0.02% (<0.01%)	0.06% (0.01%)
Eightline Wrasse	119 (26)	390 (69)	187,930	<0.1% (<0.1%)	0.2% (<0.1%)	271,982	<0.1% (<0.1%)	0.1%	249,438 (120,905-377,972)	0.05% (0.01%)	0.16% (0.03%)
Eyestripe Surgeonfish[4]	403 (18)	1,143 (30)	NA	NA	NA	1,185	34.0% (1.5%	96.5% (2.5%)	49,219 (7,905-90,533)	0.82% (0.04%)	2.32% (0.06%)
Fisher's Angelfish[4]	96 (66)	288 (257)	59,064	0.2% (0.1%)	0.5% (0.4%)	59,258	0.2% (0.1%)	0.5% (0.4%)	268,363 (0-621,616)	0.04% (0.02%)	0.11% (0.10%)

Common Name	WHRFMA (DAR 2018a) (numbers from 10 fishers in parenthesis; DAR 2019b)		2017/2018 WHAP Data (DAR 2019a, Dr. Bill Walsh personal comm., 2020)						2019 PIFSC-ESD Data (PIFSC-ESD 2020)		
	Average Catch per year	Maximum Catch per Year[1]	Open Area (30'-60') Population Estimate	Average Percent of Open Area Pop.	Max Percent of Open Area Pop.	WHRFMA (30'-60') Population Estimate (Open Areas, FRAs and MPAs)	Average Percent of WHRFMA Pop.	Max Percent of WHRFMA Pop.	WHRFMA Pop. Mean (lower-upper estimate limit)	Average Percent of WHRFMA Pop.	Max Percent of WHRFMA Pop.
Flame Wrasse	75 (24)	168 (73)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Forcepsfish	1,831 (484)	3,152 (864)	39,734	4.6% (1.2%)	7.9% (2.2%)	81,490	2.2% (0.6%)	3.9% (1.1%)	210,290 (125,955-294,624)	0.87% (0.23%)	1.02% (0.41%)
Fourline Wrasse	73 (23)	171 (64)	227,663	<0.1% (<0.1%)	<0.1% (<0.1%)	348,400	<0.1% (<0.1%)	<0.1% (<0.1%)	91,698 (33,756-149,640)	0.08% (0.03%)	0.19% (0.07%)
Fourspot Butterflyfish	889 (202)	1,630 (377)	15,034	5.9% (1.3%)	10.8% (2.5%)	18,932	4.7% (1.1%)	8.6% (2.0%)	126,564 (54,278-198,851)	0.70% (0.16%)	1.29% (0.30%)
Gilded Triggerfish	45 (6)	157 (19)	3,222	1.4% (0.2%)	4.9% (0.6%)	8,895	0.5% (0.1%)	1.8% (0.2%)	69,871 (0-149,078)	0.06% (<0.01%)	0.22% (0.03%)
Goldrim Tang	554 (156)	1,324 (651)	5,966	9.3% (2.6%)	22.2% (10.9%)	13,832	4.0% (1.1%)	9.6% (4.7%)	70,723 (0-185,569)	0.78% (0.22%)	1.87% (0.92%)
Hawaiian Dascyllus	119 (47)	231 (125)	63,359	0.2% (<0.1%)	0.4% (0.2%)	83,475	0.1% (0.1%)	0.3% (0.1%)	87,254 (0-180,358)	0.14% (0.05%)	0.26% (0.14%)
Hawaiian Whitespotted Toby	257 (100)	896 (539)	249,141	0.1% (<0.1%)	0.4% (0.2%)	328,806	0.1% (<0.1%)	0.3% (0.2%)	381,051 (218,496-543,606)	0.07% (0.03%)	0.24% (0.14%)
Kole	30,700 (9,066)	42,112 (23,014)	5,312,745	0.6% (0.2%)	0.8% (0.4%)	9,555,712	0.3% (0.1%)	0.4% (0.2%)	6,655,072 (5,210,408-8,099,735)	0.46% (0.14%)	0.63% (0.35%)
Lei Triggerfish	172 (67)	301 (252)	92,354	0.2% (<0.1%)	0.3% (0.3%)	142,699	0.1% (<0.1%)	0.2% (0.2%)	365,354 (258,661-472,047)	0.05% (0.02%)	0.08% (0.07%)
Longfin Anthias	102 (3)	102 (5)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Milletseed Butterflyfish	106 (68)	421 (402)	2,148	4.9% (3.2%)	19.6% (18.7%)	2,259	4.7% (3.0%)	18.6% (17.8%)	14,533 (0-35,023)	0.73% (0.47%)	2.90% (2.77%)
Multiband Butterflyfish	1,206 (227)	2,951 (651)	378,843	0.3% (<0.1%)	0.8% (0.2%)	810,451	0.1% (<0.1%)	0.4% (0.1%)	800,686 (504,860-1,096,513)	0.15% (0.03%)	0.37% (0.08%)
Orangeband Surgeonfish	828 (226)	2,306 (631)	53,694	1.5% (0.4%)	4.3% (1.2%)	77,641	1.1% (0.3%)	3.0% (0.8%)	276,512 (105,772-447,252)	0.30% (0.08%)	0.83% (0.23%)
Orangespine Unicornfish	5,827 (1,419)	8,813 (3,330)	180,099	3.2% (0.8%)	4.9% (1.8%)	266,945	2.2% (0.5%)	3.3% (1.2%)	512,857 (380,373-645,342)	1.14% (0.28%)	0.98% (0.65%)
Ornate Wrasse	1,657 (361)	12,445 (1,130)	196,879	0.8% (0.2%)	6.3% (0.6%)	254,626	0.7% (0.1%)	4.9% (0.4%)	451,108 (201,078-701,139)	0.37% (0.08%)	2.76% (0.25%)
Peacock Grouper - Roi	3 (0)	3 (0)	51,546	<0.1% (0.0%)	<0.1% (0.0%)	101,016	<0.1% (0.0%)	<0.1% (0.0%)	279,962 (205,111-354,813)	<0.01% (0.00%)	<0.01% (0.00%)
Pencil Wrasse	165 (69)	424 (287)	17,182	1.0% (0.4%)	2.5% (1.7%)	27,016	0.6% (0.3%)	1.6% (1.1%)	87,423 (6,330-168,515)	0.19% (0.08%)	0.48% (0.33%)

Common Name	WHRFMA (DAR 2018a) (numbers from 10 fishers in parenthesis; DAR 2019b)		2017/2018 WHAP Data (DAR 2019a, Dr. Bill Walsh personal comm., 2020)						2019 PIFSC-ESD Data (PIFSC-ESD 2020)		
	Average Catch per year	Maximum Catch per Year[1]	Open Area (30'-60') Population Estimate	Average Percent of Open Area Pop.	Max Percent of Open Area Pop.	WHRFMA (30'-60') Population Estimate (Open Areas, FRAs and MPAs)	Average Percent of WHRFMA Pop.	Max Percent of WHRFMA Pop.	WHRFMA Pop. Mean (lower-upper estimate limit)	Average Percent of WHRFMA Pop.	Max Percent of WHRFMA Pop.
Potter's Angelfish	1,086 (451)	3,370 (1,379)	265,488	0.4% (0.2%)	1.3% (0.5%)	424,980	0.3% (0.1%)	0.8% (0.3%)	437,617 (248,818-626,416)	0.25% (0.10%)	0.77% (0.32%)
Psychedelic Wrasse[4]	274 (121)	599 (390)	1,071*	25.6% (11.3%)	55.9% (36.4%)	1,966	13.9% (6.2%)	30.5% (19.8%)	5,813 (0-13,835)	4.71% (2.08%)	10.30% (6.71%)
Pyramid Butterflyfish	133 (52)	714 (375)	37,586	0.4% (0.1%)	1.9% (1.0%)	42,610	0.3% (0.1%))	1.7% (0.9%)	NA	NA	NA
Redbarred Hawkfish	13 (4)	21 (8)	6,443	0.2% (<0.1%)	0.3% (0.1%)	8,902	0.1% (<0.1%)	0.2% (0.1%)	11,626 (0-25,299)	0.11% (0.03%)	0.18% (0.07%)
Saddle Wrasse	602 (166)	982 (413)	140,947	0.4% (0.1%)	0.7% (0.3%)	773,758	0.1% (<0.1%)	0.1% (0.1%)	2,569,788 (1,740,947-3,398,628)	0.02% (<0.01%)	0.04% (0.02%)
Shortnose Wrasse	228 (134)	582 (390)	3,222	7.1% (4.2%)	18.1% (12.1%)	4,669	4.9% (2.9%)	12.5% (8.4%)	48,099 (0-107,531)	0.47% (0.28%)	1.21% (0.81%)
Spotted Boxfish	170 (126)	454 (275)	12,887	1.3% (1.0%)	3.5% (2.1%)	19,468	0.9% (0.6%)	2.3% (1.4%)	11,626 (835-22,418)	1.46% (1.08%)	3.91% (2.37%)
Thompson's Surgeonfish	182 (50)	947 (238)	271,693	<0.1% (<0.1%)	0.3% (<0.1%)	380,593	<0.1% (<0.1%)	0.2% (0.1%)	201,230 (0-419,166)	0.09% (0.02%)	0.47% (0.12%)
Tinker's Butterflyfish[4]	309 (43)	586 (159)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Yellow Tang	271,430 (68,184)	386,767 (130,152)	2,867,048	9.5% (2.4%)	13.5% (4.5%)	5,690,643	4.8% (1.2%)	6.8% (2.3%)	6,087,924 (4,194,149-7,981,699)	4.46% (1.12%)	6.35% (2.14%)
Yellowtail Coris	575 (172)	851 (434)	18,256	3.1% (0.9%)	4.7% (2.4%)	34,322	1.7% (0.5%)	2.5% (1.3%)	146,227 (43,658-248,795)	0.39% (0.12%)	0.58% (0.30%)

[1]In some instances, the maximum catch of the 10 fishers who disclosed their data is greater than the maximum catch previously reported. This is likely due to data that had previously not been disclosed (see Section 5.1).
[2]Based on the sums of the average or maximum from East Hawai'i and the average or maximum from West Hawai'i.
[3]The average and maximum catch for the Achilles Tang in the WHRFMA is limited to 2015-2017 data, after the implementation of the 2014 bag limit, to more accurately reflect future trends.
[4]These species are all noted by the DAR to not be adequately surveyed by WHAP transects, and any available WHAP population estimates are therefore likely low.

spatial coverage and provide as accurate a depiction of population numbers as possible for the WHRFMA and East Hawai'i. The DAR (2018a) catch data provide collection numbers to allow for impact analysis. As noted throughout this Revised FEIS, confidentiality regulations (HRS §189-3) and changes in the manner in which data were collected over the years did impact the analysis but was mitigated by the approach used during the analysis (i.e., using aggregate numbers). This method presents the most inclusive evaluation of the impact of the commercial aquarium fish collection on each of the 40 White List Species. Nevertheless, an analysis of the impact based on the WHAP Open Area and WHAP WHRFMA population estimates is also provided for comparison purposes in Table 5-16 (WHAP population estimates are only applicable to the WHRFMA and are thus not included in the table for East Hawai'i). It should be noted that the WHAP population estimates are for the 30' to 60' depth only, compared to the PIFSC-ESD population estimates which are from 0' to 98' in depth.

While research into the reproductive biology and fecundity (i.e., ability to produce offspring) of specific species of reef fish is limited in availability, some generalities can be derived from available research, and most reef species are long-lived and highly productive. For reef fishes in general, the relationship between size and fecundity is well documented, with larger fish producing exponentially more eggs (Thresher 1984, Berkeley et al. 2004). Moreover, evidence from a diverse set of species indicates that older individuals produce larger, faster growing, and more starvation-resistant larvae (Thresher 1984, Bobko and Berkeley 2004). For these reasons, Birkeland and Dayton (2005) recommend protecting larger or older individuals to increase the sustainability of harvested populations.

Yellow Tang is a species which provides a good example of high fecundity, as well as the relationship between size and fecundity. Bushnell et al. (2010) studied Yellow Tang and found large individual variation in batch fecundity, with a range from 44 to >24,000 eggs per female produced on a single sampling date. Smaller females (3.1-4.75-inch standard length [LS]), produced limited numbers of eggs, while larger females (≥4.75-inch LS) were capable of maximal egg production (>20,000 eggs per batch). Bushnell et al. (2010) estimated the annual fecundity of Yellow Tang to average 1,055,628 eggs per female (with a standard error of 120,596 eggs).

In addition to high levels of fecundity, many reef fish are long-lived. Choat and Axe (1996) studied four *Naso* species in the Great Barrier Reef, and found life spans of 35 to 40 years, with rapid growth during the first 3 to 4 years of life. Eble et al. (2009) found that the Hawaiian kala (*Naso unicornis*) is also long-lived, with rapid initial growth. Sampled kala ranged in age from 1 to 58 years with the majority of growth occurring within the first 15% of the life span. These two studies indicate that *Naso* species in general exhibit life-spans in excess of 40 years (Eble et al. 2009). While studying habitat- and sex-specific life history patterns of Yellow Tang, Claisse et al. (2009) found a 41-year old individual. In addition, they found median size and age at the transition between deeper coral-rich and shallow turf dominated habitat use were about 0.75 inch longer and about 2 years older for males than females and coincided with an increase in reproductive output. The sexual difference in size at habitat transition, combined with sexual size dimorphism results in differences in the size distributions of both sexes in the two habitats (Claisse et al. 2009).

Due to the combination of a high fecundity and long life-span, reef fish can likely sustain fairly high levels of continuous harvest. While specific research into sustainable levels of collection has not been conducted for the 40 White List Species, Ochavillo and Hodgson (2006) suggest collection of between 5% and 25% is

sustainable for various reef species in the Philippines that are similar to those on the White List (e.g., tang, wrasse, butterflyfish, angelfish, triggerfish).

In addition to the low percentage of the populations which are harvested each year, commercial aquarium fishing has a distinct advantage over other types of fishing because it is targeted to specific species, and within those species, it primarily targets specific size-classes which minimizes the impact to the brood stock. Because commercial aquarium fishers target the smaller individuals in populations, the larger individuals with higher fecundity are left within the population.

WHRFMA

It is anticipated that population trends of the 40 White List Species in the WHRFMA would follow trends shown in the Open Areas (Table 5-7 and Table 5-11). This includes 12 species with stable populations, 14 species with increasing populations, and 10 species with decreasing populations (DAR 2019a). Population trend status is unknown for the remaining four species (DAR 2019a).

Impacts on populations were also evaluated based on three different population estimates, each of which is summarized below and in Table 5-16:

- WHAP Open Area
- WHAP WHRFMA (Open Areas, FRAs and MPAs)
- PIFSC-ESD WHRFMA

Average annual collection under the Pre-Aquarium Collection Ban Alternative would represent 1% or less of the WHAP Open Area population estimates for 22 of the 40 White List Species (Table 5-16), and less than 5% for 30 of the species. Open Area population estimates are not available for 4 of the 40 White List Species. Even at the maximum historic collection rates, collection would be over 5% for only 10 of the 40 White List Species, including the following:

- Achilles Tang
- Black Surgeonfish
- Forcepsfish
- Fourspot butterflyfish
- Goldrim Tang
- Milletseed Butterflyfish
- Ornate Wrasse
- Psychedelic Wrasse
- Shortnose Wrasse
- Yellow Tang

Population trend data from DAR (2019a) for these species is provided in Table 5-7 and Table 5-11. Populations of seven of these species have either not significantly changed (Forcepsfish, Goldrim Tang, Milletseed Butterflyfish, Psychedelic Wrasse, Shortnose Wrasse)) or have significantly increased (Black Surgeonfish, Yellow Tang) in the Open Areas between 1999/2000 and 2017/2018, suggesting that historic rates of commercial aquarium collection are not negatively impacting the populations.

The Achilles Tang and the Ornate Wrasse have had significant declines in the Open Areas as well as significant declines in areas both open and closed to aquarium collection, suggesting that aquarium collection is not driving the decline (DAR 2019a). Both species reported greater declines in FRAs (which are closed to aquarium collection) than in Open Areas (DAR 2019a).

The fourspot butterflyfish has had significant declines in the Open Areas as well as significant declines in areas both open and closed to aquarium collection, suggesting that aquarium collection is not driving the decline (DAR 2019a).

When looking at WHAP WHRFMA population estimates (including the 30-60-foot depth of all Open Areas, FRAs and MPAs), collection under the Pre-Aquarium Collection Ban Alternative would collect less than 1% of the estimated WHRFMA population for 24 of the 40 White List Species, and less than 5% of the estimated WHRFMA population for 34 of the 40 White List Species, with 3 additional species not having population estimates available from WHAP. For the remaining three species, collection would be above 5% of the estimated WHRMFA population, including for the following:

- Achilles Tang
- Eyestripe Surgeonfish
- Psychedelic Wrasse

As noted elsewhere in this EIS, the WHAP surveys do not adequately survey for Psychedelic Wrasse or Eyestripe Surgeonfish, though the Psychedelic Wrasse population is considered stable based on WHAP surveys (Table 5-11; the DAR does not report on population trend data for the Eyestripe Surgeonfish). As noted above, the Achilles Tang has had significant declines in Open Areas as well as significant declines in areas both open and closed to aquarium collection, suggesting that aquarium collection is not driving the decline (DAR 2019a).

Lastly, average annual collection under the Pre-Aquarium Collection Ban Alternative would collect 1% or less of the PIFSC-ESD WHRFMA population estimate for 30 of the 40 White List Species (36 of which have population estimates available). Collection of 5 species would be between 1% and 5% (Black Surgeonfish, Orangespine Unicornfish, Psychedelic Wrasse, Spotted Boxfish and Yellow Tang), all of which have been stable or increasing based on WHAP population trend monitoring (Table 5-7 and Table 5-11). Only one species, the Achilles Tang, would be collected at greater than 5% of its PIFSC-ESD WHRFMA population estimate. As noted above, the Achilles Tang has had significant declines in Open Areas as well as significant declines in areas both open and closed to aquarium collection, suggesting that aquarium collection is not driving the decline (DAR 2019a).

East Hawai'i

Population trend data for East Hawai'i are not available. For the 13 species in East Hawai'i with historic collection data and with available PIFSC-ESD population estimates (Table 5-15), collection of 12 of the species would be below 1% of the estimated East Hawai'i population. One species, the Yellow Tang, would be collected at between 3.64% and 10.26% of the estimated population in East Hawai'i based on the historic average and maximum catch levels (Table 5-15). This value falls within the range of what is considered to be sustainable reef fish harvest based on available research (5% - 25%; Ochavillo and Hodgson 2006).

5.4.1.4 WHRFMA-only Programmatic Issuance of Aquarium Permits Alternative

Under the WHRFMA-only Programmatic Issuance of Aquarium Permits Alternative, an unlimited number of Aquarium Permits and CMLs would be issued for the use of fine-mesh nets within the WHRFMA, and an unlimited number of CMLs would be issued for East Hawai'i, but fine-mesh nets would not be allowed in East Hawai'i. The impact on biological resources, including reef habitat, within the WHRFMA would be similar to the Pre-Aquarium Collection Ban Alternative. In East Hawai'i, given that the WHRFMA would be open to fishing with the use of fine mesh nets, impacts to biological resources would be anticipated to be similar to the Pre-Aquarium Collection Ban Alternative or even potentially decrease since fishing in the WHRFMA may prove more favorable given the use of fine mesh nets. Therefore, impacts to fish populations are anticipated to be similar to the Pre-Aquarium Collection Ban Alternative for both the WHRFMA and East Hawai'i.

5.4.1.5 Achilles Tang Conservation Alternative

Under the Achilles Tang Conservation Alternative, impacts would be the same as those described in Section 5.4.1.3 for the Pre-Aquarium Collection Ban Alternative for all fish, invertebrate species, and reef habitat, with the exception of the Achilles Tang, in both the WHRFMA and East Hawaii.

Based on WHAP data, the DAR has suggested decreasing population trends for the Achilles Tang in the WHRFMA. Commercial aquarium fishers worked with DLNR in 2012 to pass HAR 13-60.4, which beginning in 2014 limited commercial aquarium collection of Achilles Tang to 10 individual fish per day (recreational and non-aquarium commercial harvest is not subject to the bag limit). Under the Achilles Tang Conservation Alternative, the daily bag limit for Achilles Tang in the WHRFMA would be reduced from 10 per day to 5 per day.

Therefore, under this alternative, annual catch of Achilles Tang in the WHRFMA over the 5-year analysis period is estimated to be reduced by 50%[19] from that under the Pre-Aquarium Collection Ban Alternative (5,600; the average amount collected since the 2014 bag limit was imposed) to 2,800. This would represent 20.3% of the WHAP Open Area Population Estimate (13,796), 13.0% of the WHAP WHRFMA population estimate (21,494), or 10.2% of the PIFSC-ESD WHRFMA population estimate (27,392) that would be collected annually over the 5-year analysis period. Nonetheless, since Achilles Tang populations are decreasing across all three management areas (FRAs, Open Areas and MPAs), it is anticipated that Achilles Tang populations will continue to decline under this Alternative since aquarium collection does not appear to be driving the decline (and all other existing stressors would remain the same).

In East Hawai'i, impacts to the Achilles Tang would be anticipated to be similar to those seen under the Pre-Aquarium Collection Ban Alternative or the CML-only Alternative (either remaining similar to historic catch, or potentially increasing slightly due to the bag limit in the WHRFMA), ranging from 0.38% - 0.82%

[19] A 50% reduction is assumed, as collection decreased markedly from an average of 7,732 and a maximum of 13,615 per year prior to imposing the bag limit of 10. Since the bag limit of 10 was imposed, collection has stayed fairly constant, ranging from 5,473 to 5,757 per year (difference of 284 fish), suggesting that fishers may be collecting near the maximum allowed under the bag limit since there has been no growth in collection. Therefore, if fishers are currently collecting at or near the maximum allowed under the bag limit, it is reasonable to assume that reducing that bag limit by 50% would result in a 50% reduction in collection.

of the East Hawai'i population (Table 5-15). This level of collection is below the lower end of what is considered to be sustainable reef fish harvest based on available research (5% - 25%; Ochavillo and Hodgson 2006).

5.4.1.6 Limited Permit Issuance Alternative

Under the Limited Permit Issuance Alternative, Aquarium Permits would be issued to 10 fishers for the use of fine-mesh nets within the WHRFMA. No commercial aquarium collection would be allowed in East Hawai'i.

The 10 fishers who would receive Aquarium Permits collected up to a maximum of 160,832 fish in the WHRFMA in a single year during the period from 2000-2017 (see Table 5-5). Conservatively assuming collection in the first year of the 5-year analysis period started at this maximum, and then grew at 1.49% per year, a total of 828,484 fish would be collected over the 5-year analysis period, or an average of 165,697 per year. The impact on other biological resources, including reef habitat, within the WHRFMA would be similar to the Pre-Aquarium Collection Ban Alternative.

WHRFMA

It is anticipated that population trends of the 40 White List Species in the WHRFMA would follow trends shown in the Open Areas (Table 5-7 and Table 5-11). This includes 12 species with stable populations, 14 species with increasing populations, and 10 species with decreasing populations (DAR 2019a). Population trend status is unknown for the remaining four species (DAR 2019a).

Impacts to individual species in the WHRFMA are shown in Table 5-16, using both the average and maximum number of each of the White List Species collected in the WHRFMA by the 10 fishers annually between 2000 and 2017. Impacts on populations were evaluated based on three different population estimates, each of which is summarized below and in Table 5-16:

- WHAP Open Area
- WHAP WHRFMA (Open Areas, FRAs and MPAs)
- PIFSC-ESD WHRFMA

Average annual collection under the Limited Permit Issuance Alternative would represent 1% or less of the WHAP Open Area population estimates for 28 of the 40 White List Species (Table 5-16), and less than 5% for 34 of the species. Open Area population estimates are not available for 4 of the 40 White List Species. Even at the maximum historic collection rates, collection would be over 5% for only 5 of the 40 White List Species, including the following:

- Achilles Tang
- Goldrim Tang
- Milletseed Butterflyfish
- Psychedelic Wrasse
- Shortnose Wrasse

Population trend data from DAR (2019a) for these species is provided in Table 5-7 and Table 5-11. Populations of four of these species (Goldrim Tang, Milletseed Butterflyfish, Psychedelic Wrasse, Shortnose Wrasse) did not significantly change in the Open Areas between 1999/2000 and 2017/2018, suggesting that higher historic rates (compared to what would occur under the Limited Permit Issuance Alternative) of commercial aquarium collection are not negatively impacting the populations.

The Achilles Tang has had significant declines in the Open Areas as well as significant declines in areas both open and closed to aquarium collection, suggesting that aquarium collection is not driving the decline (DAR 2019a). The species reported greater declines in FRAs (which are closed to aquarium collection) than in Open Areas (DAR 2019a). Even at historic collection rates of Achilles Tang under the Limited Permit Issuance Alternative would be within the range of what is considered sustainable collection based on available scientific research (5% to 25%, Ochavillo and Hodgson 2006). However, under this Alternative, the bag limit for Achilles Tang would be implemented, resulting in similar impacts to that species as seen under the Achilles Tang Alternative, though again, because of the limited number of Aquarium Permits that would be issued, it is anticipated that the impact may be even smaller. Therefore, under this alternative, annual catch of Achilles Tang in the WHRFMA over the 5-year analysis period is estimated to be reduced by 50% from that under the Pre-Aquarium Collection Ban Alternative (1,089; the average amount collected by the 10 fishers since the 2014 bag limit was imposed, or 2,157, the maximum collected by the 10 fishers since the bag limit was imposed) to 545 to 1,258, or 4.0.% to 9.1% of the WHAP Open Area population (13,796) that would be collected annually over the 5-year analysis period. This falls within the range of what is considered sustainable collection based on available research (5% to 25%; Ochavillo and Hodgson 2006).

When looking at WHAP WHRFMA population estimates (including the 30-60-foot depth of all Open Areas, FRAs and MPAs), average collection under the Limited Permit Issuance Alternative would collect less than 1% of the estimated WHRFMA population for 29 of the 40 White List Species, and less than 5% of 35 of the 40 White List Species, with 3 additional species not having population estimates available from WHAP. For the remaining two species, average collection would be above 5% of the estimated population, including for the following:

- Achilles Tang
- Psychedelic Wrasse

As noted elsewhere in this EIS, the WHAP surveys do not adequately survey for Psychedelic Wrasse, though the Psychedelic Wrasse population is considered stable based on WHAP surveys (Table 5-11). As noted above, the Achilles Tang has had significant declines in Open Areas as well as significant declines in areas both open and closed to aquarium collection, suggesting that aquarium collection is not driving the decline (DAR 2019a). Additionally, a reduction in the bag limit for Achilles Tang would be implemented, resulting in similar impacts to that species as seen under the Achilles Tang Alternative, though again, because of the limited number of Aquarium Permits that would be issued, it is anticipated that the impact may be even smaller. Therefore, under this alternative, annual catch of Achilles Tang in the WHRFMA over the 5-year analysis period is estimated to be reduced by 50% from that under the Pre-Aquarium Collection Ban Alternative (1,089; the average amount collected by the 10 fishers since the 2014 bag limit was imposed, or 2,157, the maximum collected by the 10 fishers since the bag limit was imposed) to 545

to 1,258, or 2.5% to 5.9% of the WHAP WHRFMA population (21,494) that would be collected annually over the 5-year analysis period. This falls below or within the range of what is considered sustainable collection based on available research (5% to 25%; Ochavillo and Hodgson 2006).

Lastly, collection under the Limited Permit Issuance Alternative would collect 1% or less of the PIFSC-ESD WHRFMA population estimate for 32 of the 40 White List Species (36 of which have population estimates available). Collection of three species would be between 1% and 5% (Psychedelic Wrasse, Spotted Boxfish and Yellow Tang), all of which have been stable or increasing based on WHAP population trend monitoring (Table 5-7 and Table 5-11). Only one species, the Achilles Tang, would be collected at greater than 5% of its estimated WHRFMA population.

As noted above, the Achilles Tang has had significant declines in Open Areas as well as significant declines in areas both open and closed to aquarium collection, suggesting that aquarium collection is not driving the decline (DAR 2019a). Additionally, a reduction in the bag limit for Achilles Tang would be implemented, resulting in similar impacts to that species as seen under the Achilles Tang Alternative, though again, because of the limited number of Aquarium Permits that would be issued, it is anticipated that the impact may be even smaller. Therefore, under this alternative, annual catch of Achilles Tang in the WHRFMA over the 5-year analysis period is estimated to be reduced by 50% from that under the Pre-Aquarium Collection Ban Alternative (1,089; the average amount collected by the 10 fishers since the 2014 bag limit was imposed, or 2,157, the maximum collected by the 10 fishers since the bag limit was imposed) to 545 to 1,258, or 2.0% to 4.6% of the PIFSC-ESD WHRFMA population (27,392) that would be collected annually over the 5-year analysis period.

East Hawai'i

No impacts would occur in East Hawai'i, as no CMLs would be issued for commercial aquarium collection in East Hawai'i. Population trend data for East Hawai'i are not available.

5.4.1.7 Revised White List and Limited Permit Issuance (Preferred) Alternative

WHRFMA

Under the Revised White List and Limited Permit Issuance (Preferred) Alternative, collection in the WHRFMA would be limited to the eight species on the Revised White List. The impact on other biological resources, including reef habitat, within the WHRFMA would be similar to the Pre-Aquarium Collection Ban Alternative. Each of the eight species on the Revised White list would have an individual catch quota for each fisher, and since permit issuance would be limited to seven permits, the total potential catch in the WHRFMA is simply seven times the individual catch quota for each species (Table 3-2). The impact of this maximum collection on the three population estimates available for the WHRFMA is shown in Table 5-17 below.

Table 5-17. Summary of 2017/2018 WHAP population estimates (DAR 2019a, Dr. Bill Walsh, personal communication, 2020), 2019 PIFSC-ESD (2020) population estimates, and the impact of collection under the Preferred Alternative.

Species	Total Potential Catch (all 7 fishers)	WHAP Open Area (30'-60') Population Estimate	WHAP WHRFMA (30'-60') Population Estimate (Open Areas, FRAs and MPAs)	PIFSC-ESD WHRFMA Pop. Mean (lower-upper estimate limit)	Percent of Open Area Population	Percent of WHAP WHRFMA Population Estimate	Percent of PIFSC-ESD WHRFMA Population Estimate
Bird Wrasse	344	66,581	130,529	420,492 (236,468-604,517)	0.5%	0.3%	0.1%
Black Surgeonfish	3,152	98,067	156,595	315,065 (168,732-461,398)	3.2%	2.0%	1.0%
Brown Surgeonfish	800	2,980,402	4,140,802	4,336,269 (2,788,493-5,884,044)	<0.1%	<0.1%	<0.1%
Kole	30,000	5,312,745	9,555,712	6,655,072 (5,210,408-8,099,735)	0.6%	0.3%	0.5%
Orangespine Unicornfish	5,872	180,099	266,945	512,857 (380,373-645,342)	3.3%	2.2%	1.1%
Potter's Angelfish	4,376	265,488	424,980	437,617 (248,818-626,416)	1.7%	1.0%	1.0%
Thompson's Surgeonfish	2,016	271,693	380,593	201,230 (0-419,166)	0.7%	0.5%	1.0%
Yellow Tang	200,000	2,867,048	5,690,643	6,087,924 (4,194,149-7,981,699)	7.0%	3.5%	3.3%

It is anticipated that population trends of the eight species on the Revised White List would remain stable or increase, as they have historically under commercial aquarium collecting pressure.

Impacts on populations were also evaluated based on three different population estimates, each of which is summarized below and in Table 5-17:

- WHAP Open Area
- WHAP WHRFMA (Open Areas, FRAs and MPAs)
- PIFSC-ESD WHRFMA

Collection would impact less than 1% of the estimated WHAP Open Area population for 4 of the 8 species, and between 1% and 5% for 3 of the 8 species, with only one species (the Yellow Tang) being collected at greater than 5% of the estimated Open Area Population. However, all eight of these species were chosen for the Revised White List due to increasing or stable population trends across all WHRFMA areas under historic collection rates, and therefore this level of collection is not anticipated to cause population declines.

For the WHAP WHRFMA population estimates (Open Areas, FRAs and MPAs), collection would be less than 1% for 4 of the 8 species, and between 1% and 5% for the remaining 4 species. The percentage of the population collected would be highest for the Yellow Tang (3.5% of the estimated population). However, as noted previously, Yellow Tang populations have been increasing even under higher levels of historic collection since establishment of the WHRFMA.

The PIFSC-ESD population estimates provide the best estimate for these species, since they include a wider depth range, and collection under the Preferred Alternative would collect 1% or less of the estimated population for 7 of the 8 species. The last species, the Yellow Tang, would be collected at 3.3% of the estimated population. However, as noted previously, Yellow Tang populations have been increasing even under higher levels of historic collection since establishment of the WHRFMA.

East Hawai'i

No impacts would occur in East Hawai'i, as no CMLs would be issued for commercial aquarium collection in East Hawai'i. Population trend data for East Hawai'i are not available.

5.4.2 Indirect Effects

Under all alternatives, mortality of fish post-harvest will occur. As described in Munday et al. (2015), after a fish has been collected from the reef, they are brought to the surface, transported to an export facility, shipped to import facilities, and then transported to a retail store and eventually to a hobbyist aquarium. Mortality can occur at any point in this supply chain, though immediate mortality is less than 1% (Stevenson et al. 2011, as cited in Munday et al. 2015).

When bringing the fish to the surface, there are two methods commonly used in the Hawai'i fishery for avoiding barotrauma to collected fish (either ascent without decompression stops, or ascent with one decompression stop, followed by venting), and neither method resulted in any immediate or delayed mortality (Munday et al. 2015). Furthermore, the stress levels of vented fish versus fish brought to the surface using decompression (multiple stops along the way to the surface, with no venting) were not statistically different (Munday et al. 2015). While this study included limitations, including the lack of additional stressors, since fish were kept for 21 days for observations, and did not have to undergo additional shipment and handling, it does suggest that the collection methods used in Hawai'i minimize the post-collection mortality of fish compared to other methods (e.g., no decompression, or use of cyanide). Munday et al. (2015) stated that while venting has been controversial in this industry due to criticism from animal rights groups, other fishing groups are often encouraged to vent fish before returning them to the ocean.

Additional mortality may occur during transportation, shipping, or once the fish has reached its final destination. Cyanide-free net-caught fish in the Philippines have been found to have mortality rates of less than 10% through the chain from the reef to retailer (Rubec et al. 2001). Dierking et al. (2002) found the mortality rates of aquarium fish in Hawai'i are between 1% to 5% post-collection, including 0% to 1% between the collector and the wholesaler, 0% to 2% while in the wholesaler's tanks, and 0.75% to 2% in shipment (Dierking et al. 2002).

This is compared to rates of 14.12% to 21.69% (depending on the experience of the final aquarist) found by Cartwright et al. (2012), which included fish collected using cyanide or other methods. While it is possible that higher post-collection mortality rates could result in the need to collect more fish from the reef, it is not expected that mortality rates will increase over what has previously occurred under historic collection rates. Therefore, because post-collection mortality is not expected to increase under any of the alternatives, it is not anticipated that collection rates will need to increase as a result of increased mortality.

5.4.2.1 No Action Alternative

Under the No Action Alternative issuance of Aquarium Permits and CMLs for aquarium collection would not occur and commercial aquarium fishing would not be permitted in the WHRFMA or East Hawai'i. An unquantifiable increase in number of White List Species, non-White List Species, and SGCN may occur over the 5-year analysis period, which may provide additional viewing opportunities for tourists, an increase in the prey base, additional individual herbivores to maintain the reef, and increased competition between species for available resources. However, data do not exist that would allow for a thorough analysis of such effects, and many species did not see differences in population trends between areas open and closed to commercial aquarium collection since establishment of the FRAs in 1999 (Table 5-7 and Table 5-11; DAR 2019a). Any increase in populations that may occur cannot be quantified, as other stressors on these species would continue to occur (e.g., those discussed in Section 5.4.3).

5.4.2.2 CML-only Alternative

Under the CML-only Alternative issuance of Aquarium Permits would not occur and commercial aquarium fishing would stop in the WHRFMA. In East Hawai'i, CMLs for aquarium collection would be issuance, and aquarium collection using legal gear or methods other than fine-mesh nets would occur. Commercial aquarium fishers may no longer find it feasible to target aquarium fish and may begin to participate in other fisheries, but this is not possible to quantify at this time.

In the WHRFMA, where no fish would be collected, an unquantifiable increase in number of White List Species, non-White List Species, and SGCN may occur over the 5-year analysis period, which may provide additional viewing opportunities for tourists, an increase in the prey base, additional individual herbivores to maintain the reef, and increased competition between species for available resources. However, data do not exist that would allow for a thorough analysis of such effects, and many species did not see differences in population trends between areas open and closed to commercial aquarium collection since establishment of the FRAs in 1999 (Table 57 and Table 5-11; DAR 2019a).

In East Hawai'i, collection may increase under the CML-only Alternative (see Section 5.4.1.2), and without the use of fine mesh nets, the size class of fish collected may increase over that which is caught with fine mesh nets (i.e., the smaller fish would escape the larger mesh), but again this impact cannot be quantified at this time. With only a few exceptions for certain species where fishers classify fish as "small", "medium" or "large", the size of fish collected under CMLs is not required to be reported to the DAR, and thus these data are not available. If the size class of fish collected is larger, these larger fish may represent the brood stock.

Based on the analysis provided in Section 5.4.1.2, the impact to any population of White List Species of fish would be below or within the range of sustainable collection (5% to 25%; Ochavillo and Hodgson 2006). Additionally, research conducted on herbivores showed that numbers did not decline in areas open to commercial aquarium collection in the WHRFMA between 2003 and 2017. Since collection rates are generally higher in the WHRFMA, even with the anticipated increase in collection under the CML-only Alternative in East Hawai'i, no indirect impacts due to commercial aquarium collection on the biological function of herbivore populations are anticipated.

5.4.2.3 Pre-Aquarium Collection Ban Alternative

Under the Pre-Aquarium Collection Ban Alternative issuance of an unlimited number of Aquarium Permits would occur and commercial aquarium fish collection would take place. An estimated 1.7 million individual, primarily juvenile fish would be collected from the WHRFMA and an estimated 91,000 primarily juvenile fish and 67,229 invertebrates would be collected from East Hawai'i. Collection of these primarily juvenile fish and invertebrates would result in a decrease in the number of White List Species, non-White List Species, and SGCN over the 5-year analysis period, which may provide fewer viewing opportunities for tourists, a decrease in the prey base, and reduced competition between species for available resources,

Given the low proportion of the populations of the species that would be removed (Table 5-15 and Table 5-16, Section 5.4.1.3), and the geographic area over which the collection would occur (i.e., WHRFMA, island of Hawai'i), it is anticipated that indirect impacts on viewing opportunities, prey base, and competition would be minor or nonexistent. This conclusion is supported by the observation that population trends for many species did not differ between areas open and closed to commercial aquarium collection (Table 5-7 and Table 5-11). Additionally, between 2003 and 2017, total fish abundance significantly increased by 34.9% within Open Areas, where commercial aquarium collection was occurring (DAR 2019a, Gove et al. 2019). Total fish biomass also increased by 19.8%, though this change was not statistically significant (DAR 2019a, Gove et al. 2019). Species richness (the number of species observed per survey) remained constant for MPAs, FRAs and Open Areas (DAR 2019a, Gove et al. 2019).

As discussed in Section 5.4.1, herbivore numbers did not decline in the Open Areas between 2003 and 2017, and therefore, no indirect impacts due to commercial aquarium collection under the Pre-Aquarium Collection Ban Alternative on the biological function of herbivore populations are anticipated.

Based on the Tissot and Hallacher (2003) study and the 15 years of coral reef data collected and analyzed by the DAR (2018c), it is not anticipated that any indirect impacts to reef habitat above what has historically been observed would occur under the Pre-Aquarium Collection Ban Alternative. From 2003 to 2017, mean coral cover declined less within Open Areas than within areas closed to commercial aquarium collection (though the difference was not statistically significant; DAR 2019a). The DAR (2019a) concluded that commercial aquarium collecting is not having any measurable negative impact on percent coral cover or change in coral cover over time.

It is anticipated that implementation of the Pre-Aquarium Collection Ban Alternative would have a beneficial effect on invasive fish species over the 5-year analysis period. A total of 128 individual Bluestripe Snappers have been caught in the WHRFMA since 2000, based on disclosed data (DAR 2018a). The Peacock

Grouper and Blacktail Snapper have not been reported as caught from the WHRFMA over the 18-year assessment period. Of the three invasive fish species, only the Peacock Grouper has been reported as caught (all *n.d.* data) in East Hawai'i.

5.4.2.4 WHRFMA-only Programmatic Issuance of Aquarium Permits Alternative

Under the WHRFMA-only Programmatic Issuance of Aquarium Permits Alternative, Aquarium Permits would be issued for the use of fine-mesh nets within the WHRFMA, but fine-mesh nets would not be allowed in East Hawai'i. The indirect effect on biological resources within the WHRFMA would be similar to the Pre-Aquarium Collection Ban Alternative. In East Hawai'i, indirect effects to biological resources would be anticipated to be similar to the CML-only Alternative, though with the WHRFMA open to fishing with the use of fine mesh nets, indirect effects of aquarium fish collection in East Hawai'i may return to levels seen under the Pre-Aquarium Collection Ban Alternative or even decrease since fishing in the WHRFMA may prove more favorable given the use of fine mesh nets.

5.4.2.5 Achilles Tang Conservation Alternative

Indirect impacts under the Achilles Tang Conservation Alternative would be similar to those of the Pre-Aquarium Collection Ban Alternative. The implementation of the 5 per day bag limit on Achilles Tang may provide a benefit to Achilles Tang populations, potentially leading to minor population growth as well as increased viewing opportunities for tourists, but this cannot be quantified at this time.

5.4.2.6 Limited Permit Issuance Alternative

Under the Limited Permit Issuance Alternative, Aquarium Permits would be issued to 10 fishers for the use of fine-mesh nets within the WHRFMA. No commercial aquarium collection would be allowed in East Hawai'i.

It is anticipated that collection of approximately 828,484 fish would occur in the WHRFMA, resulting in indirect impacts similar, though smaller in scale, to the Pre-Aquarium Collection Ban Alternative.

Additionally, this alternative would implement a bag limit on Achilles Tang, leading to similar indirect impacts on that species as the Achilles Tang Conservation Alternative, though again, because of the limited number of Aquarium Permits that would be issued, it is anticipated that the indirect effects may be even smaller.

5.4.2.7 Revised White List and Limited Permit Issuance (Preferred) Alternative

Under the Revised White List and Limited Permit Issuance (Preferred) Alternative, Aquarium Permits and CMLs would be issued to seven fishers for the use of fine-mesh nets within the WHRFMA, but the White List would be reduced to eight species, and individual catch quotas would be implemented for each of those species. No commercial aquarium collection would be allowed in East Hawai'i.

It is anticipated that up to 246,560 fish might be collected in the WHRFMA, resulting in indirect impacts similar, though smaller in scale, to the Pre-Aquarium Collection Ban Alternative. Additionally, these impacts would be limited to only eight species, all of which have had stable or increasing populations under historical

collection. No impacts would occur to the other 32 species which previously could be collected in the WHRFMA, so viewing opportunities of those species may increase.

5.4.3 Cumulative Impacts

As stated in Section 4.4, Toonen et al. (2011) conclude that the Hawaiian Archipelago is not a single, well-mixed marine community, but rather there are at least four significant multi-species barriers to dispersal along the length of the island chain, and that species that appear capable of extensive dispersal, such as Yellow Tang and Kole, show significant population differentiation within the Hawaiian Archipelago. In addition, there are significant consensus genetic breaks that restrict gene flow between islands, including a barrier between the island of Hawai'i and the rest of the Main Hawaiian Islands (MHI). Therefore, the geographic boundary for analysis of cumulative effects is the island of Hawai'i.

Between 2008 and 2018, total fish biomass decreased by 45% in the WHRFMA, with a variety of drivers potentially causing these declines (Foo at al. 2020). The cumulative impacts of the seven alternatives under consideration are addressed in this section.

5.4.3.1 Recreational Aquarium Fish Collection

As of April 2018, all recreational permits for collection of aquarium species with fine mesh nets were voided, and no collection with fine mesh nets is currently legally allowed, pending environmental review (DAR 2019a). Given the five-year analysis period, it cannot currently be predicted when or if these permits will be reinstated, therefore, the following discussion focuses on the cumulative impacts if the permits were to be reinstated, and pressure remained similar to historic trends.

Recreational aquarium fish collection is governed by state law and regulations. Under HRS 188-31, individuals may use fine mesh nets (< 2-inch mesh) to collect aquatic life for an aquarium. A permit is not required if:

- The net has large mesh (more than two-inch mesh);
- The net has small mesh but is less than three feet in length, height, or width, including the handle; or,
- Using a slurp gun.

A recreational aquarium permit is required if using a small mesh net other than a hand net, or a small mesh hand net larger than the dimensions indicated above. Small mesh throw nets are always prohibited. Regardless of whether a permit is required, regulations that impose bag limits, seasons, and limit the size of fish that can be collected apply to all recreational fish collection. The aquarium permit only exempts a person from the small mesh restriction. The recreational aquarium permit rules apply everywhere in the state, except for West Hawai'i, which has its own rules and permits specific to the WHRFMA (HAR §13-60.4).

Under a recreational aquarium permit, individuals are authorized to collect up to five aquatic animals per day (1,825 per year) (HAR 13-60.4). Since 2000, the number of recreational permits issued for the state

(island-specific numbers not available) has averaged 159 annually (DAR 2018a). The DAR collected recreational aquarium fish catch information from 1975 until 1985, after which, data collection was discontinued, and currently no reporting of catch is required for recreational aquarium permit holders. Historic recreational catch data were not digitized or processed into a database, and therefore, are not available for analysis (DAR 2018a).

Because reporting of recreational aquarium catch is not required, the impact of recreational collection on White List Species cannot be quantified. An unpublished survey of 310 recreational aquarium permit holders found that only 42.7% of respondents had fished or used a small mesh net over a 12-month period from June 2016 to June 2017. Of the 56 fishers who had utilized their permit, 81% stated that they fished 1-2 days a month using a small mesh net, while only 9% indicated that they fished more than 5 days per month, and the majority (59%) reported catching only 1-2 fish per month (only 8% of fishers reported over 10 per month, and the maximum reported in a single month was 136). Overall, 82% of the recreational collectors had at least one month where they collected no aquarium fish.

Based on these survey results, as well as practicality, it is likely that not all recreational permit holders collect the maximum allowable number (1,825); however, if each of the average 159 statewide permit holders were to collect 50% of the allowable catch (913), it would result in the collection of 145,088 aquatic animals per year statewide. If it is assumed that only 50% are White List Species, it would result in an estimated 72,544 White List Species collected by recreational aquarium permit holders annually. The same estimation would apply to non-White List Species. These estimates are likely high based on results from Harding (2017), which found that 57% of recreational aquarium permit holders surveyed had not utilized their permit in the previous 12-month period. Of the 43% who had used their permits, their average yearly catch was 45 fish per permit (Harding 2017), which is below the maximum allowable number of 1,825 fish or the 50% used to estimate impacts above.

Because reporting of recreational aquarium catch is not required, the impact of the collection on SGCN cannot be quantified. Nevertheless, it is likely that SGCN are occasionally collected by recreational aquarium permit holders. However, given the low number of SGCN individuals collected by commercial aquarium collectors (average 274 Psychedelic Wrasse/year; average 309 Tinker's Butterflyfish/year; average 96 Fisher's Angelfish/year) it is estimated that recreational collectors are collecting fewer individuals of these species.

Because reporting of interactions (e.g., damage from contact with collection equipment) with corals resulting from recreational aquarium collecting and recreational aquarium catch is not required, the impact of the interaction with reef habitat cannot be quantified. However, studies conducted by Tissot and Hallacher (2003) found that aquarium collecting had no significant impact (beneficial nor detrimental) on reef habitat. In addition, 15 years of coral reef data collected and analyzed by the DAR (2018b) found no significant difference in coral cover in areas open to commercial aquarium fish collection. It is assumed that recreational aquarium collect would likewise not have a significant impact.

Recreational aquarium collection impacts to biological resources cannot be fully quantified. However, data presented by DAR (2014a, 2019a) indicate that some species may be declining in various management areas (e.g., FRA, MPA, Open) due to factors other than commercial aquarium collecting which may include recreational aquarium collection.

5.4.3.2 Non-Aquarium Commercial and Non-Commercial Fishing (Non-Aquarium Fish)

Coral reef species are targeted by non-aquarium commercial fishers using numerous fishing gears including nets, traps, hook and line, spear, hand, and other methods. Commercial fish industry landings in Hawai‘i have increased annually since 2006 and the NOAA reported total landings in 2013 were valued near $108 million dollars (DLNR 2015). Akule (coastal pelagic scads) dominate nearshore commercial landings and are typically collected using surround or fence nets, gillnets or hook and line (Western Pacific Regional Fishery Management Council-WPRFMC 2017). Other top species by weight and value include soldierfishes, parrotfish, surgeonfishes and goatfishes, which may be targeted because they may bring a high price in some seasons (WPRFMC 2017).

Foo et al. (2021) found that commercial fishing has led to decreases in parrotfish biomass in the WHRFMA, where current commercial fishing levels are negatively affecting scraper populations. As stated in Section 5.4.1.3, parrotfish cannot be collected in the WHRFMA by commercial aquarium collectors as there are none on the White List (neither the previous 40 White List Species nor the revised 8 White List Species).

Non-commercial fishing includes subsistence/consumptive, recreational, and cultural fishing and gathering activities that occur in ocean and coastal zones. The State of Hawai’i has the most developed recreational fishing infrastructure in the U.S. Pacific and is a substantial economic contributor to the State. The State of Hawai’i does not track non-commercial fish collection. However, creel surveys suggest that the total inshore non-commercial catch from reef areas could be as high as the reported commercial catch (WPRFMC 2017). It is important to note that resource species (fish targeted for human consumption) are predominantly herbivorous species (DAR 2018 as cited in Foo et al. 2021).

The most recent DAR summary report available on the West Hawai’i aquarium fishery (DAR 2019a) analyzed data collected since 2003 by the Hawai’i Marine Recreational Marine Fishing Survey (HMRFS) and subsequently since 2007 by NOAA’s Marine Recreational Information Program (MRIP) to gain perspective on the generalized impact on reef fishes by aquarium collecting versus other types of reef fishing activities.

Statewide, looking at the period from 2008-2011, the number of reef fishes caught by the recreational and commercial sectors was found to be comparable, averaging 1,511,025 per year for recreational fishers and 1,554,010 per year for commercial (i.e., non-aquarium) fishers.

McCoy et al. (2018) found that 12.8% of households on Hawai’i participate in recreational (non-aquarium) fishing. Most of this fishing is conducted using lines from shore (65.6%), which catches an estimated 0.33 pounds of reef fish per hour fished (McCoy et al. 2018). The results of this study found that on Hawai’i, non-commercial annual catch was approximately 10.5 times commercial catch when comparing the average pounds per year between 2004 and 2013 (McCoy et al. 2018).

In West Hawai’i (i.e., the WHRFMA), on average the commercial aquarium fishery annually takes 1.8 times (343,729/year) the number of reef fishes taken annually by recreational and other commercial fishers combined (194,674/year) (DAR 2019a). However, if Yellow Tang, which is primarily collected at small sizes and generally not targeted by other fishers, is excluded, on average the recreational and commercial fisheries combine to take 3 times the number of reef fishes (194,674/year) caught annually by aquarium

collectors (64,815/year) (DAR 2019a). In terms of reef fish biomass caught by the different fisheries in West Hawai'i (i.e., the WHRFMA), DAR (2019a) concluded that more biomass is taken by the combined recreational and commercial fisheries regardless of including Yellow Tang (2.8 times) or excluding Yellow Tang (8.6 times). In addition, unlike the aquarium fishery which targets mostly immature fish, the commercial and recreational fisheries selectively target the larger breeding portion of the population which has profound implications for the sustainable usage of the resource (DAR 2019a). Therefore, on the island of Hawai'i, commercial aquarium fish collection constitutes 25% of the total catch and 11% of the biomass (when excluding Yellow Tang, whose population has been increasing even with commercial aquarium collection).

The non-aquarium commercial fish industry targets some coral reef species; however, commercial non-aquarium fishers do not directly target most White List Species. Data for non-aquarium commercial fishing is lacking due to the DAR confidentiality regulations (HRS §189-3). Because most non-aquarium commercial fishers do not target aquarium species, there are usually less than three fishers reporting. Therefore, the data presented in Table 5-18 are underestimated. Under the Preferred Alternative, aquarium collection would only include the Yellow Tang, Kole, Black Surgeonfish, and Brown Surgeonfish from the species shown in Table 5-18, and therefore there would be no cumulative impacts to Achilles Tang, Peacock Grouper, Eyestripe Surgeonfish, Orangeband Surgeonfish, or Bluestripe Snapper.

Table 5-18. Available data on White List Species collected by commercial non-aquarium fishers in the State and on the island of Hawai'i from 2000-2020 (DAR 2020). n.d. = Not Disclosed (see Section 5.1).

White List Species	Island of Hawai'i Catch (2000-2017)		Island of Hawai'i Catch (2018-2020)	
	Total	Annual Average	Total	Annual Average
Achilles Tang	8,847	492	226	113
Yellow Tang	n.d. (reported in two years; 2000 and 2008)		0	0
Kole	40,144	2,231	1,715	858
Milletseed Butterflyfish	n.d. (reported in one year, 2010)		0	0
Orangespine Unicornfish	2,139	214	0	0
Peacock Grouper (=Roi, Bluespot Peacock Grouper)	1,043	75	30	30
Eyestripe Surgeonfish (=Palani)	9,799	545	290	97
Orangeband (=Shoulder) Surgeonfish	2,510	168	9	9
Black surgeonfish	1,149	89	0	0

White List Species	Island of Hawai'i Catch (2000-2017)		Island of Hawai'i Catch (2018-2020)	
	Total	Annual Average	Total	Annual Average
Brown Surgeonfish (=Lavender, Forktail Tang)	137	10	0	0
Bluestripe Snapper (=Taape)	85,438	4,747	10,486	3,496
Total Collected	**151,206**		**12,756**	

It is expected that the average number of White List individuals collected annually by non-aquarium commercial fishers would continue at these rates (at a minimum) over the 5-year analysis period. While the DAR has requested that food fishers not collect herbivores[20], the species and sizes of fish caught for consumption are generally larger than those targeted for aquarium collection, and therefore contribute disproportionately more to herbivory when compared to the fish collected by aquarium fishers.

Because reporting of non-aquarium recreational, cultural and subsistence/consumptive catch is not required, the impact of recreational, cultural and subsistence/consumptive collection on White List Species, non-White List Species, and SGCN cannot be quantified. However, nearshore recreational and subsistence catch is likely at similar catch levels as that of non-aquarium commercial fishing (Friedlander 2017).

The impacts of non-aquarium commercial and non-commercial fishing on biological resources cannot be fully quantified. However, as discussed above data presented by DAR (2019a) indicate that some species are declining in various management areas (e.g., FRA, MPA, Open) due to factors other than commercial aquarium collecting, which include non-aquarium commercial and non-commercial fishing. However, there is no way to fully quantify the cumulative effects of past and ongoing non-aquarium commercial and non-commercial fishing on biological resources. Given the assumed past and present impacts of non-aquarium commercial and non-commercial fishing on biological resources, foreseeable future actions would likely result in some impacts to biological resources.

5.4.3.3 Commercial Aquarium Collection

As noted in Section 1.0, the commercial aquarium collection fishery has existed in Hawai'i since the late 1940s, and the fishery has had varying degrees of impacts on fish populations since that time. Commercial aquarium collection pursuant to permits issued by DLNR was only recently halted after the Supreme Court of Hawai'i's determination that DLNR's issuance of the permits required compliance with HEPA. Cumulatively, since 1976, a total of 8.6 million White List Species individuals have been collected by commercial aquarium fishers in the WHRFMA area (DAR 2018a). Over 69% of that catch has occurred since 2000 and was included in the analysis of this Revised FEIS. Regardless, this collection has already

[20] https://dlnr.hawaii.gov/dar/files/2019/10/coral_card.pdf

occurred, and is reflected in the current population estimates used to evaluate impacts on species (see Section 5.4.1.3).

Gove et al. (2019) compared the three primary management areas in the WHRFMA: MPAs (where all fishing is prohibited), FRAs (which ban only commercial aquarium collection) and Open Areas (open to all fishing/collection). The impact of commercial aquarium collection can therefore be evaluated by comparing FRAs with Open Areas; MPAs do not provide a proper baseline as other fishing is also banned in these areas. As of 2017, adult fish length was significantly longer, species richness was significantly lower, and there were significantly more juvenile yellow yang in FRAs compared to Open Areas, but there were no significant differences in total fish abundance, total biomass, herbivore biomass, coral cover, algal cover or clacifying:non-calcifying ratio (Gove et al. 2019).

Given the long history of commercial aquarium collection in Hawai'i, it is reasonably foreseeable that commercial aquarium collection will continue if permitted. Based on available data regarding species abundance and yearly commercial aquarium catch over the past 18 years, it is expected that in the reasonably foreseeable future, commercial aquarium collection will proceed generally at the same rate and have the same level of impact as in the past 18 years. To the extent new data regarding the impacts of commercial aquarium collection on biological resources becomes available in the future, DLNR may consider those data and, to the extent necessary, supplement this impacts analysis.

As noted in Section 5.4.1.3:

- Reef fish have high fecundity and are long lived, and as such produce a large number of young each year over many years;
- Commercial aquarium collection targets juvenile fish leaving behind the adult broodstock; and,
- A low percentage of the overall population of each of the targeted species would be collected annually by commercial aquarium fishers, and this collection would be spread throughout the year and across multiple areas.

As shown in Section 5.4.1.7, the Preferred Alternative would substantially reduce the impact of aquarium collection on WHRFMA and island of Hawai'i reef fish populations. Thus, it is not anticipated that losses would accumulate over time due to the low percentage collected each year and the high fecundity of reef fishes.

5.4.3.4 Tourism

Hawai'i is a major tourist destination and the tourism industry contributes the most to the state's economy. Over time this industry has grown and reshaped the native landscapes and sensitive ecosystems through major coastal development, increased energy consumption, and tourism based recreational activities. Major coastal development for tourism (i.e., hotels, resorts, restaurants, recreational outfitters) and associated point source pollution (e.g., petroleum hydrocarbons, pharmaceuticals, heavy metals, and sediment from agriculture and development) threaten the quality of coral reef ecosystems (State of Hawai'i 2010). When coral reefs are damaged, it could potentially expose reef dependent organisms and leave them vulnerable to other threats such as disease, predation, and climate change (State of Hawai'i 2010),

including the reef fishes and other aquatic animals targeted by both commercial and recreational aquarium fishers.

Human interaction with native flora and fauna is also a growing concern. Damage to sensitive ecosystems (i.e., coral reefs, tide pools, shorelines) through tourism-based recreation overuse (e.g., SCUBA diving, snorkeling, etc.) has been attributed to killing many aquatic organisms that in turn may affect many more species that rely on such organisms as a food source. Damage to coral reef habitat in association with tourism (through coastal development, point source pollution, and recreational activities) threatens most White List Species that are dependent on reefs for habitat and foraging in the foreseeable future (State of Hawai'i 2010).

5.4.3.5 Climate Change

Warming of the planet and rising average temperatures may produce variations in precipitation and temperature patterns, sea levels, and storm severity. This process is commonly referred to as "climate change." Increased temperatures and acidity will reduce the health and resilience of coral reefs and other ocean resources (Hawai'i Climate Change Mitigation and Adaptation Commission 2017). Changes in sea surface temperatures have been documented, with temperatures warmer than normal in recent years (increase of 0.22 °F per decade), and even reaching record levels of thermal stress in September 2015 (Casey 2001; Gove et al. 2016). Warmer water temperatures can result in coral bleaching, which places corals into a weakened state where they will eventually die if temperatures and light levels remain high (University of Hawai'i 2017). When water is too warm, corals will expel the algae living in their tissues causing the coral to turn completely white. When coral bleaches, it is not dead; corals can survive a bleaching event, but they are under more stress and are subject to increased mortality.

In 1998, global coral bleaching and die-off was unprecedented in geographic extent, depth, and severity. Researchers predict that coral bleaching events would occur when the average sea temperatures are 33.8 °F or more above average (DLNR 2015). In the fall of 2015, leeward reefs of Hawai'i Island suffered catastrophic coral mortality due to widespread and severe coral bleaching. Survey results indicated that overall coral bleaching prevalence averaged 53.3% (but reached up to 93% in some areas) and resulted in an average coral cover loss of 49.7% (as cited in University of Hawai'i 2017). Regional differences in bleaching prevalence and subsequent coral mortality were not detected. High post-bleaching mortality was detected for the coral species, *Pocillopora meandrina, Porites evermanni*, and *Porites lobata* (Kramer et al., 2016). *Porites lobata* and *Porites compressa*, reef-building species, saw catastrophic mortality rates of 55% and 33%, respectively (University of Hawai'i 2017). Acidification can also damage corals and marine life that depend on minerals for shell/skeletal development. The acidity of the Pacific Ocean has increased by about 25% over the last 300 years and is predicted to increase 40-50% by 2100 (EPA 2016).

Based on studies in the Great Barrier Reef, fishing pressure had minimal effect on bleaching (Hughes et al. 2017). On the island of Hawai'i, the total cover of hard coral decreased between 2003 and 2017 in MPAs, FRAs and in Open Areas, with the smallest decline seen in Open Areas, though all areas saw significant declines ranging from 48.7% in Open Areas to 57.8% in FRAs (DAR 2019a, Gove et al. 2019). Open Areas did not see a more severe decline than areas closed to commercial aquarium collection. Nonetheless, the "Coral Bleaching Recovery Plan" developed for the DLNR identified establishing a network of permanent no-take MPAs and a network of Herbivore Fishery Management Areas (HFMAs) as the top ranked actions

for combatting coral bleaching in Hawai'i (University of Hawai'i 2017). Under all alternatives considered in this EIS, a network of MPAs already exists within the WHRFMA, and it should be noted that this recommendation applies to all fisheries, not just the commercial aquarium fishery, which also has a network of FRAs where no collection by commercial aquarium collectors would occur under any of the alternatives under consideration.

Overall, the Coral Bleaching Recovery Plan (University of Hawai'i 2017) identified five management goals:

1. Preventing additional damage to coral through spatial protection for disturbed areas and reduction of land-based pollution;
2. Controlling algal overgrowth by reduction of land-based pollution, spatial protection of herbivores (particularly parrotfish), and herbivore protection through fisheries rules;
3. Stimulating new coral settlement through reduction of land-based pollution, spatial protection of larval sources, and secure substrate of larvae;
4. Stimulating new coral growth through facilitating conditions for rapid tissue regeneration; and
5. Replacing dead coral through transplanting fragments from unaffected areas and farming bleaching-resilient genotypes.

The Coral Bleaching Recovery Plan looked at a temporary moratorium on aquarium collecting as a management action for increasing herbivores, but it was one of the lowest ranked management actions for effectiveness ([1]9th of 22 management actions) (University of Hawai'i 2017). It should be noted that among the top 10 management actions was prohibition of all take (commercial and non-commercial) of herbivorous fish (ranked 4th). However, there are large natural differences in the capacity of individual reefs to support herbivore populations, and as such, not all reefs will respond similarly to actions such as fishing prohibitions (Heenan et al. 2016), and some studies such as Carassou et al. (2013) have found that current fishing pressure only slightly affects herbivorous fish communities, and that protection of herbivores is unlikely to improve coral reef resilience to climate change. Foo et al. (2021) suggested that regional management of multiple factors, including habitat, pollution, and fisheries, would best benefit resource fish biomass off the island of Hawai'i.

Under all of the alternatives under consideration some of the Coral Bleaching Recovery Plan management goals would be met, including retention of the existing MPA and FRA network, providing spatial protection through the WHRFMA, no addition of land-based pollution, and no collection of parrotfish. The collection of herbivores would differ by alternative based on where collection would occur (East Hawai'i versus the WHRFMA), the number of permits which would be issued (ranging from zero to unlimited), and the number of species which could be collected in the WHRFMA (ranging from zero to 8 to all 40 White List Species). The Preferred Alternative was specifically designed to help buffer climate change by creating individual catch quotas (i.e., hard upper limits on the number of individuals that could be collected) and implementation of a Revised White List limiting the number of species that could be collected.

Graham et al. (2020) found that the species which benefit from marine reserves may change post-bleaching, and that coral and macroalgal cover between fished areas and marine reserves do not differ

post-bleaching. Coral bleaching leads to declines in species richness within marine reserves, and while greater fish biomass in the marine reserve persists, the feeding groups of fish changes, with upper trophic piscivores and mixed-diet carnivore densities decreasing and the enhanced biomass of reserves being driven by lower trophic level herbivores. These conclusions illustrate the need to address climate change, as marine reserves alone cannot mitigate the multiple threats to coral reefs. Currently, it is projected that with warming of approximately 5ºF per decade, coral reefs will experience annual bleaching beginning by about 2040 in the Hawaiian Islands, though this may be delayed by approximately 11 years if the warming reductions in the 2015 Paris Agreement are met (U.S. Global Change Research Program [USGCRP] 2018). Bleaching and acidification will result in a loss of reef structure and lead to declines in fishery yields and loss of habitat (USGCRP 2018). Bleaching events in Hawai'i are tracked by NOAA, the DLNR, DAR, and other partners (found online at www.hawaiicoral.org). Changes in climate currently impact the physical resources of Hawai'i. Warming sea temperatures and acidification could result in damage, disease outbreaks, and ultimately death of coral reefs. The weakening or loss of coral reef ecosystems may threaten entire marine ecosystems in the region as many organisms, including numerous fish species, are not only dependent on these ecosystems for suitable habitat, but due to the isolation of the islands in the central pacific, are unable to move to new environments that provide suitable conditions for survival (EPA 2016).

Several White List and non-White List Species are endemic to the Hawaiian Archipelago (including Johnston Atoll) and therefore may be impacted when faced with changes in climate over time (e.g., warming temperatures, habitat loss due coral bleaching, etc.). The extent and severity of impacts to White List Species from climate change have been ongoing for decades and are expected to increase in the foreseeable future. If environmental fluctuations resulting from climate change (e.g., tropical storms, coral bleaching episodes, acidification, etc.), or other natural or human factors, change habitat conditions, fishing mortality may present a higher risk to some White List and non-White List Species and SGCN. Therefore, the cumulative impacts of commercial aquarium collection, when coupled with climate change, could change as new data become available and conditions change.

5.4.3.6 Poaching and Underreporting

It is acknowledged that poaching of aquarium fish could occur under any of the alternatives under consideration. For example, two fishers were cited in February 2020 for illegal harvesting of aquarium fish offshore of Kawaihae[21]. An inspection of the vessel allegedly turned up aquarium fishing gear, including a small mesh net, and the hold contained 550 live tropical fish of various species. The two fishers were cited by DOCARE officers for violation of HAR 13-60.4.4(3). The boat, trailer, and various fishing gear were seized as evidence. While poaching does occur, there are no available data on the number of aquarium fish, and specifically White List Species, taken by poachers in a given year. However, we assume the impact of poaching would be the same under all alternatives under consideration.

Analysis by the DAR (2014a) has shown that actual underreporting of catch is small, with a 3.5% difference between the number of animals reported caught and sold in 2010 and a 0.4% difference in 2014, which likely represent live releases and mortality. Therefore, it is anticipated that actual collection may be 0.4% to 3.5% higher than what had been reported prior to the October 2017 ban on fine-mesh nets, or 1,399 to

[21] https://www.hawaiitribune-herald.com/2020/02/22/hawaii-news/kona-men-cited-for-illegal-aquarium-fish-gear/

12,237 additional reef fish from the WHRFMA and East Hawai'i (based on 0.4% to 3.5% of the 349,620 average fish collected in a year). It is assumed that this rate of underreporting could occur under any of the alternatives under consideration (i.e., up to a 3.5% additional collection of any species). For example, under the Limited Permit Issuance Alternative, an additional 3.5% collection of the species with the highest collection of its population (Achilles Tang, at 20.44% of the population, see Table 5-21) would result in a collection of 21.16% of the population[22]. All other species would have even lower rates of collection. This 0.4% to 3.5% increase would also apply to the other alternatives under consideration. Poaching under the No Action Alternative may be less given that no legal commercial aquarium collection would be occurring, therefore potentially making it more difficult to sell illegally obtained aquarium fish, though this impact cannot be quantified at this time.

5.4.3.7 Cumulative Impact Conclusion

In the WHRFMA, cumulative impacts would occur under the Pre-Aquarium Collection Ban Alternative, WHRFMA-only Programmatic Issuance of Aquarium Permits Alternative, Achilles Tang Conservation Alternative, Limited Permit Issuance Alternative, and the Preferred Alternative. No cumulative impacts would occur under the No Action Alternative or the CML-only Alternative.

The DAR (2019a) has noted significantly declining populations in one or more of the WHRFMA management areas for 12 of the White List Species, and cumulatively, all of the factors discussed above likely contribute to the declines. Therefore, cumulative impacts to these 12 White List Species would occur under the Pre-Aquarium Collection Ban Alternative, the WHRFMA-only Programmatic Issuance of Aquarium Permits Alternative, the Achilles Tang Conservation Alternative, and the Limited Permit Issuance Alternative. No cumulative impacts to these 12 White List Species would occur under the Preferred Alternative or the No Action Alternative. Impacts to these 12 species would be limited to East Hawai'i under the CML-only Alternative.

However, as noted in Section 5.4.3, these declines are occurring in both areas open and closed to commercial aquarium fishing for all but one species, indicating that aquarium collection is not driving the decline (DAR 2019a). Because these declines are occurring in FRAs and/or MPAs as well (i.e., areas not open to commercial aquarium collection) it is reasonable to assume that banning commercial aquarium collection would not halt the declines. In addition, for the 12 species that have shown a significant decline in population size in one or more management area since establishment of the WHRFMA in 1999, commercial aquarium collection under any of the four alternatives which include collection of these species in the WHRFMA would collect less than 1% of the PIFSC-ESD WHRFMA estimates for 10 of the species (Table 5-21), and 2.0%-20.44% for the Achilles Tang (no population estimate is available for the Pyramid Butterflyfish).

Additionally, measures included in the Achilles Tang Conservation Alternative and Limited Permit Issuance Alternative may mitigate potential impacts to the Achilles Tang by limiting the number of Aquarium Permits issued as well as the number of Achilles Tang that can be collected by commercial aquarium collectors each day. As described above, commercial aquarium collection is not the only stressor on this species, and

[22] 0.2044*1.035 = 0.2116

therefore, it is anticipated that additional conservation measures designed to address the other stressors (e.g., commercial and recreational fisheries) will need to be implemented in order to sustain the population. The DAR (2019a) supports this conclusion, stating that conservative bag limits, as proposed in the Preferred Alternative for commercial aquarium collection, should be considered for other fisheries as well. There are currently no bag limits for Achilles Tang applied to any other fishery.

Minor cumulative impacts to the remaining 28 White List Species are anticipated under the Pre-Aquarium Collection Ban Alternative, the WHRFMA-only Programmatic Issuance of Aquarium Permits Alternative, the Achilles Tang Conservation Alternative, and the Limited Permit Issuance Alternative, given that populations have remained stable or increased for 24 of those species, and population trend data is not available for the other four species[23]. Cumulative impacts to these 28 White List Species would be limited to the 8 species on the Revised White List under the Preferred Alternative. No cumulative impacts to these 28 species would occur under the No Action Alternative, and impacts would be limited to East Hawai'i under the CML-only Alternative.

The Preferred Alternative is not anticipated to be a major contributor to greenhouse gas emissions because at most only seven boats would be operating in the aquarium fish collection industry, an insignificant number when compared to the thousands of other boats operated by other users in Hawai'i's waters. Under the Preferred Alternative, no cumulative impacts would occur to the 32 species no longer included on the Revised White List, including the 12 species showing significant population declines.

In East Hawai'i, cumulative impacts would occur under the CML-only Alternative, Pre-Aquarium Collection Ban Alternative, WHRFMA-Programmatic Issuance of Aquarium Permits Alternative, and the Achilles Tang Conservation Alternative. No cumulative impacts would occur in East Hawai'i under the No Action Alternative, Limited Permit Issuance Alternative, or the Preferred Alternative.

As Aquarium Permits for the 7 fishers who would be issued Aquarium Permits under the Proposed Action come up for renewal each year, DLNR should evaluate whether there are significant new circumstances or information relevant to environmental concerns and bearing on the commercial aquarium fishery or its impacts requiring a supplemental HEPA review (e.g., changing climate).

5.5 SUMMARY OF IMPACTS

Table 5-19 summarizes the environmental consequences by alternative during the 5-year analysis period.

[23] Species not adequately surveyed by WHAP include Tinker's Butterflyfish, Longfin Anthias, Flame Wrasse, and Eyestripe Surgeonfish.

Table 5-19. Summary of direct and indirect impacts by alternative over the 5-year analysis period.

Alternative	Socioeconomics			Cultural Resources	Biological Resources	
	Direct	Indirect	Tourism	Direct and Indirect	Collection of Fish	Coral Reefs and Herbivores
No Action	$0 added to the economy	$0 added to the economy	No interactions between collectors and tourists in the WHRFMA or in East Hawai'i	No impact in the WHRFMA or East Hawai'i	No collection in WHRFMA or in East Hawai'i	No impact in the WHRFMA or East Hawai'i
CML-only	$2 million added to the economy (based on fishing in East Hawai'i), unknown number of jobs (<57)	$10 million added to the economy, unknown number of indirect jobs (less than other alternatives)	No interactions between collectors and tourists in the WHRFMA, potential increase in East Hawai'i	No impact in the WHRFMA, unknown impact in East Hawai'i	No collection in WHRFMA Collection of 287,516 fish in East Hawai'i	No direct impact on coral anticipated. Minimal impact on herbivore numbers. The Preferred Alternative would have the least impact as a result of the implementation of individual catch quotas and a Revised White List.
Pre-Aquarium Collection Ban	$8.3 million added to the economy and 57 jobs	$41.7 million added to the economy, unknown number of indirect jobs	No known quantifiable impact on the tourism industry	Unknown impact	Collection of 1.7 million White List Species fish from the WHRFMA Collection of 91,000 fish from East Hawai'i	
WHRFMA-only Programmatic Issuance of Aquarium Permits	$7.9 to $8.3 million added to the economy and 57 jobs.	$39.7 to $41.7 million added to the economy, unknown number of indirect jobs	No known quantifiable impact on the tourism industry	Unknown impact	Collection of 1.7 million White List Species fish from the WHRFMA Collection of less than 91,000 fish from East Hawai'i	
Achilles Tang Conservation	$8 million added to the economy and 57 jobs	$40 million added to the economy, unknown number of indirect jobs	No known quantifiable impact on the tourism industry, may increase viewing potential for Achilles Tang	Unknown impact	Collection of 1.7 million White List Species fish from the WHRFMA, collection of Achilles reduced by 50% Collection of 91,000 fish from East Hawai'i	
Limited Permit Issuance	$1.8 to $3.7 million added to the economy and 10 jobs	$19.1 to $18.7 million added to the economy, unknown number of indirect jobs	No known impact on the tourism industry, may increase viewing potential for Achilles Tang. May increase viewing opportunities in East Hawai'i where no collection would occur.	Unknown impact in WHRFMA. No impact in East Hawai'i.	Collection of 828,484 White List Species fish from the WHRFMA, collection of Achilles Tang reduced by >50%, No collection in East Hawai'i	
Revised White List and Limited Permit Issuance (Preferred)	$2.5 to $10.1 million added to the economy, and 8 jobs	$212.5 to $50.6 million added to the economy, unknown number of indirect jobs	No known quantifiable impact on the tourism industry, may increase viewing potential for 32 species no longer included on the Revised White List or in East Hawai'i where no collection would occur	Unknown impacts in the WHRFMA but limited to the Revised White List (no impact to the other 32 species). No impact in East Hawai'i	Collection of 1.2 million White List Species fish from the WHRFMA (limited to 8 species), no collection of Achilles Tang, No collection in East Hawai'i	

5.5.1 Summary of Impacts on White List Species Populations

Sections 5.5.1.1 through 5.5.1.4 below summarize the population impacts (based on the percent of the population collected) of the seven alternatives on each of the 40 White List Species. The impact analysis in East Hawai'i is limited to the 15 White List Species with historic collection data from East Hawai'i. The Pre-Aquarium Collection Ban Alternative and the WHRFMA-only Programmatic Issuance of Aquarium

Permits Alternative are based on average and maximum collection for East Hawai'i and average collection rates for the WHRFMA (see Table 5-13). The Achilles Tang Conservation Alternative is also based on the average collection for the island of Hawai'i, but with a decreased Achilles Tang collection in the WHRFMA. The Limited Permit Issuance Alternative is based on the average collection of the 10 fishers in the WHRFMA, with a decrease in the Achilles Tang collection, with no collection occurring in East Hawai'i. The Revised White List and Limited Permit Issuance (Preferred) Alternative is based on the 8 species on the Revised White List and the individual catch quotas proposed under that alternative for the WHRFMA, and then no impacts for East Hawai'i as no CMLs would be issued for East Hawai'i.

5.5.1.1 East Hawai'i

In East Hawai'i, collection is projected to follow historic trends for the Pre-Aquarium Collection Ban Alternative, the WHRFMA-only Programmatic Issuance of Aquarium Permits Alternative, and the Achilles Tang Conservation Alternative. Under the CML-only Alternative, collection in East Hawai'i is anticipated to follow trends seen in 2018, when the WHRFMA was closed to commercial aquarium collection. Collection in East Hawai'i would not occur under the No Action Alternative, the Limited Permit Issuance Alternative or the Revised White List and Limited Permit Issuance Alternative. The impacts by alternative and species are summarized in Table 5-20 below.

Table 5-20. Summary of the annual impact (percent collected by commercial aquarium collectors) on East Hawai'i populations of the White List Species based on 2019 PIFSC-ESD (2020) population estimates and the projected annual collection under each alternative (see Table 5-15 for additional details). NA indicates the species does not have a population estimate or that no data on collection in East Hawai'i is available.

Common Name	No Action Alternative	CML-only Alternative	Pre-Aquarium Collection Ban Alternative	WHRFMA-only	Achilles Tang Conservation	Limited Permit Issuance Alternative	Revised White List and Limited Permit Issuance Alternative
Achilles Tang	0% - No Collection in East Hawai'i	1.40%	0.38%-0.82%		0.38%-1.4%	0% - No Collection in East Hawai'i	0% - No Collection in East Hawai'i
Bird Wrasse		NA	NA				
Black Durgon		NA	NA				
Black Surgeonfish		0.16%	NA				
Blacklip Butterflyfish		NA	NA				
Blackside Hawkfish		NA	NA				
Bluestripe Snapper – Taape		NA	0.00%-0.00%				
Brown Surgeonfish		NA	NA				
Eightline Wrasse		NA	NA				
Eyestripe Surgeonfish		NA	NA				

Common Name	No Action Alternative	CML-only Alternative	Pre-Aquarium Collection Ban Alternative	WHRFMA-only	Achilles Tang Conservation	Limited Permit Issuance Alternative	Revised White List and Limited Permit Issuance Alternative
Fisher's Angelfish		NA	0.00%-0.00%				
Flame Wrasse		NA	NA				
Forcepsfish		NA	<0.01%-0.01%				
Fourline Wrasse		NA	NA				
Fourspot Butterflyfish		NA	<0.01%				
Gilded Triggerfish		NA	NA				
Goldrim Tang		0.27%	0.13%-0.26%				
Kole		0.09%	0.08%-0.27%				
Hawaiian Dascyllus		NA	0.05%				
Hawaiian Whitespotted Toby		NA	NA				
Lei Triggerfish		NA	NA				
Longfin Anthias		NA	NA				
Milletseed Butterflyfish		NA	NA				
Multiband Butterflyfish		NA	NA				
Orangeband Surgeonfish		NA	<0.01%				
Orangespine Unicornfish		0.02%	<0.01%-0.01%				
Ornate Wrasse		NA	<0.01%				
Peacock Grouper – Roi		NA	NA				
Pencil Wrasse		NA	NA				
Potter's Angelfish		NA	NA				
Psychedelic Wrasse		NA	NA				
Pyramid Butterflyfish		NA	NA				
Redbarred Hawkfish		NA	NA				
Saddle Wrasse		NA	<0.01%				
Shortnose Wrasse		NA	0.02%				
Spotted Boxfish		NA	NA				
Thompson's Surgeonfish		NA	NA				
Tinker's Butterflyfish		NA	NA				

Common Name	No Action Alternative	CML-only Alternative	Pre-Aquarium Collection Ban Alternative	WHRFMA-only	Achilles Tang Conservation	Limited Permit Issuance Alternative	Revised White List and Limited Permit Issuance Alternative
Yellow Tang		14.95%	3.64% - 10.26%				
Yellowtail Coris		NA	0.01%-0.02%				

5.5.1.2 WHRFMA WHAP Open Area Population Estimate

For the WHRFMA WHAP Open Area (30-60-foot depth) populations, collection is projected to follow historic trends for the Pre-Aquarium Collection Ban Alternative, the WHRFMA-only Programmatic Issuance of Aquarium Permits Alternative, and the Achilles Tang Conservation Alternative, with a decrease in Achilles Tang collection under the Achilles Tang Conservation Alternative of approximately 50%. Under the No Action Alternative and CML-only Alternative, no collection would occur in the WHRFMA, and therefore the WHAP Open Area populations would not be impacted. Collection under the Limited Permit Issuance Alternative is anticipated to follow historic trends from the 10 fishers who would be issued permits, and collection under the Revised White List and Limited Permit Issuance Alternative is calculated as a worst-case scenario of all 7 fishers reaching the full individual catch quota for each of the 8 species on the Revised White List. There would be no impacts to the other 32 White List Species under the Revised White List and Limited Permit Issuance Alternative, since collection of those species in the WHRFMA would not be allowed.

Based on the projected collection under each alternative, population trends within the Open Areas would be anticipated to follow the trends seen in the FRAs for the No Action and CML-only alternatives, as well as for the species not on the Revised White List under the Preferred Alternative. This includes 17 species with stable populations, 13 species with increasing populations, and 6 species with decreasing populations (DAR 2019a). Population trend status is unknown for the remaining four species (DAR 2019a).

Under the remaining alternatives, as well as for the 8 species on the Revised White List under the Preferred Alternative, Open Area populations would be expected to follow the trends seen between 2000 and 2017. This includes 12 species with stable populations, 14 species with increasing populations, and 10 species with decreasing populations (DAR 2019a). Population trend status is unknown for the remaining four species (DAR 2019a). The populations of the eight species on the Revised White List were all stable or increasing between 2000 and 2017.

The impacts by alternative and species based on the percent of each population anticipated to be collected are summarized in Table 5-21 below.

Table 5-21. Summary of the annual impact (percent collected by commercial aquarium collectors) on WHRFMA Open Area populations of the White List Species based on 2017/2018 WHAP population estimates (for the 30-60-foot depth within Open Areas only) and the projected annual collection under each

alternative (see Table 5-16 and 5-17 for additional details). NA indicates the species does not have a population estimate.

Common Name	No Action Alternative and CML-only Alternative	Pre-Aquarium Collection Ban Alternative	WHRFMA -only	Achilles Tang Conservation	Limited Permit Issuance Alternative	Revised White List and Limited Permit Issuance Alternative
Achilles Tang	0% - No Collection in the WHRFMA	40.6%		20.3%	4.0%-9.1%	0.00% - No Collection in the WHRFMA
Bird Wrasse		<0.1%			<0.1%	0.5%
Black Durgon		<0.1%			<0.1%	0.00% - No Collection in the WHRFMA
Black Surgeonfish		3.6%			0.6%	3.2%
Blacklip Butterflyfish		0.2%			<0.1%	0.00% - No Collection in the WHRFMA
Blackside Hawkfish		0.2%			<0.1%	0.00% - No Collection in the WHRFMA
Bluestripe Snapper - Taape		0.1%			<0.1%	0.00% - No Collection in the WHRFMA
Brown Surgeonfish		<0.1%			<0.1%	<0.1%
Eightline Wrasse		<0.1%			<0.1%	0.00% - No Collection in the WHRFMA
Eyestripe Surgeonfish		NA			NA	0.00% - No Collection in the WHRFMA
Fisher's Angelfish		0.2%			0.1%	0.00% - No Collection in the WHRFMA
Flame Wrasse		NA			NA	0.00% - No Collection in the WHRFMA
Forcepsfish		4.6%			1.2%	0.00% - No Collection in the WHRFMA
Fourline Wrasse		<0.1%			<0.1%	0.00% - No Collection in the WHRFMA
Fourspot Butterflyfish		5.9%			1.3%)	0.00% - No Collection in the WHRFMA
Gilded Triggerfish		1.4%			0.2%	0.00% - No Collection in the WHRFMA
Goldrim Tang		9.3%			2.6%	0.00% - No Collection in the WHRFMA
Kole		0.2%			<0.1%	0.6%
Hawaiian Dascyllus		0.1%			<0.1%	0.00% - No Collection in the WHRFMA

Common Name	No Action Alternative and CML-only Alternative	Pre-Aquarium Collection Ban Alternative	WHRFMA -only	Achilles Tang Conservation	Limited Permit Issuance Alternative	Revised White List and Limited Permit Issuance Alternative
Hawaiian Whitespotted Toby		0.6%			0.2%	0.00% - No Collection in the WHRFMA
Lei Triggerfish		0.2%			<0.1%	0.00% - No Collection in the WHRFMA
Longfin Anthias		NA			NA	0.00% - No Collection in the WHRFMA
Milletseed Butterflyfish		4.9%			3.2%	0.00% - No Collection in the WHRFMA
Multiband Butterflyfish		0.3%			<0.1%	0.00% - No Collection in the WHRFMA
Orangeband Surgeonfish		1.5%			0.4%	0.00% - No Collection in the WHRFMA
Orangespine Unicornfish		3.2%			0.8%	3.3%
Ornate Wrasse		0.8%			0.2%	0.00% - No Collection in the WHRFMA
Peacock Grouper - Roi		<0.1%			0.0%	0.00% - No Collection in the WHRFMA
Pencil Wrasse		1.0%			0.4%	0.00% - No Collection in the WHRFMA
Potter's Angelfish		0.4%			0.2%	1.7%
Psychedelic Wrasse		25.6%			11.3%	0.00% - No Collection in the WHRFMA
Pyramid Butterflyfish		0.4%			0.1%	0.00% - No Collection in the WHRFMA
Redbarred Hawkfish		0.2%			<0.1%	0.00% - No Collection in the WHRFMA
Saddle Wrasse		0.4%			0.1%	0.00% - No Collection in the WHRFMA
Shortnose Wrasse		7.1%			4.2%	0.00% - No Collection in the WHRFMA
Spotted Boxfish		1.3%			1.0%	0.00% - No Collection in the WHRFMA
Thompson's Surgeonfish		<0.1%			<0.1%	0.7%
Tinker's Butterflyfish		NA			NA	0.00% - No Collection in the WHRFMA
Yellow Tang		9.5%			2.4%	7.0%

Common Name	No Action Alternative and CML-only Alternative	Pre-Aquarium Collection Ban Alternative	WHRFMA -only	Achilles Tang Conservation	Limited Permit Issuance Alternative	Revised White List and Limited Permit Issuance Alternative
Yellowtail Coris		3.1%			0.9%	0.00% - No Collection in the WHRFMA

5.5.1.3 WHRFMA WHAP Population Estimate

For the WHRFMA WHAP (30-60-foot depth) populations, collection is projected to follow historic trends for the Pre-Aquarium Collection Ban Alternative, the WHRFMA-only Programmatic Issuance of Aquarium Permits Alternative, and the Achilles Tang Conservation Alternative, with a decrease in Achilles Tang collection under the Achilles Tang Conservation Alternative of approximately 50%. Under the No Action Alternative and CML-only Alternative, no collection would occur in the WHRFMA, and therefore the WHRFMA populations would not be impacted. Collection under the Limited Permit Issuance Alternative is anticipated to follow historic trends from the 10 fishers who would be issued permits, and collection under the Revised White List and Limited Permit Issuance Alternative is calculated as a worst-case scenario of all 7 fishers reaching the full individual catch quota for each of the 8 species on the Revised White List. There would be no impacts to the other 32 White List Species under the Revised White List and Limited Permit Issuance Alternative, since collection of those species in the WHRFMA would not be allowed. The impacts by alternative and species are summarized in Table 5-22 below.

Table 5-22. Summary of the annual impact (percent collected by commercial aquarium collectors) on WHRFMA populations of the White List Species based on 2017/2018 WHAP population estimates (for the 30-60-foot depth within Open Areas, FRAs and MPAs) and the projected annual collection under each alternative (see Table 5-16 and 5-17 for additional details). NA indicates the species does not have a population estimate.

Common Name	No Action Alternative and CML-only Alternative	Pre-Aquarium Collection Ban Alternative	WHRFMA-only	Achilles Tang Conservation	Limited Permit Issuance Alternative	Revised White List and Limited Permit Issuance Alternative
Achilles Tang	0% - No Collection in the WHRFMA	26.1%		13.0%	2.5%-5.9%	0.00% - No Collection in the WHRFMA
Bird Wrasse		0.3%			<0.1%	0.3%
Black Durgon		<0.1%			<0.1%	0.00% - No Collection in the WHRFMA
Black Surgeonfish		2.3%			0.4%	2.0%
Blacklip Butterflyfish		0.2%			<0.1%	0.00% - No Collection in the WHRFMA
Blackside Hawkfish		0.1%			<0.1%	0.00% - No Collection in the WHRFMA
Bluestripe Snapper - Taape		0.1%			<0.1%	0.00% - No Collection in the WHRFMA
Brown Surgeonfish		<0.1%			<0.1%	<0.1%
Eightline Wrasse		<0.1%			<0.1%	0.00% - No Collection in the WHRFMA
Eyestripe Surgeonfish		34.0%			1.5%	0.00% - No Collection in the WHRFMA

Common Name	No Action Alternative and CML-only Alternative	Pre-Aquarium Collection Ban Alternative	WHRFMA-only	Achilles Tang Conservation	Limited Permit Issuance Alternative	Revised White List and Limited Permit Issuance Alternative
Fisher's Angelfish		0.2%			0.1%	0.00% - No Collection in the WHRFMA
Flame Wrasse		NA			NA	0.00% - No Collection in the WHRFMA
Forcepsfish		2.2%			0.6%	0.00% - No Collection in the WHRFMA
Fourline Wrasse		<0.1%			<0.1%	0.00% - No Collection in the WHRFMA
Fourspot Butterflyfish		4.7%			1.1%	0.00% - No Collection in the WHRFMA
Gilded Triggerfish		0.5%			0.1%	0.00% - No Collection in the WHRFMA
Goldrim Tang		4.0%			1.1%	0.00% - No Collection in the WHRFMA
Kole		0.1%			0.1%	0.3%
Hawaiian Dascyllus		0.1%			<0.1%	0.00% - No Collection in the WHRFMA
Hawaiian Whitespotted Toby		0.3%			0.1%	0.00% - No Collection in the WHRFMA
Lei Triggerfish		0.1%			<0.1%	0.00% - No Collection in the WHRFMA
Longfin Anthias		NA			NA	0.00% - No Collection in the WHRFMA
Milletseed Butterflyfish		4.7%			3.0%	0.00% - No Collection in the WHRFMA
Multiband Butterflyfish		0.1%			<0.1%	0.00% - No Collection in the WHRFMA
Orangeband Surgeonfish		1.1%			1.1% (0.3%)	0.00% - No Collection in the WHRFMA
Orangespine Unicornfish		2.2%			0.5%	2.2%
Ornate Wrasse		0.7%			0.1%	0.00% - No Collection in the WHRFMA
Peacock Grouper - Roi		<0.1%			0.0%	0.00% - No Collection in the WHRFMA
Pencil Wrasse		0.6%			0.3%	0.00% - No Collection in the WHRFMA
Potter's Angelfish		0.3%			0.1%	1.0%
Psychedelic Wrasse		13.9%			6.2%	0.00% - No Collection in the WHRFMA
Pyramid Butterflyfish		0.3%			0.1%	0.00% - No Collection in the WHRFMA
Redbarred Hawkfish		0.1%			<0.1%	0.00% - No Collection in the WHRFMA
Saddle Wrasse		0.1%			<0.1%	0.00% - No Collection in the WHRFMA
Shortnose Wrasse		4.9%			2.9%	0.00% - No Collection in the WHRFMA
Spotted Boxfish		0.9%			0.6%	0.00% - No Collection in the WHRFMA
Thompson's Surgeonfish		<0.1%			<0.1%	0.5%
Tinker's Butterflyfish		NA			NA	0.00% - No Collection in the WHRFMA
Yellow Tang		4.8%			1.2%	3.5%
Yellowtail Coris		1.7%			0.5%	0.00% - No Collection in the WHRFMA

5.5.1.4 WHRFMA PIFSC-ESD Population Estimate

For the PIFSC-ESD estimated WHRFMA populations, collection is projected to follow historic trends for the Pre-Aquarium Collection Ban Alternative, the WHRFMA-only Programmatic Issuance of Aquarium Permits Alternative, and the Achilles Tang Conservation Alternative, with a decrease in Achilles Tang collection under the Achilles Tang Conservation Alternative of approximately 50%. Under the No Action Alternative and CML-only Alternative, no collection would occur in the WHRFMA, and therefore the WHRFMA populations would not be impacted. Collection under the Limited Permit Issuance Alternative is anticipated to follow historic trends from the 10 fishers who would be issued permits, and collection under the Revised White List and Limited Permit Issuance Alternative is calculated as a worst-case scenario of all 7 fishers reaching the full individual catch quota for each of the 8 species on the Revised White List. There would be no impacts to the other 32 White List Species under the Revised White List and Limited Permit Issuance Alternative, since collection of those species in the WHRFMA would not be allowed. The impacts by alternative and species are summarized in Table 5-23 below.

Table 5-23. Summary of the annual impact (percent collected by commercial aquarium collectors) on WHRFMA populations of the White List Species based on 2019 PIFSC-ESD (2020) population estimates and the projected annual collection under each alternative (see Table 5-16 and 5-17 for additional details). NA indicates the species does not have a population estimate.

Common Name	No Action Alternative and CML-only Alternative	Pre-Aquarium Collection Ban Alternative	WHRFMA-only	Achilles Tang Conservation	Limited Permit Issuance Alternative	Revised White List and Limited Permit Issuance Alternative
Achilles Tang	0% - No Collection in the WHRFMA	20.44%		10.2%	2.0%-4.6%	0.00% - No Collection in the WHRFMA
Bird Wrasse		0.08%			0.01%	0.1%
Black Durgon		<0.01%			<0.01%	0.00% - No Collection in the WHRFMA
Black Surgeonfish		1.12%			0.20%	1.0%
Blacklip Butterflyfish		0.10%			0.05%	0.00% - No Collection in the WHRFMA
Blackside Hawkfish		0.05%			0.02%	0.00% - No Collection in the WHRFMA
Bluestripe Snapper - Taape		0.02%			0.01%	0.00% - No Collection in the WHRFMA
Brown Surgeonfish		0.02%			0.02% (<0.01%)	<0.1%
Eightline Wrasse		0.05%			0.05% (0.01%)	0.00% - No Collection in the WHRFMA
Eyestripe Surgeonfish		0.82%			0.82% (0.04%)	0.00% - No Collection in the WHRFMA
Fisher's Angelfish		0.04%			0.02%	0.00% - No Collection in the WHRFMA
Flame Wrasse		NA			NA	0.00% - No Collection in the WHRFMA
Forcepsfish		0.87%			0.23%	0.00% - No Collection in the WHRFMA
Fourline Wrasse		0.08%			0.03%	0.00% - No Collection in the WHRFMA
Fourspot Butterflyfish		0.70%			0.16%	0.00% - No Collection in the WHRFMA

Common Name	No Action Alternative and CML-only Alternative	Pre-Aquarium Collection Ban Alternative	WHRFMA-only	Achilles Tang Conservation	Limited Permit Issuance Alternative	Revised White List and Limited Permit Issuance Alternative
Gilded Triggerfish		0.06%			<0.01%	0.00% - No Collection in the WHRFMA
Goldrim Tang		0.78%			0.22%	0.00% - No Collection in the WHRFMA
Kole		0.14%			0.05%	0.5%
Hawaiian Dascyllus		0.07%			0.03%	0.00% - No Collection in the WHRFMA
Hawaiian Whitespotted Toby		0.46%			0.14%	0.00% - No Collection in the WHRFMA
Lei Triggerfish		0.05%			0.02%	0.00% - No Collection in the WHRFMA
Longfin Anthias		NA			NA	0.00% - No Collection in the WHRFMA
Milletseed Butterflyfish		0.73%			0.47%	0.00% - No Collection in the WHRFMA
Multiband Butterflyfish		0.15%			0.03%	0.00% - No Collection in the WHRFMA
Orangeband Surgeonfish		0.30%			0.08%	0.00% - No Collection in the WHRFMA
Orangespine Unicornfish		1.14%			0.28%	1.1%
Ornate Wrasse		0.37%			0.08%	0.00% - No Collection in the WHRFMA
Peacock Grouper - Roi		<0.01%			0.00%	0.00% - No Collection in the WHRFMA
Pencil Wrasse		0.19%			0.08%	0.00% - No Collection in the WHRFMA
Potter's Angelfish		0.25%			0.10%	1.0%
Psychedelic Wrasse		4.71%			2.08%	0.00% - No Collection in the WHRFMA
Pyramid Butterflyfish		NA			NA	0.00% - No Collection in the WHRFMA
Redbarred Hawkfish		0.11%			0.03%	0.00% - No Collection in the WHRFMA
Saddle Wrasse		0.02%			<0.01%	0.00% - No Collection in the WHRFMA
Shortnose Wrasse		0.47%			0.28%	0.00% - No Collection in the WHRFMA
Spotted Boxfish		1.46%			1.08%	0.00% - No Collection in the WHRFMA
Thompson's Surgeonfish		0.09%			0.02%	1.0%
Tinker's Butterflyfish		NA			NA	0.00% - No Collection in the WHRFMA
Yellow Tang		4.46%			1.12%	3.3%
Yellowtail Coris		0.39%			0.12%	0.00% - No Collection in the WHRFMA

5.5.2 Identification of Preferred Alternative

Of the alternatives which meet the Applicant's purpose and need, the Revised White List and Limited Permit Issuance Alternative is the Preferred Alternative, as it results in the lowest collection of the 40 White List Species, limits collection to species which have shown stable or increasing population trends, limits the geographic scope of Aquarium Permits and CMLs to the WHRFMA, and limits the number of permits that would be issued (7 permits). The Preferred Alternative was specifically designed to help buffer climate

change by creating individual catch quotas (i.e., hard upper limits on the number of individuals that could be collected) and implementation of a Revised White List limiting the number of species that could be collected. It is anticipated that population trends of the eight species on the Revised White List would remain stable or increase, as they have historically under commercial aquarium collecting pressure, and the percent of each population that would be collected under a worst case scenario (all seven fishers collect their individual catch quota for each of the eight species) is summarized in Table 5-24.

Table 5-24. Summary of the annual impact (percent collected by commercial aquarium collectors) on various populations of the Revised White List Species based on the maximum total allowable catch under the Preferred Alternative.

Species	East Hawai'i	WHRFMA WHAP Open Area Population	WHRFMA WHAP Population	WHRFMA PIFSC-ESD Population
Yellow Tang	0% - no collection	7.0%	3.5%	3.3%
Black Surgeonfish	0% - no collection	3.2%	2.0%	1.0%
Orangespine Unicornfish	0% - no collection	3.3%	2.2%	1.1%
Kole	0% - no collection	0.6%	0.3%	0.5%
Bird Wrasse	0% - no collection	0.5%	0.3%	0.1%
Potter's Angelfish	0% - no collection	1.7%	1.0%	1.0%
Thompson's Surgeonfish	0% - no collection	0.7%	0.5%	1.0%
Brown Surgeonfish	0% - no collection	<0.1%	<0.1%	<0.1%

5.6 APPLICANT'S EVALUATION OF HEPA SIGNIFICANCE CRITERIA

Below is a summary of the Applicant's evaluation of the significance criteria described in Title II, Chapter 200, Hawai'i Administrative Rules, with the five criteria where the DLNR has previously requested further analysis shown in bold. It is understood that the DLNR and the BLNR will conduct their own independent evaluations of the HEPA significance criteria.

- **Significance Criteria #1:** The Preferred Alternative (i.e., Revised White List and Limited Permit Issuance Alternative) does not involve an irrevocable commitment or loss or destruction of any natural, historic, or cultural resource.

  Fish Populations: The Preferred Alternative limits the number permits to 7, implements individual catch quotas (i.e., hard upper limits on the number of individuals that could be collected), and implements a Revised White List reducing the number of species on the list to 8 from the current 40 and only includes species which have shown stable or increasing population trends. No impacts would occur to the 32 species no longer included on the Revised White List, including the 12 species showing significant population declines.

  Collection would impact less than 1% of the estimated WHAP Open Area population for 4 of the 8 species, and between 1% and 5% for 3 of the 8 species, with only one species

(the Yellow Tang) being collected at greater than 5% of the estimated Open Area Population. However, all eight of these species were chosen for the Revised White List with input from the DLNR due to increasing or stable population trends across all WHRFMA areas under historic collection rates, and therefore this level of collection is not anticipated to cause population declines.

For the WHAP WHRFMA population estimates (Open Areas, FRAs and MPAs), collection would be less than 1% for 4 of the 8 species, and between 1% and 5% for the remaining 4 species. The percentage of the population collected would be highest for the Yellow Tang (3.5% of the estimated population). However, Yellow Tang populations have been increasing even under higher levels of historic collection since establishment of the WHRFMA.

For the PIFSC-ESD population estimates, collection would be 1% or less of the estimated population for 7 of the 8 species. The Yellow Tang would be collected at 3.3% of the estimated population; however, Yellow Tang populations have been increasing even under higher levels of historic collection since establishment of the WHRFMA.

Based on the low percentage of the overall populations that would be collected annually by commercial aquarium fishers under the Preferred Alternative, which is spread throughout the year and across multiple areas, as well as the targeted collection of smaller less fecund individuals, commercial aquarium collection under the Preferred Alternative is anticipated to have minimal impacts on populations in general. The DAR (2019a) has noted that populations of all 8 of the species on the proposed Revised White List have remained stable or significantly increased between 1999 and 2017, when commercial aquarium collection was occurring.

Reef Habitat: Tissot and Hallacher (2003) concluded that there were no significant differences in damaged coral between control and collected sites (i.e., sites where aquarium collection occurs) to indicate the presence of destructive fishing practices. In addition, they found no increases in the abundance of macroalgae where the abundance of herbivores was reduced by aquarium collecting. Additionally, the DAR (2019a) reported that herbivore biomass has not changed since 2003 in the Open Areas or FRAs and has increased by 30.8% in the MPAs. While there has been no significant change in Open Areas or FRAs, there has still been an increasing trend, with a 14.4% increase in herbivore biomass in FRAs and a 26.0% increase in herbivore biomass in Open Areas between 2003 and 2017 (DAR 2019a, Gove et al. 2019). This occurred even with the pressures from commercial aquarium collection which was occurring during this time. The pressures from commercial aquarium collection under the Preferred Alternative are anticipated to be lower than rates seen prior to the October 2017 ban on commercial aquarium collection. While these two studies do not indicate significant differences between fished and unfished areas, that does not mean that no damage occurs. However, until further studies are conducted, they provide the best available science on the direct effects of commercial aquarium collection on coral.

Herbivorous fish are known to be important in reef ecosystems and play a role in the recovery of reefs damaged as a result of climate change or other causes. The Preferred Alternative would lessen the impact of aquarium fishing on herbivores by reducing the number of species that can be collected and establishing individual catch quotas for the 8 species on the Revised White List. Additionally, DAR (2019a) reported that herbivore biomass has not changed since 2003 in the Open Areas or FRAs and has increased by 30.8% in the MPAs. While there has been no significant change in Open Areas or FRAs, there has still been an increasing trend, with a 14.4% increase in herbivore biomass in FRAs and a 26.0% increase in herbivore biomass in Open Areas between 2003 and 2017 (DAR 2019a, Gove et al. 2019). This occurred even with higher pressure from commercial aquarium collection than would be seen under the Preferred Alternative. Furthermore, the marked increase in herbivore biomass in more restrictive MPAs, and the fact that there is no significant difference between Open Areas and FRAs, indicates that any declining trends or differences in herbivore biomass are not due to aquarium collection, but rather due to other types of fishing (i.e., food fishing).

Cultural Resources: As concluded in the CIA, cultural impacts would occur if issuance of Aquarium Permits under an alternative would cause a significant decline in the population of a White List Species considered to be a cultural resource, either directly through the collection of fish or indirectly through habitat impacts. As detailed in Section 5.4, populations of the 8 species on the proposed Revised White List are not anticipated to substantially decline under the Preferred Alternative. However, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, the Preferred Alternative may impact cultural practices, but the extent of the impact is unknown.

Other Resources: Aside from reducing the number of Aquarium Permits issued and reducing the White List to 8 species from the current 40, the Preferred Alternative does not include any activities different from, or in addition to, those that have occurred in the past. There would be no construction of permanent or semi-permanent infrastructure, no discharges into coastal, surface or ground waters, and no dredging, and no significant use of hazardous materials that could be released into the environment. The Preferred Alternative would not result in beneficial or adverse impacts to water and air quality, geology and soil resources, aesthetics, noise, vegetation, terrestrial wildlife, avian species, threatened and endangered species, land use, public health and safety, communications, transportation, utilities, or population and demographics from the current baseline condition.

- **Significance Criteria #2**: The Preferred Alternative does not curtail the range of beneficial uses of the environment. Act 306 has created a platform on which the public can learn about and participate in the management of the fishery. Since the Act's implementation, the DAR has created FRAs and conducts annual monitoring and research on the fish and coral, ensuring that the full range of beneficial uses of the environment remain now and into the future.

Aquatic Invasive Algae Control: Tissot and Hallacher (2003) found no increases in the abundance of macroalgae where the abundance of herbivores was reduced by aquarium collecting. Additionally, the DAR (2019a) reported that herbivore biomass has not changed since 2003 in the Open Areas or FRAs and has increased by 30.8% in the MPAs. While there has been no significant change in Open Areas or FRAs, there has still been an increasing trend, with a 14.4% increase in herbivore biomass in FRAs and a 26.0% increase in herbivore biomass in Open Areas between 2003 and 2017 (DAR 2019a, Gove et al. 2019). This occurred even when the pressures from commercial aquarium collection were higher than would be seen under the Preferred Alternative. The marked increase in herbivore biomass in more restrictive MPAs, and the fact that there is no significant difference between Open Areas and FRAs, indicates that any declining trends or differences in herbivore biomass are not due to aquarium collection, but rather due to other types of fishing (i.e., food fishing).

Tourism: Available data do not suggest that the commercial aquarium collection has impacted the tourism industry in Hawai'i. The Hawai'i's tourism industry achieved new records in total visitor spending and visitor arrivals in 2017, marking the sixth consecutive year of record growth in both categories. Total spending by visitors to the Hawaiian Islands increased 5.6% to a new high of $16.81 billion (HTA 2018). When adjusted for inflation, total visitor spending was up 3.5% from 2016. A total of 9,404,346 visitors came by air or by cruise ship to the state, up 5.3% from the previous record of 8,934,277 visitors in 2016. Total visitor days rose 4.8% compared to 2016. The average spending per day by these visitors ($198 per person) was also higher than 2016 ($197 per person; HTA 2018). Additionally, as described in Section 5.4, populations of the White List Species are not anticipated to significantly decline, therefore not substantially impacting viewing opportunities.

Integrity of Diverse Aquatic Ecosystems: The Preferred Alternative limits the number permits to seven, implements individual catch quotas (i.e., hard upper limits on the number of individuals that could be collected), and implements a Revised White List reducing the number of species on the list to 8 from the current 40 and only includes species which have shown stable or increasing population trends. As described in Section 5.4, populations of the eight species on the proposed Revised White List are not anticipated to significantly decline. Additionally, Tissot and Hallacher (2003) concluded that there were no significant differences in damaged coral between control and collected sites (i.e., sites where aquarium collection occurs) to indicate the presence of destructive fishing practices. Tissot and Hallacher (2003) further found no increases in the abundance of macroalgae where the abundance of herbivores was reduced by aquarium collecting. Additionally, the DAR (2019a) reported that herbivore biomass has not changed since 2003 in the Open Areas or FRAs and has increased by 30.8% in the MPAs. While there has been no significant change in Open Areas or FRAs, there has still been an increasing trend, with a 14.4% increase in herbivore biomass in FRAs and a 26.0% increase in herbivore biomass in Open Areas between 2003 and 2017 (DAR 2019a, Gove et al. 2019). The marked increase in herbivore biomass in more restrictive MPAs, and the fact that there is no significant

difference between Open Areas and FRAs, indicates that any declining trends or differences in herbivore biomass are not due to aquarium collection, but rather due to other types of fishing (i.e., food fishing).

Significance Criteria #3: The Preferred Alternative does not conflict with the State's environmental policies or long-term environmental goals as established by law. As described in Section 5.4, populations of the eight species on the Revised White List are not anticipated to significantly decline under the Preferred Alternative and substantial impacts to coral reefs or herbivores are not anticipated, therefore the Preferred Alternative is not in conflict with the conservation of natural resources or the flora and fauna. There would be a beneficial impact to the economy and no impact on human population, threatened and endangered species, parks, recreation, and open spaces, transportation, energy use, community life and housing, education, or culture under the Preferred Alternative. As described in Section 1.2.4.1, multiple opportunities have been provided throughout the history of the commercial aquarium fishery for citizen participation, including public comment periods during the previous EA and EIS (see Section 1.1.3), and as part of this Revised FEIS.

- **Significance Criteria #4:** The Preferred Alternative does not substantially affect the economic welfare, social welfare, and cultural practices of the community or State, but plays an important role as a nearshore fishery in the State. According to DAR (2019a), the marine aquarium fishery is the most economically valuable commercial inshore fishery in the State of Hawai'i, with 68% of the value coming from the Island of Hawai'i, mainly West Hawai'i. The Preferred Alternative would add an estimated $2.5 to $10 million over the 5-year analysis period (range of $499,416 to $2,022,686 per year), and another five times this value in indirect economic benefits. Loss of the fishery would result in the loss of income, tax revenue, and jobs.

  Cultural Practices: As concluded in the CIA, cultural impacts would occur if issuance of Aquarium Permits under an alternative would cause a significant decline in the population of a White List Species considered to be a cultural resource, either directly through the collection of fish or indirectly through habitat impacts. Table 4-4 lists the 40 White List Species, including the 8 proposed for the Revised White List, and Section 4.4 includes a brief summary of known cultural significance by species. While only 7 of the 8 species on the proposed Revised White list have a known cultural use for food, medicinal, religious or ceremonial purposes, it is assumed a negative cultural impact could occur if populations of any of the 8 species were impacted. As detailed in Section 5.4, populations of the eight species on the proposed Revised White List Specie are not anticipated to substantially decline under the Preferred Alternative. Nevertheless, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, the Preferred Alternative may impact cultural practices, but the extent of the impact is unknown.

- Significance Criteria #5: The Preferred Alternative would not affect public health.

- Significance Criteria #6: The Preferred Alternative does not involve substantial secondary impacts, such as population changes or effects on public facilities. There is no expectation that populations or the public would be negatively impacted by continuing the fishery.

- Significance Criteria #7: The Preferred Alternative does not involve a substantial degradation of environmental quality. Two studies have concluded that the fishery has no significant impact on coral or the reef ecosystem (Tissot and Hallacher 2003; DAR 2019a). The marked increase in herbivore biomass in more the restrictive MPAs, and the fact that there is no significant difference between Open Areas and FRAs, indicates that any declining trends or differences in herbivore biomass are not due to aquarium collection, but rather due to other types of fishing (i.e., food fishing).

- **Significance Criteria #8:** The Preferred Alternative does not involve a commitment for larger actions. When the full range of impacts to White List Species are considered (e.g., recreational aquarium collection, non-aquarium commercial fishing, recreational fishing, tourism, climate change), there is a significant cumulative impact to some White List Species. However, the Preferred Alternative limits the number permits to seven, implements individual catch quotas (i.e., hard upper limits on the number of individuals that could be collected), and implements a Revised White List reducing the number of species on the list to 8 from the current 40 and only includes species which have shown stable or increasing population trends (i.e., the 12 species that have shown a significant decline in population size, along with SGCN species, are no longer on the list). Therefore, while commercial aquarium collection does contribute to cumulative impact, the Preferred Alternative is not anticipated to be a significant contributor.

- Significance Criteria #9: The Preferred Alternative does not affect threatened or endangered species or their habitats nor does it have an impact on rare species as no SGCN would be included on the Revised White List.

- Significance Criteria #10: The Preferred Alternative does not detrimentally affect air or water quality or ambient noise levels. At most, seven boats would be involved in the island of Hawai'i aquarium fishery under the Preferred Alternative as compared to the thousands of other boats on the waters of Hawai'i.

- Significance Criteria #11: The Preferred Alternative would not significantly affect or suffer damage by being located in environmentally sensitive areas such as a floodplain, tsunami zone, sea level rise exposure area, beach, erosion-prone area, geologically hazardous land, estuaries, freshwater, or coastal water. As noted earlier, the fishery has been active since the late 1940s. Regulations have been implemented restricting the fishery from sensitive areas.

- Significance Criteria #12: The Preferred Alternative does not substantially affect scenic vistas and view planes identified in county or state plans or studies.

- Significance Criteria #13: The Preferred Alternative does not require substantial energy consumption or emit substantial greenhouse gases.

Under HRS 188-31, the DLNR may issue a commercial Aquarium Permit to a qualified party for a period of one year in duration, subject to renewal. Therefore, this Revised FEIS analyzes the direct, indirect, and cumulative impacts of issuance of seven Aquarium Permits on affected resources for a period of five years.

6.0 AGENCIES, ORGANIZATIONS, AND INDIVIDUALS CONSULTED

See the FEA[24] and FEIS[25] for a list of agencies, organizations, and individuals consulted during development of the FEA and FEIS, which were used as the basis for development of the Revised FEIS.

6.1 CONSULTED PARTIES

The following individuals previously requested to be a Consulted Party and were contacted again during development of the Revised DEIS:

- Keith Dane, Hawai'i Policy Advisor, The Humane Society of the United States
- Rene Umberger, Executive Director, For the Fishes
- Laura Smythe, Litigation Fellow, The Humane Society of the United States
- Miyoko Sakashita, Oceans Director, Center for Biological Diversity
- Mike Nakachi, President, Moana Ohana
- Inga Gibson, Policy Director, Pono Advocacy, LLC
- Kealoha Pisciotta, Mauna Kea Anaina Hou and Kai Palaoa

Each of these individuals was sent a letter on December 14, 2020 via email, specifically seeking advice and input on 11 of the concerns raised by the BLNR in its June 23, 2020 FEIS Acceptance Determination in which the BLNR decided on non-acceptance of the FEIS (3 of the 14 concerns were determined by the Environmental Council to be arbitrary and capricious and therefore were not addressed in the consultation). Consulted Parties were asked to respond within 30 days. Comments received and responses to those comments are provided in Appendix B. The consultation process for cultural resources is described in depth in Section 4 of Appendix A.

These consulted parties were sent links to the Revised DEIS, and any comments received on the DEIS and the Applicant's responses are provided in Appendix C.

6.2 FEDERAL AGENCIES

The following federal agencies were consulted:

- NOAA Pacific Islands Fishers Science Center Ecosystem Sciences Division

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[24] http://oeqc2.doh.hawaii.gov/EA_EIS_Library/2018-08-08-HA-FEA-EISPN-Hawaii-Island-Commercial-Aquarium-Permits.pdf
[25] http://oeqc2.doh.hawaii.gov/EA_EIS_Library/2020-04-23-HA-FEIS-Hawaii-Island-Commercial-Aquarium-Permits.pdf

6.3 STATE AGENCIES

The following state agencies were consulted:

- Hawai'i Department of Land and Natural Resources, Division of Aquatic Resources
- Hawai'i State Department of Health, Office of Environmental Quality Control

7.0 DISTRIBUTION OF THE REVISED FEIS

The distribution list for the Revised FEIS is included in Appendix D.

8.0 LIST OF PREPARERS

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APPENDIX A—CULTURAL IMPACT ASSESSMENT

A Cultural Impact Assessment for the Proposed Issuance of Fourteen Commercial Aquarium Permits within the West Hawai‘i Regional Fishery Management Area

Including the Near Shore Waters from ‘Upolu Point to Ka Lae, Kohala, Kona, and Ka‘ū Districts, Island of Hawai‘i (except those areas already designated for no collection)

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A Cultural Impact Assessment for the Proposed Issuance of Fourteen Commercial Aquarium Permits within the West Hawai‘i Regional Fishery Management Area

‘Upolu Point to Ka Lae,
Kohala, Kona, and Ka‘ū Districts,
Island of Hawai‘i

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1. INTRODUCTION

At the request of K & L Gates, LLP, on behalf of the Pet Industry Joint Advisory Council (PIJAC), ASM Affiliates (ASM) has prepared a Cultural Impact Assessment (CIA) for the proposed issuance of fourteen commercial aquarium permits within the West Hawai‘i Regional Fishery Management Area (WHRFMA). The WHRFMA(the study area), established in 1998 by ACT 306 of the State Legislature of Hawai‘i, includes the nearshore waters of the Kohala, Kona, and Ka‘ū Districts on the west side of Hawai‘i Island, extending from ‘Upolu Point to Ka Lae, and from the upper reaches of the wash of the waves onshore, seaward to the limit of the State’s police power and management authority (Figure 1). This CIA is intended to inform an HRS Chapter 343 Environmental Impact Statement (EIS) being prepared on behalf of PIJAC (the applicant) that will allow for the issuance of fourteen annual commercial aquarium permits for the collection of forty fish species (referred to as ‘white list’ species) from within the WHRFMA, excluding those areas already designated for no collection. The no collection areas include all previously established Marine Life Conservation Districts (MLCDs), Fish Replenishment Areas (FRAs), Netting Restricted Areas (NRAs), and Fisheries Management Areas (FMAs) located within the WHRFMA (see Figure 1). Per the draft EIS for this project, the proposed action is as follows:

> Under the Limited Permit Issuance Alternative, the DLNR would begin issuing new Aquarium Permits to 14 aquarium fishers in the WHRFMA, thereby allowing these 14 individuals to resume commercial aquarium fish collection in the WHRFMA. No additional permits would be issued. Permittees would abide by all rules and regulations set forth in HRS 189-2,3 (Commercial Marine Permit), HRS-188-31 (Section 1.2.1), governing Commercial Aquarium Permit use, and would obtain a West Hawai′i Aquarium Permit as required under HAR 13-60.4 (Section 1.2.3.2). These rules and regulations include restrictions on equipment, restrictions on access to various areas, bag limits on various collected fish species, collection in the WHRFMA restricted to 40 White List species only, and reporting requirements. In addition, daily bag limit for commercial aquarium collection of Achilles Tang within the WHRFMA would be reduced from 10 per day to 5 per day.

The following report, which has been prepared in accordance with the Office of Environmental Quality Control (OEQC) *Guidelines for Assessing Cultural Impacts*, adopted by the Environmental Council, State of Hawai‘i, on November 19, 1997 (Office of Environmental Quality Control (OEQC) 1997), assesses the potential cultural impacts of aquarium collection by the proposed fourteen permit holders.

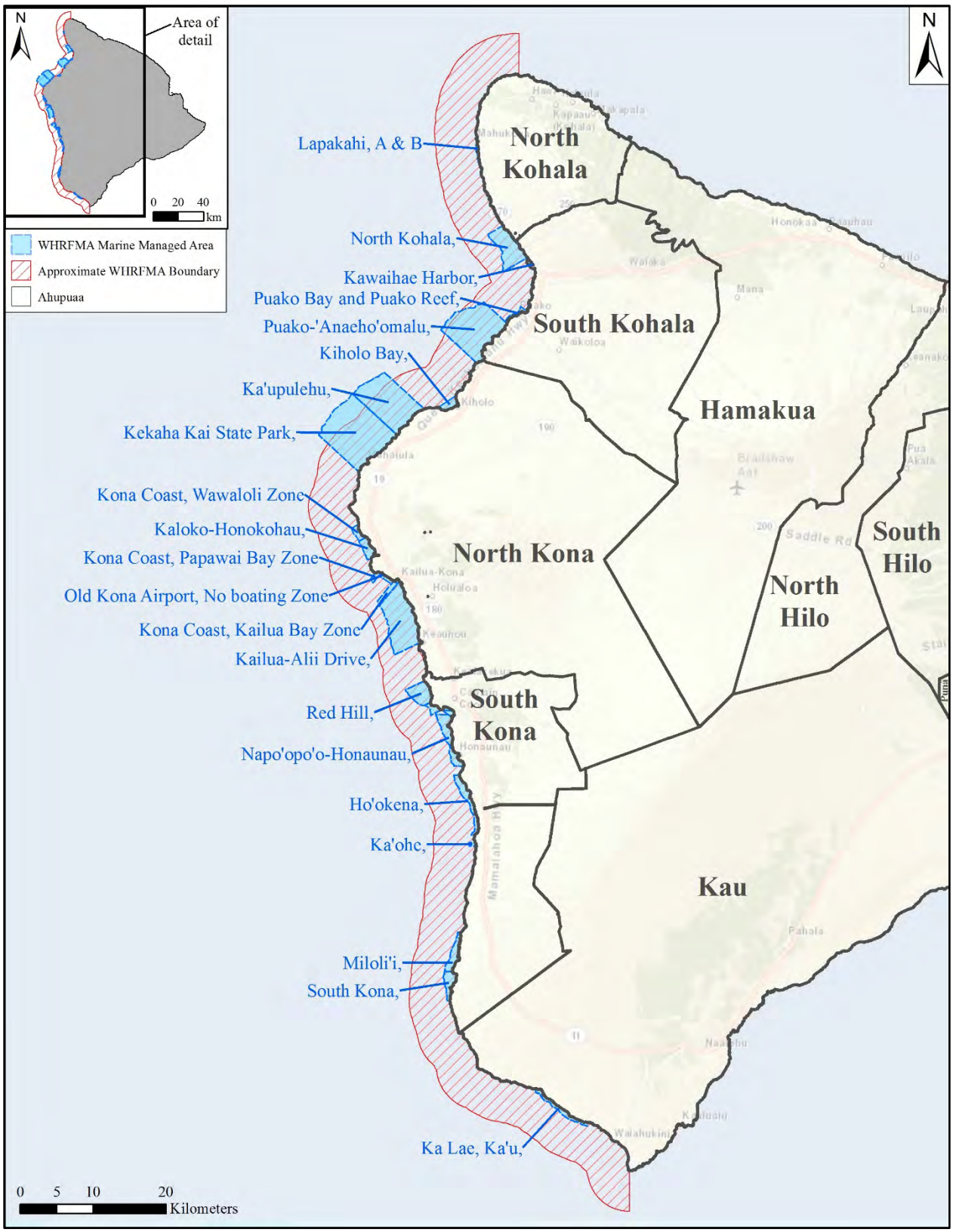

Figure 1. Map showing the extent of the West Hawai‘i Regional Fishery Management Area, extending from the Kohala to the Ka‘ū Districts of Hawai‘i Island, with the no collection areas indicated.

REGULATORY BACKGROUND OF THE PROPOSED ACTION

The objective of the action proposed in the EIS is to create a program under the Department of Land and Natural Resources (DLNR) (the approving agency) that will help to facilitate a permitting process for the issuance of commercial aquarium permits within the WHRFMA (pursuant to Aquarium Fishing Permits issued under Hawai'i Revised Statute §188-31) so that fourteen commercial aquarium fishers' on the Island of Hawai‘i can continue to operate their businesses in compliance with all applicable State of Hawai‘i laws, rules, and regulations pertaining to the industry. Hawai'i Revised Statute (HRS) §188-31 (2013; Title 12 – Conservation and Resources; 188 – Fishing Rights and Regulations; 188-31 – Permits to take aquatic life for aquarium purposes) states that:

> 1. Except as prohibited by law, the department, upon receipt of a written application, may issue an aquarium fish permit, not longer than one year in duration, to use fine meshed traps, or fine meshed nets other than throw nets, for the taking of marine or freshwater nongame fish and other aquatic life for aquarium purposes.
> 2. Except as prohibited by law, the permits shall be issued only to persons who can satisfy the department that they possess facilities to and can maintain fish and other aquatic life alive and in reasonable health.
> 3. It shall be illegal to sell or offer for sale any fish and other aquatic life taken under an aquarium fish permit unless those fish and other aquatic life are sold alive for aquarium purposes. The department may adopt rules pursuant to HRS chapter 91 for the purpose of this section.

Additionally, aquarium permits issued for commercial aquarium collection within the WHRFMA are subject to the terms and conditions set forth in Hawai‘i Administrative Rule (HAR) 13-60.4, which includes provisions for restrictions on equipment and access to various areas within the fishery, collection restrictions (40 White List species only), bag limits on certain fish species, and catch reporting requirements.

From 2000 to 2017, the DLNR issued between 24 and 60 commercial aquarium permits annually within the WHRFMA (Pet Industry Joint Advisory Council 2018). However, no commercial aquarium fishing permits have been issued or renewed by the DLNR under HRS §188-31—and no aquarium collection has occurred within the WHRFMA—since September of 2017, when the Supreme Court of Hawai‘i ruled that the issuance of such permits (for aquarium collection using fine meshed traps or nets) constitutes a discretionary State action and is thus subject to the Hawai‘i Environmental Policy Act (HEPA). HEPA requires that State agencies consider the impact of governmental actions on the environment by preparing an Environmental Assessment (EA) or an Environmental Impact Statement (EIS) to document the potential impacts of the State action.

Accordingly, a Final Environmental Assessment (FEA) for the issuance of commercial aquarium permits for the entire Island of Hawai‘i (Pet Industry Joint Advisory Council 2018) was prepared (by the current applicant) and submitted to the DLNR for review on June 7, 2018. The FEA, proposed a "finding of no significant impacts" (FONSI) for the action, but the DLNR disagreed with that finding and determined, based on the significance criteria outlined in Title 11, Chapter 200, Hawai‘i Administrative Rules, that the project could have a significant impact on the environment, and therefore required the preparation of an Environmental Impact Statement (EIS).

As stated in Act 50, proposed and passed as Hawai‘i State House of Representatives Bill No. 2895, and signed into law by the Governor on April 26, 2000, "environmental assessments or environmental impact statements should identify and address effects on Hawaii's culture, and traditional and customary rights," as:

> . . . native Hawaiian culture plays a vital role in preserving and advancing the unique quality of life and the "aloha spirit" in Hawai‘i. Articles IX and XII of the state constitution, other state laws, and the courts of the State impose on governmental agencies a duty to promote and protect cultural beliefs, practices, and resources of native Hawaiians as well as other ethnic groups.
>
> Moreover, the past failure to require native Hawaiian cultural impact assessments has resulted in the loss and destruction of many important cultural resources and has interfered with the exercise of native Hawaiian culture. The legislature further finds that due consideration of the effects of human activities on native Hawaiian culture and the exercise thereof is necessary to ensure the continued existence, development, and exercise of native Hawaiian culture.

It is the need to identify and address the effects of the proposed action (issuing fourteen commercial aquarium fishing permits within the WHRMA) on Hawaii's culture, and traditional and customary rights, that has necessitated the preparation of this CIA.

ASSESSING THE POTENTIAL CULTURAL IMPACTS OF THE PROPOSED ACTION

In a letter reviewing the FEA for the issuance of commercial aquarium permits for the Island of Hawai‘i (dated July 26, 2018), Suzanne Case, Chair of the DLNR, specifically requested that further analysis occur in the EIS on several significance criteria under HAR § 11-200-12, including the take of aquarium fish as an irrevocable commitment to loss or destruction of natural or cultural resources, and the impact of the take of aquarium fish on cultural practices in the state. More specifically, with regards to assessing the cultural impacts, Case writes that:

> Cultural impacts of aquarium fishing need significantly more analysis than provided in the FEA. The OEQC guidelines should be followed for assessing cultural impacts, including consulting with traditional cultural practitioners and other knowledgeable informants and sources about cultural resources, cultural practices, and the proposed action's potential impacts. Traditional Hawaiian practices and subsistence uses, local place-based and life-cycle knowledge, and traditional Hawaiian cultural significance of each type of aquarium fish taken should be reviewed. The indirect impact of modern technologies for highly efficient catch methods on traditional harvest capabilities should be included in the analysis.

While the action proposed in the current EIS differs somewhat from the action previously proposed in the FEA—limiting the geographic extent for the issuance of permits to the WHRFMA (rather than the entire Island of Hawai‘i) and capping the total number of annual commercial aquarium permits issued at 14—the additional analysis requested above by the DLNR has been used to guide the scope of work presented in this CIA, which was prepared following the OEQC *Guidelines for Assessing Cultural Impacts* (adopted by the Environmental Council, State of Hawai‘i, November 19, 1997). According to those guidelines:

> In scoping the cultural portion of an environmental assessment, the geographical extent of the inquiry should, in most instances, be greater than the area over which the proposed action will take place. This is to ensure that cultural practices which may not occur within the boundaries of the project area, but which may nonetheless be affected, are included in the assessment. (State of Hawai'i, Office of Environmental Quality Control 2012:11)

For this reason, for assessing the potential cultural impacts of the issuance of fourteen commercial aquarium permits within the WHRFMA, the entire fishery management area along the western coast of Hawai‘i Island is considered, not just those areas within which commercial aquarium fishing will be permitted. To Hawai‘i's host culture, the ocean is viewed as an integrated whole, flowing unrestrained by politically imposed boundaries. While the proposed collection of fish to supply the aquarium industry will not be conducted in all existing marine managed areas, this study, in alignment with the OEQC guidelines seeks to understand the cultural beliefs, practices, and resources, even within those communities situated in or adjacent to previously established marine managed areas. This study therefore, utilizes a *moku* (district) level analysis and at times draws upon cultural-historical background for specific *ahupua‘a*.

The following CIA report is divided into five main sections, which includes: 1) and introduction of the proposed action; 2) a description of the general geographic context of the study area, which includes a discussion on the formalization of the WHRFMA and the establishment of the marine managed areas; 3) a culture-historical background for the nearshore waters of West Hawai‘i Island that includes a discussion of the traditional Hawaiian cultural significance of each type of aquarium fish taken; 4) a summary of the methods and results of consultation with traditional cultural practitioners and other knowledgeable informants regarding cultural resources and cultural practices of the study area, and the proposed action's potential impacts; and 5) an analysis of potential cultural impacts that may result from the proposed action. At the conclusion of the CIA recommendations are offered regarding appropriate mitigation strategies that may be employed by the applicant and DLNR to help minimize the potential for cultural impacts that could result from the issuance of fourteen commercial aquarium permits within the WHRFMA.

2. STUDY AREA DESCRIPTION

The study area for the CIA consists of the entire West Hawai‘i Regional Fishery Management Area (WHRFMA), which extends for 147 miles along the west coast of Hawai‘i Island from its northernmost extent at ‘Upolu Point in the Kohala District to its southern most extent at Ka Lae in the Ka‘ū District (see Figure 1). The DLNR describes the geographical jurisdiction of the WHRFMA as extending from "the upper reaches of the wash of the waves on shore, seaward to the limit of the State's police power and management authority" (DLNR 1999:3). The specific boundaries of the WHRFMA are described as follows in Hawai‘i Administrative Rules §13-60.4-2:

> …The four points shall be identified as the landward northern point, the landward southern point, the seaward northern point, and the seaward southern point. The landward boundary for each of these areas shall be an imaginary line drawn along the highest wash of the waves between the landward northern point and the landward southern point. Should there be a stream or river flowing into the ocean, the landward boundary shall be an imaginary straight line drawn between the shoreline on either side of the stream or river, as if the stream or river was not there. Imaginary straight lines drawn through the landward and seaward northern points, and through the landward and seaward southern points, shall constitute the northern and southern boundary lines of each area. The seaward boundary of each area shall be determined by an imaginary line drawn along the one hundred fathom (six hundred feet) depth contour, between the intersection of the one hundred fathom depth contour and the northern and southern boundary lines. Seaward GPS reference points are for guidelines and the one hundred fathom depth contour otherwise controls the seaward boundary. Any area designated in this chapter shall include the submerged lands and overlying waters within these four boundaries. (DLNR 1999:5)

The WHRFMA spans the coastline of three traditional *moku* (districts) on the west side of Hawai‘i Island—Kohala (North and South), Kona (North and South), and Ka‘ū—and includes more than 170 distinct *ahupua‘a* (Soehren 2004, 2005a, 2005b), whose boundaries encompass the shoreline resources and, in many cases, extend out into the nearshore waters of the fishery. Geologically, the jagged coastline is formed by four of the island’s five volcanoes (Kohala, Mauna Kea, Hualālai, and Mauna Loa; Figure 2), and the underwater terrain typically follows the sloping profile of those volcanoes to the bottom of the Pacific Ocean (Sherrod et al. 2007). West Hawai‘i Island also has the longest continuous coral reef in the main Hawaiian Islands, and is home to a highly productive and diverse marine ecosystem that supports an abundance of tropical corals, reef fishes, sea turtles, cetaceans, and manta rays. Boating access to the WHRFMA is limited to four small boat harbors (SBH) located at Kawaihae, Honokōhau, Kailua-Kona, and Keauhou, an anchorage at Mahukona, and launch ramps at Puakō, Honaunau, Kauhako (the beach at Ho‘okena), Miloli‘i, and Kaulana that are operated by the DLNR, Division of Boating and Ocean Recreation (DOBOR) and the County of Hawai‘i (Figure 3).

The Kohala District (North and South) encompasses the northernmost region of the study area (Figure 4). Beginning at the northern tip of the Island at ‘Upolu Point in the *ahupua‘a* of Kahei, this district extends south to the *ahupua‘a* of Waikoloa and the *‘ili kūpono* of ‘Anaeho‘omalu—traditionally a politically independent land division within the Waikoloa Ahupua‘a. Within the Kohala District are seven marine managed areas: Lapakahi MLCD-Subzones A and B; North Kohala FRA; Kawaihae Harbor FMA; Wailea Bay MLCD; Puakō Bay and Puakō Reef FMA; and the Puakō-‘Anaeho‘omalu FRA and NRA (see Figure 4 and Figure 5). The Kohala portion of the study area (Figure 6) is comprised of short expanses of reefs, sheltered bays, rocky shoreline that are interspersed with low lying cliffs, with a few white sand beaches near the Kawaihae area. Most of the North Kohala shoreline (from Kāhei-Hualua Ahupua‘a at the north to Waikā Ahupua‘a at the south) has remained undeveloped with the exception of a few homes situated *makai* (seaward) of the ‘Akoni Pule Highway and the Kawaihae-Mahukona Road. This modern settlement pattern stands in contrast to the South Kohala shoreline (from Kawaihae 1 Ahupua‘a at the north to Waikoloa Ahupua‘a and ‘Anaeho‘omalu at the south) portion of the study area, which contains several large resort developments along the coast. Geologically speaking, this northernmost section of the study area is situated along the coast of Kohala Volcano, and contains the oldest lava substrates (see Figure 2).

Similar to North Kohala, the South Kohala coast (Figure 7) is comprised of low rocky shorelines interspersed with both large and small stretches of fine white sand beaches. The reef system in this portion of the study area is far more developed and in some places extends for some distance into the sea. It is at these white sand beaches fronting the well-developed reef areas that residential and large scale commercial developments specifically resorts and condominiums) are concentrated. A distinguishing characteristic of this region are the many shallow bays, some of which were traditionally walled (both natural and artificial) and converted into *loko i‘a* (fishponds), and the many naturally occurring *loko wai* (freshwater ponds). Both of these features were traditionally utilized for aquaculture and were strictly managed. Currently, within South Kohala, DOBOR maintains the Kawaihae small boat harbor and the Puakō launch ramp (see Figure 3). This section of the study area includes the coastal portions of three of the island’s volcanoes, Kohala, Mauna Kea, Mauna Loa (see Figure 2).

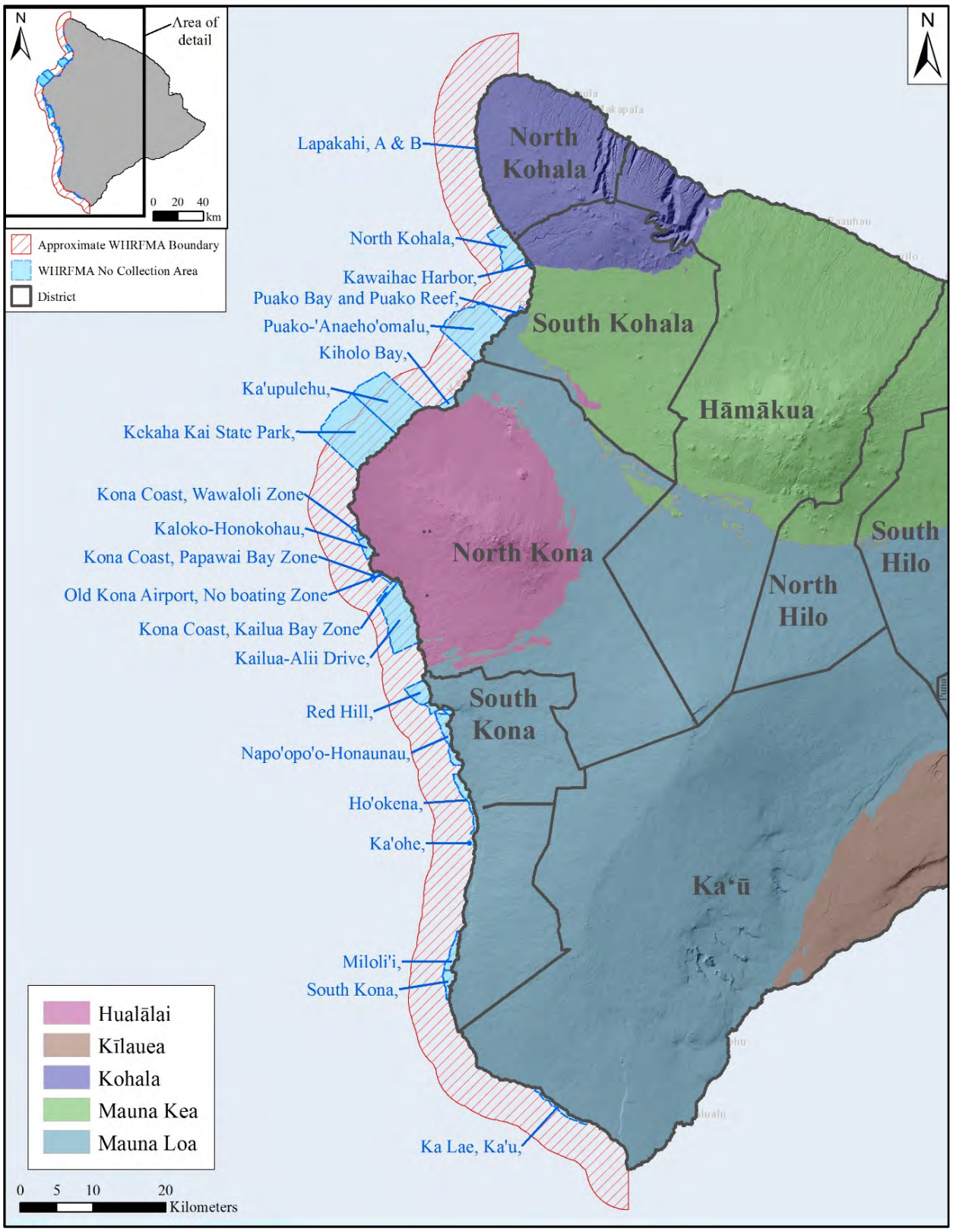

Figure 2. Geological map of the West Hawai'i Regional Fishery Management Area.

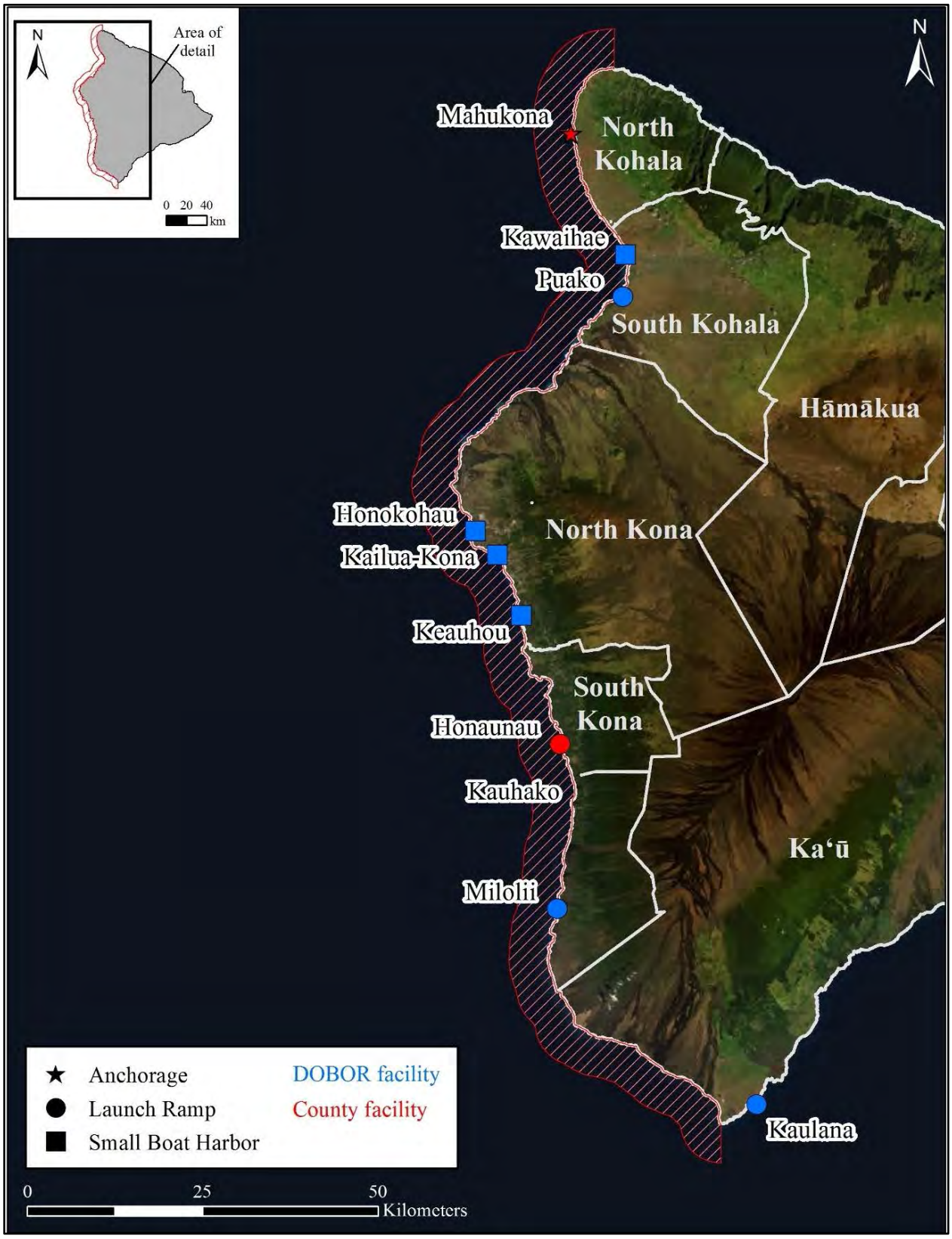

Figure 3. Map showing the location of harbors and launch ramps within (and nearby) the WHRFMA.

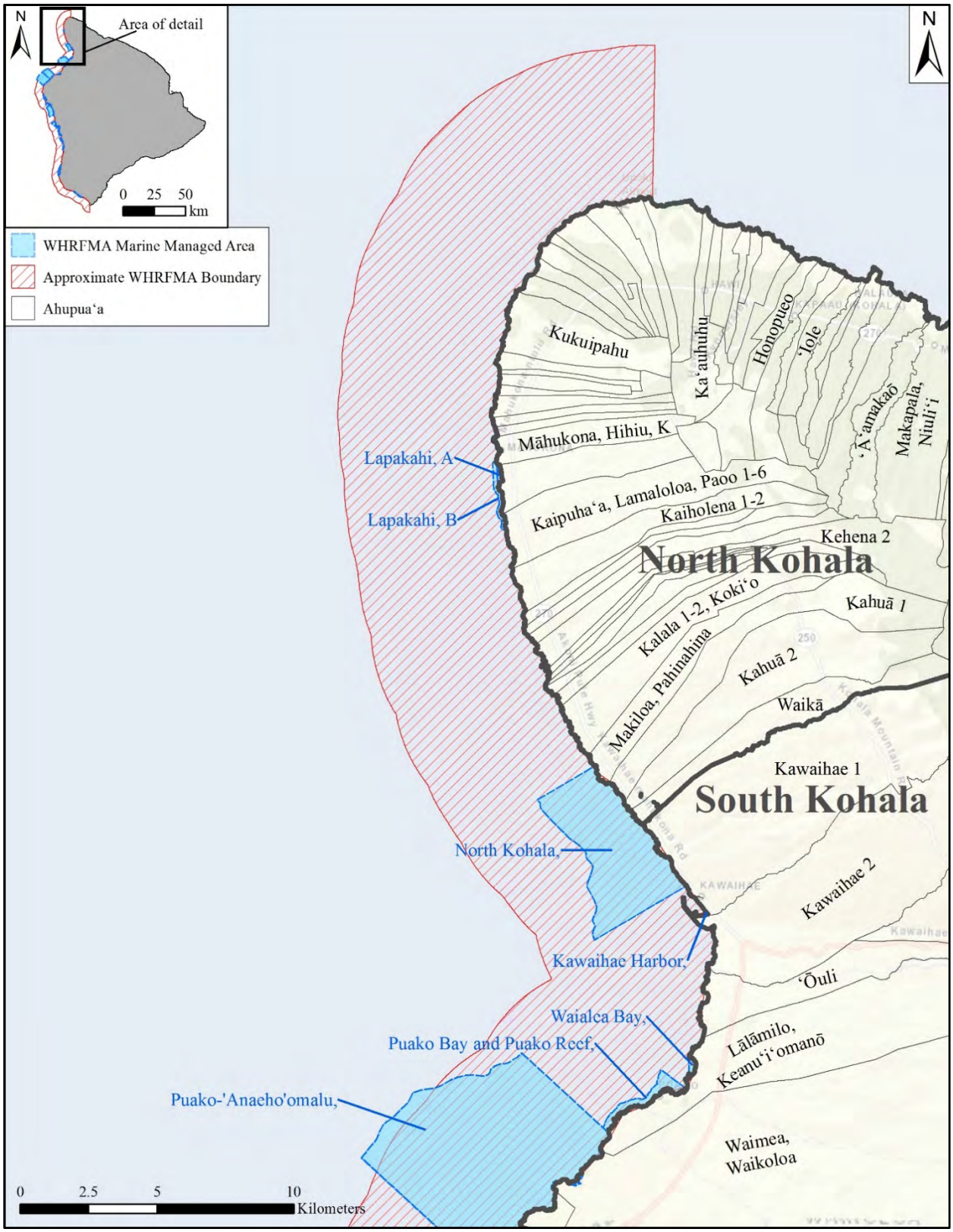

Figure 4. Detail of the North and South Kohala portion of the West Hawai'i Regional Fishery Management Area.

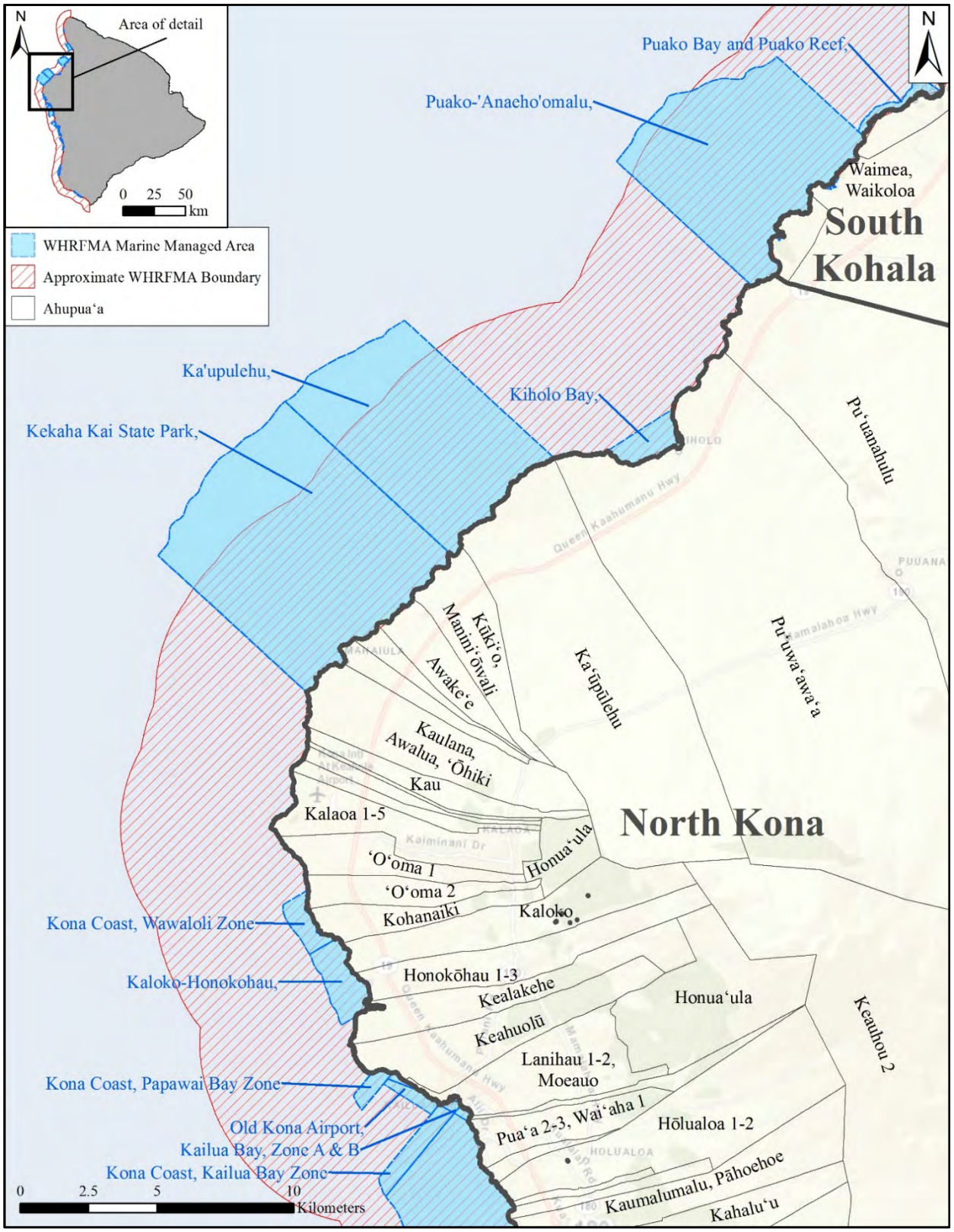

Figure 5. Detail of the North Kona portion of the West Hawai'i Regional Fishery Management Area.

Figure 6. North Kohala coastline fronting Kaiholena Ahupuaʻa, view to the south.

Figure 7. South Kohala coastline fronting Puakō in Lālāmilo Ahupuaʻa, view to the north with Kohala Volcano visible in the background.

The Kona District, which makes up the greatest portion of the WHRFMA (see Figure 5 and Figure 8), commences at its northernmost *ahupuaʻa* of Puʻu Anahulu at the boundary of the South Kohala District, and extends south to Kaulanamauna Ahupuaʻa at the boundary of the Kaʻū District. The Kona portion of the WHRFMA includes at least ninety-eight *ahupuaʻa* (Soehren 2004). Within the North Kona District (from Puʻuanahulu Ahupuaʻa at the north to Honalo-Māʻihi 1 & 2 Ahupuaʻa at the south) are eleven marine managed areas: Kīholo Bay FMA; Kaʻūpūlehu Marine Reserve; Kikaua Point-Mākoleʻā NRA (labeled in Figure 5 as the "Kekaha Kai State Park"); the Kona Coast FMAs, which includes the Wāwāloli, Papawai Bay, and Kailua Bay; Kaloko-Honokōhau FRA; Old Kona Airport MLCD and no boating zone; Kailua Bay Zones A & B FMA, Kailua-Keauhou Bay FRA (labeled in Figure 8 as the "Kailua-Alii Drive" and "Keauhou Bay").

The coastline of the North Kona region is characterized by its rocky shoreline, low lying cliffs, many sheltered bays, speckled with both white and black sand beaches, as well as pebbled beaches (Figures 9 and 10). The latter two beach types were created as a result of more recent volcanic activity originating from the slopes of Hualālai Volcano, upon which most of this district is situated, although the northernmost section of this district includes coastal Mauna Loa flows as well (see Figure 2). The reefs in this area are well developed, and in some areas extend upwards of 0.5 miles into the ocean. Also, present within this region are *loko wai* and *loko iʻa*. Similar to South Kohala, modern settlement in North Kona (inclusive of residential and large scale commercial development) is centered primarily around the sandy beaches and *loko wai*, although it does extend into the more desolate lava fields adjacent to those areas as well. Population density along the Kona coast increases significantly in the region extending south from the Kona Airport at Keāhole Point (the western tip of Hawaiʻi Island) to Keauhou Bay, within the town of Kailua-Kona. The area *makai* Aliʻi Drive along the coast within Kailua-Kona is extensively developed and heavily populated. Within North Kona, DOBOR maintains the Honokōhau, Kailua-Kona, and Keauhou small boat harbors (see Figure 3).

The South Kona District (from Keʻekeʻe-Kanakau Ahupuaʻa at its northern extent to Kaulanamauna Ahupuaʻa at its southern extent) includes eight marine managed areas (see Figure 8 and Figure 11): Red Hill FMA; Kealakekua Bay MLCD Zones A & B; Nāpoʻopoʻo-Hōnaunau FRA; Hoʻokena FRA; Kaʻohe FRA; Miloliʻi FRA, and the Hanamalo Point-Kanewaʻa Point NRA (labeled as South Kona in Figure 11). The coastline in this area is predominately rocky, comprised of both high and low-lying cliffs interspersed with an occasional black sand beach. Many sheltered bays are also present along the South Kona coast. The reefs in this area are well developed, especially in the larger sheltered bays. Modern coastal development, now comprised of residential lots has, for the most part, followed traditional coastal settlement patterns which are concentrated in the vicinity of Kealakekua Bay, Kahauloa, Keʻei, Hōnaunau, Keālia, Kauhakō, Hoʻokena, Kaʻohe, Pāpā, and Miloliʻi (Figure 12). DOBOR currently maintains the Miloliʻi launch ramp, while the County of Hawaiʻi maintains the Hōnaunau launch ramp (see Figure 3). Although no longer considered an active boat ramp, historically, Hoʻokena beach (Kauhakō) also served as a major landing point. Geologically this section of the study area is situated entirely along the coast of Mauna Loa, as is the adjacent section of the study area within the Kaʻū District (see Figure 2).

The southernmost portion of the WHRFMA, within the Kaʻū District, extends from Manukā Ahupuaʻa at its northern end to Ka Lae (the southernmost point of Hawaiʻi Island) and the *ahupuaʻa* of Puʻuʻeo, at its southern end (see Figure 11). The only marine managed area in this portion of the WHRFMA is the Kanonohe-Kalipoa netting restricted area, which is labeled "Ka Lae, Kaʻu" in Figure 11. This portion of Kaʻū is characterized by its rocky coastline with both high and low-lying cliffs and the occasional white or black sand beach occurring within some of the many sheltered bays (Figure 13). The reefs in this area are mostly short, but highly developed. DOBOR currently maintains one (Kaulana launch ramp) of the two launch ramps in the Kaʻū District. The Kaulana launch ramp is, however, located to the east beyond the WHRFMA boundaries (see Figure 3).

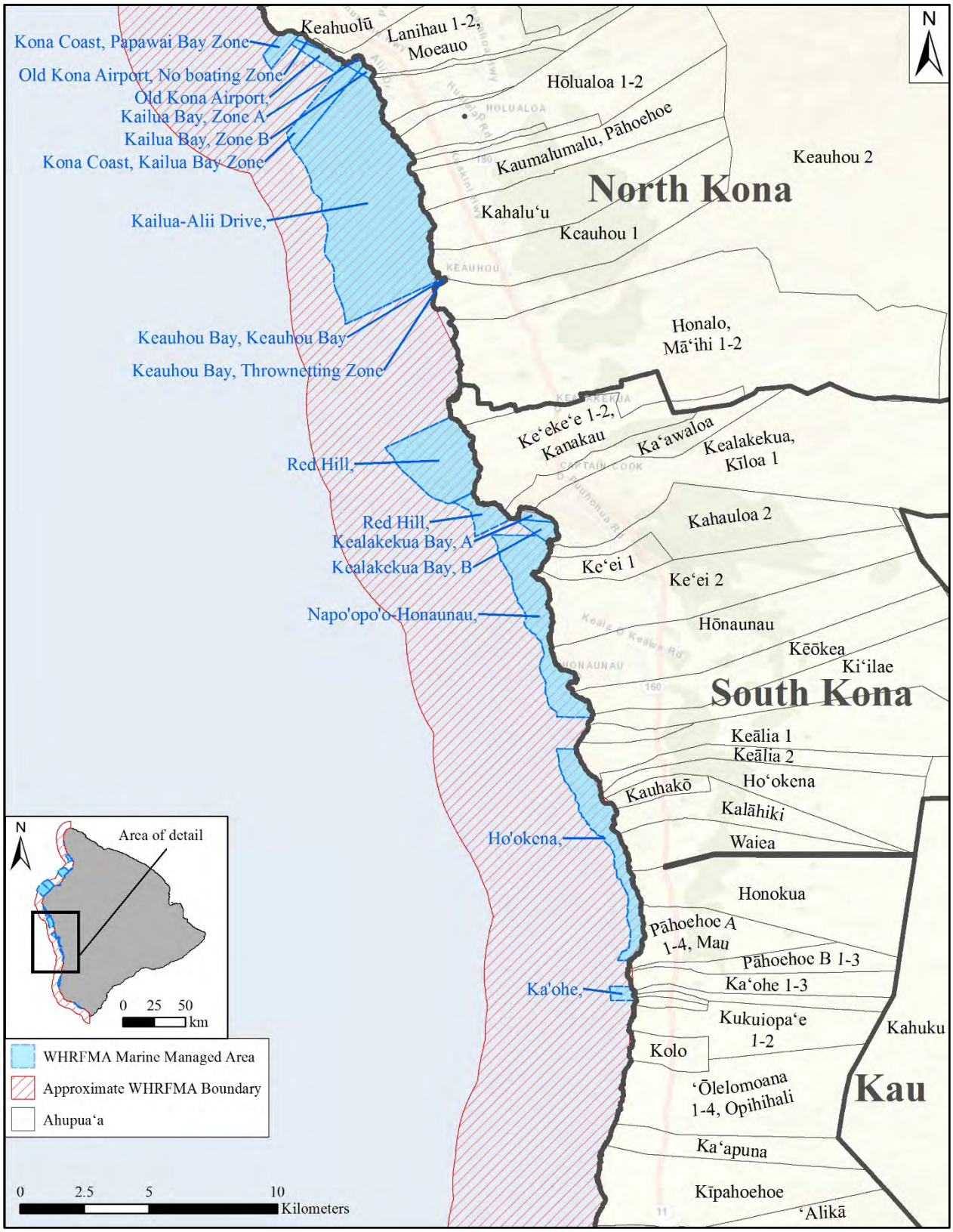

Figure 8. Detail of the South Kona portion of the West Hawai'i Regional Fishery Management Area.

Figure 9. Low, rocky coastline of North Kona fronting Keahuolū Ahupuaʻa, view to the north.

Figure 10. Laʻaloa Beach Park along the North Kona coastline, view to the north.

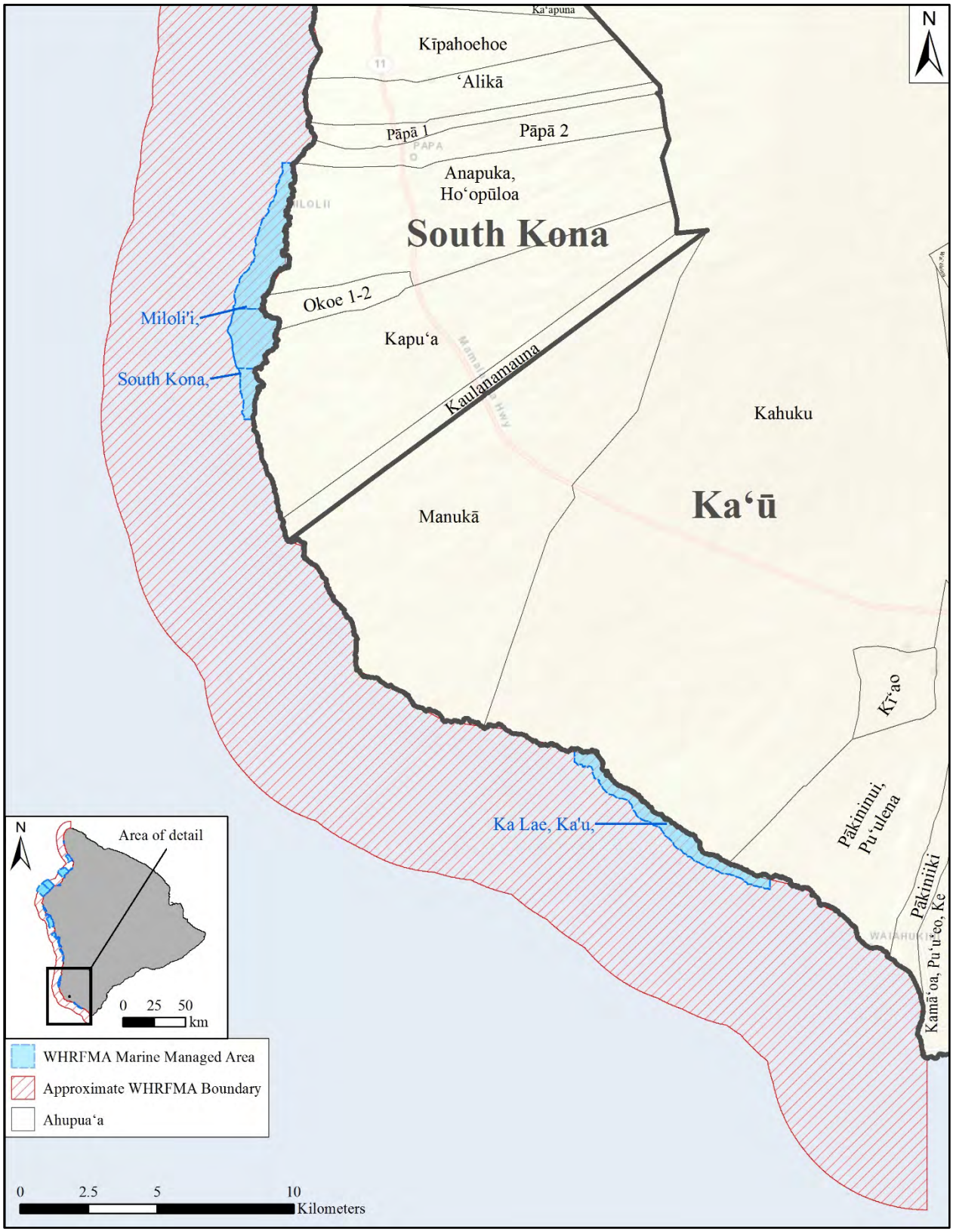

Figure 11. Detail of the Ka'ū portion of the West Hawai'i Regional Fishery Management Area.

Figure 12. South Kona coastline, view to the south across Pāpā Bay towards Miloli‘i.

Figure 13. Ka‘ū coastline, view to the northwest from Ka Lae.

AQUARIUM FISHING AND THE ESTABLISHMENT OF THE WHRFMA

The collection of aquarium fish in West Hawai‘i has a long and contentious history (Walsh 2000). While Division of Fish and Game received legislative authority to regulate the industry and issue Aquarium Fishing Permits as early as the 1950s, and division suspended those permits for a time in 1973 over public concern about aquarium collection, aquarium collection activities remained largely unregulated in West Hawai‘i until roughly twenty years ago, when the WHRFMA was established. The concept of the WHRFMA was introduced to the Hawai‘i legislature by Democratic Representative David Tarnas in 1997 as House Bill (HB) 3457. This bill was introduced following decades of conflict between various user groups within West Hawai‘i fishery (Walsh 2000). The discussions to improve marine management efforts within West Hawai‘i came primarily through the West Hawai‘i Reef Fish Working Group (WHRFWG), a group that formed in May of 1996 following the passage of House Concurrent Resolution (HCR) 184, which requested that the DLNR convene a task force to assist in developing a comprehensive management plan to regulate the take of aquarium fish within the area. In describing the purpose of HB 3457, Walsh writes:

> This bill established a West Hawaii Regional Fishery Management Area along the entire West Hawaii coast (Upolu Pt. to Ka Lae) to provide for effective management of marine resources. Along several provisions of this bill was a requirement to set aside 50% of the FMA as Fish Replenishment Areas (FRAs) where aquarium collecting was prohibited….During committee hearings of HB3457, the 50% provision for FRAs was reduced to “a minimum of 30%”. (Walsh 2000:3)

With the support of aquarium collectors and other user groups, HB 3457 was approved by the Hawai‘i State Legislature on July 13, 1998, where it became Act 306 and subsequently codified as HRS 188F (Walsh 2014). This Act established the WHRFMA to: “(1) Effectively manage fishery activities to ensure sustainability; (2) Enhance nearshore resources; and (3) Minimize conflicts of use in this coastal area” (ibid.:3). With the passage of the act, the DLNR, Division of Aquatic Resources (DAR) was tasked with meeting four additional management goals for the fishery: “(1) Designate a minimum of 30% of coastal waters as Fish Replenishment Areas (FRAs) where aquarium collecting is prohibited. (2) Establish a day-use mooring buoy system and designate some high-use areas where no anchoring is allowed. (3) Establish a portion of the FRAs as fish reserved where no fishing of reef-dwelling fish is allowed. (4) Designate areas where the use of gill nets is prohibited” (ibid.:9).

Community Consultation and the Creation of the Fish Replenishment Areas within the WHRFMA

Additionally, Act 306 also mandated that the DLNR/DAR conduct close and substantial consultation with community members and resource users during the FRA designation process. To aid with the execution of Act 306, in 1998, Pete Hendricks of DAR, along with Sara Peck of the West Hawaii Sea Grant and Dr. William J. Walsh began to assemble a council that would have broad geographic representation and representation from various stakeholders, communities, and user groups in West Hawai‘i. On June 16, 1998, this council, originally dubbed the West Hawai‘i Fisheries Management Council (WHRFMC) convened with twenty-four voting members and representation from various state agencies, user groups, and community members. The council’s name was later changed to the West Hawai‘i Fisheries Council (WHFC). As the FRA designation process unfolded, the participating aquarium collectors, after seeing that the FRA site selection process included more than 30% of the WHRFMA, began to openly oppose the designation process. Despite the challenges faced by the council in maintaining attendance and reaching critical management decisions, nine separate areas (including previously protected areas) comprising a total of 35.2% of the WHRFMA were selected (Walsh 2000).

One of the major complications that arose during the selection process concerned the fishing communities in both Miloli‘i and Ho‘okena, who had worked previously with Dr. Kimberly Lowe of DAR in creating FMA proposal for their respective areas. According to Walsh (2000:5), the FMA proposals “specified a ban on aquarium collecting in a 33-mile zone in the vicinity of these communities” and that “of and by itself this zone exceeded 30% of the coastline.” Despite this prior plan, all parties including those representing these communities were able to reach a compromise, “which ultimately reduced these no collecting areas to slightly more than a third of what the communities had expected” (ibid.:5).” In order to enhance enforceability and stabilize the West Hawai‘i fishery, the council added several provisions to the draft FRA rule (Hawai‘i Revised Statutes (HAR) §13-60.3), which included:

> Two boundary changes, establishment of seaward boundaries at 600 ft., inclusion of GPS boundary coordinates, prohibition of aquarium collecting gear or collected animals within FRAs, and aquarium vessel registration/identification system, and a control date for possible future use in a limited entry program. (Walsh 2000:5)

The proposed FRA rules were subsequently presented to the public on April 28, 1999 at a well-attended public hearing, where they received overwhelming support (93.5% of the 876) from a wide range of the community members present (Walsh 2014). The FRA rules were later voted on by the Board of Land and Natural Resources (BLNR), who unanimously approved them and their provisions, with the exception of the prohibition on aquarium collecting gear within the FRAs, which was ultimately omitted from the final rules package without explanation. After review by the Attorney General's office, on December 17, 1999 the proposed rules were sent back to the BLNR for re-approval, and HAR §13-60.3 was signed by Governor Ben Cayetano on December 31, 1999 (Walsh 2000:1). The latter four management goals described above, which prohibit the collecting of aquarium fish anywhere within the FRA boundaries, were subsequently adopted as HAR §13-60.4 (following the repeal of HAR §13-60.3), and signed into law by Governor Neil Abercrombie on December 26, 2013 (Walsh 2014). The on shore boundaries of the FRAs created by Act 306—whose seaward boundaries extend to a depth of 100 fathoms—are marked with distinct yellow signs that indicate that the taking of aquarium fish is prohibited (Figure 14). There a currently ten established FRAs located within the WHRFMA, along with various other Marine Life Conservation Districts (MLCDs), Netting Restricted Areas (NRAs), and Fisheries Management Areas (FMAs) where aquarium fishing is not permitted (see Figure 1).

Figure 14. Example of a yellow FRA sign (located at Makahiki Point, Pāpā Bay, South Kona) indicating that aquarium collection is prohibited, view to the north.

Creation of the "White-List" Species

The rules adopted in 2013 (HAR §13-60.4) also called for the establishment of a list of fish species (a "white-list") that could be taken by aquarium collectors within the WHRFMA (Walsh 2013). After an analysis of relative catch report data, population data, and habitat maps provided by DAR and NOAA, the DLNR established a list of forty distinct fish species (henceforth referred to as the "white-list") that could be taken, while the capture of all other fish (not on the list) was prohibited. Subsection b of HAR §13-60.4-7 states that, "In addition to other regulations deemed necessary for the management of the West Hawai'i regional fishery management area, an aquarium permit holder may only take or possess specimens of the following species of fish for aquarium purposes while within the West Hawai'i regional fishery management area…" (DLNR 1999:15–16). Table 1, presented below, lists all forty fish white-list species sorted by scientific name and the common name as it appears in subsection b of HAR §13-60.4-7 (ibid).

Table 1. "White-List" Species

Scientific Name	*Common Name*	*Scientific Name*	*Common Name*
Acanthurus achilles	Achilles tang	*Ctenochaetus strigosus*	goldring surgeonfish
Acanthurus dussumieri	eyestripe surgeonfish	*Dascyllus albisella*	Hawaiian Dascyllus
Acanthurus nigricans	goldrim surgeonfish	*Forcipiger flavissimus*	forcepsfish
Acanthurus nigrofuscus	brown surgeonfish	*Gomphosus varius*	bird wrasse
Acanthurus olivaceus	orangeband surgeonfish	*Halichoeres ornatissimus*	ornate wrasse
Acanthurus thompsoni	Thompson's surgeonfish	*Hemitaurichthys polylepis*	pyramid butterflyfish
Anampses chrysocephalus	psychedelic wrasse	*Lutjanus kasmira*	bluestripe snapper, taape
Canthigaster jactator	whitespotted Toby	*Macropharyngodon geoffroy*	shortnose wrasse
Centropyge fisheri	Fisher's angelfish	*Melichthys niger*	black Durgon
Centropyge potteri	Potter's angelfish	*Naso lituratus*	orangespine unicornfish
Cephalopholis argus	peacock grouper, roi	*Ostracion meleagris*	spotted boxfish
Chaetodon kleinii	blacklip butterflyfish	*Paracirrhites forsteri*	blackside hawkfish
Chaetodon miliaris	milletseed butterflyfish	*Pseudanthias hawaiiensis*	Hawaiian longfin Anthias
Chaetodon multicinctus	multiband butterflyfish	*Pseudocheilinus octotaenia*	eightline wrasse
Chaetodon quadrimaculatus	fourspot butterflyfish	*Pseudocheilinus tetrataenia*	fourlined wrasse
Chaetodon tinkeri	Tinker's butterflyfish	*Pseudojuloides cerasinus*	smalltail wrasse
Cirrhilabrus jordani	flame wrasse	*Sufflamen bursa*	lei triggerfish
Cirrhitops fasciatus	redbarred hawkfish	*Thalassoma duperrey*	saddle wrasse
Coris gaimard	yellowtail coris	*Xanthichthys auromarginatus*	gilded triggerfish
Ctenochaetus hawaiiensis	chevron tang	*Zebrasoma flavescens*	yellow tang

3. CULTURE-HISTORICAL CONTEXT

To understand the vast landscape of the study area and the inherent cultural mores and traditions that developed as a direct result of interacting with this very landscape, it is imperative that the culture-historical research be conducted within the epistemological framework of the host culture. This is achieved by presenting indigenous narratives wherever possible. As such, this chapter presents a discussion of the culture-historical background for the study area. The information presented below is meant to provide a comprehensive understanding of the cultural significance of the area and the "white-list" species, and to establish an analytical basis for the assessment of any potential cultural impacts that the proposed issuance of fourteen commercial aquarium permits within the WHRFMA might have.

The chronological summary presented below begins with the settlement of the Hawaiian Islands followed by a discussion on the development of the *ahupua'a* system and its marine components. This is followed by a presentation of legendary accounts that focuses on the oceanic origins and cosmogony of the Hawaiian people, or Kānaka Maoli (lit. the true people), and a discussion on traditional marine resource management strategies and fishing practices, as well as traditional nearshore fishing techniques. To develop an understanding of the customary uses of the "white-list" species, a discussion on Hawaiian fish nomenclature is provided, which is followed by a detailed presentation on the cultural uses of all species listed on the "white-list." This is followed by a summary of hallmark historic events specific to West Hawai'i, which include the arrival of westerners in 1779 and the first company of missionaries in 1820, and the subsequent transformation of traditional marine resource management practices. A discussion of the 1848 *Māhele 'Āina* and its effects on traditional marine resource procurement are then presented which is followed by a presentation on the boundary commission testimonies for the respective districts. The culture-historical background section concludes with a summary of the events during the second half of the 19th century, with emphasis on the gradual transformation of commercial fishing in Hawai'i.

SETTLEMENT OF THE HAWAIIAN ISLANDS

While the question of the timing of the first settlement of Hawai'i by Polynesians remains unanswered, several theories have been offered that derive from various sources of information (i.e., archaeological, genealogical, mythological, oral-historical, and radiometric). However, none of these theories is today universally accepted. What is more widely

accepted is the answer to the question of where Hawaiian populations came from and the transformations they went through on their way to establish a uniquely Hawaiian culture. More recently, with advances in palynology and radiocarbon dating techniques, Kirch (2011) and others (Athens et al. 2014; Wilmshurst et al. 2011) have convincingly argued that Polynesians arrived in the Hawaiian Islands, sometime between A.D. 1000 and A.D. 1200 and expanded rapidly thereafter (c.f., Kirch 2011). The initial migration to Hawai‘i is believed to have occurred from Kahiki (the ancestral homelands of Hawaiian gods and people) with long distance voyages occurring fairly regularly through at least the thirteenth century. It has been generally reported that the sources of the early Hawaiian populations originated from the southern Marquesas Islands (Emory in Tatar 1982). In these early times, Hawai‘i’s inhabitants were primarily engaged in subsistence-level agriculture and fishing (Handy and Handy 1991). This was a period of great exploitation and environmental modification when early Hawaiian fishers and farmers developed new subsistence strategies by adapting their familiar patterns and traditional tools to their new environment (Kirch 1985; Pogue 1978). According to Fornander (1969), the Hawaiians brought from their homeland certain Polynesian customs and belief: the major gods Kāne, Kū, Lono, and Kanaloa; the *kapu* system of law and order; the *pu‘uhonua* (places of refuge), their *‘aumakua* (family or personal gods), and the concept of *mana* (supernatural or divine power).

For generations following initial settlement, communities were clustered along the watered, *ko‘olau* (windward) shores of the Hawaiian Islands. Along the *ko‘olau* shores, streams flowed and rainfall was abundant, and agricultural production became established. The *ko‘olau* region also offered sheltered bays from which deep-sea fisheries could be easily accessed, and nearshore fisheries, enriched by nutrients carried in the freshwater, could be maintained in fishponds and coastal waters. It was around these bays that clusters of houses where families lived could be found (McEldowney 1979). In these early times, Hawai‘i’s inhabitants were primarily engaged in subsistence-level agriculture and fishing (Handy and Handy 1972).

Following the initial settlement period, areas with the richest natural resources became populated and perhaps crowded, and by about A.D. 1200, the population began expanding to the *kona* (leeward side) and more remote regions of the island (Cordy 2000). Along the *kona* coast of Hawai‘i Island, communities were initially established near sheltered bays with access to fresh water, where an abundance of marine resources were readily available. As indicated by the archaeological record, historic documentation, and legendary accounts, this shoreline zone was used primarily for habitation and related activities, such as recreation, ceremonial practices, canoe storage, fishing and associated rituals, and burial (Johnson and Wolforth 2006). Smaller temporary habitations associated with fishing activities were also common along the shore (Cordy 1995).

By the early 17th century, the Hawaiian royalty built chiefly centers within the shoreline zone of central Kona with royal compounds located at Kailua in the vicinity of Kamakahonu and Kaiakeakua, Kahalu‘u-Keauhou, Ka‘awaloa-Kealakekua, and Hōnaunau. Such royal centers included dwellings for chiefs, their court, and local *maka‘āinana* (common people) in addition to public structures, such as *heiau,* sporting grounds and places of refuge (Cordy 1995). As the population continued to expand so did social stratification, which was accompanied by major socioeconomic changes and intensive land modification. Most of the ecologically favorable zones of the windward and coastal regions of all major islands were settled and the more marginal leeward areas were being developed. During this expansion period, additional migrations to Hawai‘i occurred from Tahiti in the Society Islands (Kamakau 1976).

Rosendahl (1972) has proposed that settlement along the leeward coast of Hawai‘i Island at this time was seasonal and recurrent, and that coastal sites were primarily occupied during the drier summer to exploit marine resources, while the upland sites were primarily occupied during the wetter winter months to focus on agriculture. An increasing reliance on agricultural products may have eventually caused a shift in social networks, as Hommon (1976) argues kinship links between coastal settlements disintegrated as those links within the *mauka-makai* settlements expanded to accommodate the exchange of agricultural products for marine resources. This shift is believed to have resulted in the establishment of the *ahupua‘a* system sometime during the A.D. 1400s (Kirch 1985), which added another component to an already well-stratified society. The implications of this model include a shift in residential patterns from seasonal, temporary occupation, to the permanent dispersed occupation of both coastal and upland areas.

DEVELOPMENT OF THE *AHUPUA‘A* SYSTEM

For Hawai‘i Island, the formalization of the *ahupua‘a* land management system is attributed to ‘Umi a Līloa, a renowned *ali‘i* of the Pili line who rose to power during the early 16th century (Cordy 1994). ‘Umi a Līloa was also known for separating the various classes of chiefs, priests, and laborers (Beamer 2014; Cordy 2000; Kamakau 1992). An *ahupua‘a* is a traditional land division that typically incorporated all of the eco-zones from the mountains to the sea, and for several hundred yards beyond the shore, assuring a diverse subsistence resource base for its residents, and a source of taxation (tribute) for the chiefs (Hommon 1986). Although the *ahupua‘a* land division typically

incorporated all of the eco-zones, their size and shape varied greatly (Cannelora 1974; Kamakau 1976). *Ahupua'a* boundaries were generally defined by the natural topography (i.e. hills, ridgelines, gulches, craters, etc.) as well as the natural resources that occurred within a given area (Lyons 1875). In summarizing the types of ecozones that could be found in a given *ahupua'a*, Hawaiian scholar and historian, Samuel Kamakau writes:

> Here are some names for [the zones of] the mountains—the *mauna* or *kuahiwi*. A mountain is called a *kuahiwi*, but *mauna* is the overall term for the whole mountain, and there are many names applied to one, according to its delineations (*'ano*). The part directly in back and in front of the summit proper is called the *kuamauna* , mountaintop; below the *kuamauna* is the *kuahea*, and makai of the *kuahea* is the *kuahiwi* proper. This is where small trees begin to grow; it is the *wao nahele*. Makai of this region the trees are tall, and this is the *wao lipo*. Makai of the *wao lipo* is the *wao 'eiwa*, and makai of that the *wao ma'ukele*. Makai of the *wao ma'ukele* is the *wao akua*, and makai of there is the *wao kanaka*, the area that people cultivate. Makai of the *wao kanaka* is the *'ama'u*, fern belt, and makai of the *'ama'u* the *'apa'a*, grasslands.
>
> A solitary group of trees is a *moku la'au* (a "stand" of trees) or an *ulu la'au*, grove. Thickets that extend to the *kuahiwi* are *ulunahele*, wild growth. An area where *koa* trees suitable for canoes (*koa wa'a*) grow is a *wao koa* and mauka of there is a *wao la'au*, timber land. These are dry forest growths from the *'apa'a* up to the *kuahiwi*. The places that are "spongy" (*naele*) are found in the *wao ma'ukele*, the wet forest.
>
> Makai of the *'apa'a* are the *pahe'e* [*pili* grass] and *'ilima* growths and makai of them the *kula*, open country, and the *'apoho* hollows near to the habitations of men. Then comes the *kahakai*, coast, the *kahaone*, sandy beach, and the *kalawa*, the curve of the seashore—right down to the *'ae kai*, the water's edge.
>
> That is the way *ka po'e kahiko* [the ancient people] named the land from mountain peak to sea. (Kamakau 1976:8–9)

The *ahupua'a* were also divided into smaller individual parcels of land (such as the *'ili, kō'ele, māla*, and *kīhāpai*, etc.), generally oriented in a *mauka-makai* direction, and often marked by stone alignments (*kuaiwi*). In these smaller land parcels the native tenants tended fields and cultivated crops necessary to sustain their families, and the chiefly communities with which they were associated. As long as sufficient tribute was offered and *kapu* (restrictions) were observed, the common people, who lived in a given *ahupua'a* had access to most of the resources from mountain slopes to the ocean. These access rights were almost uniformly tied to residency on a particular land, and earned as a result of taking responsibility for stewardship of the natural environment, and supplying the needs of the *ali'i* (see Kamakau 1961:372-377 and Malo 1951:63-67).

Entire *ahupua'a*, or portions of the land were generally under the jurisdiction of appointed *konohiki* or lesser chief-landlords, who answered to an *ali'i-'ai-ahupua'a* (chief who controlled the *ahupua'a* resources). The *ali'i-'ai-ahupua'a* in turn answered to an *ali'i 'ai moku* (chief who claimed the abundance of the entire district). Thus, *ahupua'a* resources supported not only the *maka'āinana* and *'ohana* who lived on the land, but also contributed to the support of the royal community of regional and/or island kingdoms. This form of district subdividing was integral to Hawaiian life and was the product of strictly adhered to resources management planning. In this system, the land provided fruits and vegetables and some meat in the diet, and the ocean provided a wealth of protein resources. Also, in communities with long-term royal residents, divisions of labor (with specialists in various occupations on land and in procurement of marine resources) came to be strictly adhered to. It is in this cultural setting that we find the present study area.

Nā Papakū O Ka Moana: Marine Extension of the *Ahupua'a*

The *ahupua'a* land management system and its traditional resource zones also served as a terrestrial extension of Hawai'i's oceanic ecosystem. Kānaka Maoli organized the *kai* into distinct ecological zones along both horizontal and vertical planes known as *nā papakū o ka moana* (marine zones). Each named zone was unique based on location, depth, color, geographical character, and procurable coastal and pelagic resources, as well as *wiliau* (ocean currents). These zones extended from where the waves gently dissolve over the sand to the distant *kahikimoe* (horizon). In his book *Hawaiian Antiquities*, Hawaiian scholar David Malo (1951:48–49) enumerated some of these *papakū o ka moana* as follows:

> 1. The ancients applied the name *kai* to the ocean and all its parts. That strip of the beach over which the waves ran after they had broken was called *ae-kai*.
> 2. A little further out where the waves break was called *poina-kai*. The name *pue-one* was likewise applied to this place. But the same expressions were not used of places where

shoal water extended to a great distance, and which were called *kai-kohola* (such as largely prevail for instance at Waikiki).

3. Outside of the *poina-kai* lay a belt called the *kai-hele-ku*, or *kai-papau*, that is, water in which one could stand, shoal water; another name given it was *kai-ohua*.
4. Beyond this lies a belt called *kua-au* where the shoal water ended; and outside of the *kua-au* was a belt called *kai-au*, *ho-au*, *kai-o-kilo-hee*, that is, swimming deep or sea for spearing squid, or *kai-hee-nalu*, that is, a surf swimming region. Another name still for this belt was *kai-kohola*.
5. Outside of this was a belt called *kai-uli*, blue sea, squid-fishing sea *kai-lu-hee*, or sea-of-the-flying-fish, *kai malolo*, or sea-of-the-*opelu*, *kai-opelu*.
6. Beyond this lies a belt called *kai-hi-aku*, sea for trolling the *aku*, and outside of this lay a belt called *kai-kohola*, where swim the whales, monsters of the sea; beyond this lay the deep ocean, *moana*, which was variously termed *waho-lilo* (far out to sea), or *lepo* (underground), or *lewa* (floating), or *lipo* (blue-black), which reach Kahiki-moe, the utmost bound of the ocean.
7. When the sea is tossed into billows they are termed *ale*. The breakers which roll in are termed *nalu*. The currents that move through the ocean are called *au* or *wili-au*.
8. Portions of the sea that enter into recesses of the land are *kai-hee-nalu*, that is a surf-swimming region. Another name still *kai-o-kilo-hee*, that is swimming deep, or sea for spearing squid, or called *kai-kuono*; that belt of shoal where the breakers curl is called *pu-ao*; another name for it is *ko-aka*.
9. A blow-hole where the ocean spouts up through a hole in the rocks is called a *puhi* (to blow). A place where the ocean is sucked with force down through a cavity in the rocks is called a *mimili*, whirlpool; it is also called *mimiki* or an *aaka*.
10. The rising of the ocean tide is called by such names as *kai-pii* (rising sea), *kai-nui* (big-sea), *kai-piha* (full sea), and *kai-apo* (surrounding sea).
11. When the tide remains stationary, neither rising nor falling, it is called *kai-ku*, standing sea; when it ebbs it is called *kai-moku* (the parted sea), or *kai-emi* (ebbing sea), or *kai-hoi* (retiring sea), or *kai-make* (defeated sea).
12. A violent, raging surf is called *kai-koo*. When the surf beats violently against a sharp point of land, that is a cape (*lae*), it is termed *kai-ma-ka-ka-lae*.
13. A calm in the ocean is termed a *lai* or a *malino* or a *pa-e-a-e-a* or a *pohu*.

As coastline geography is variable along the western shore of Hawai‘i Island, ranging from nearly vertical sea cliffs to fine-sanded bays, not all oceanic zones exist in all locales. According to Kamakau (1979), there were names for sea ponds that were nearly entirely surrounded by land—*kai hāloko* or *kai puhi lala*; for bays—*kai kū‘ono*; for lagoons—*loko kai*; for areas of the sea that were nearly landlocked—*hāloko kai*; and for places where seawater surged into a pond—*kai hī*. There were also specific names to indicate areas where waves multiplied—*kai ko‘o*, and subsequently diverged from each other—*kai kulana.* Kamakau (1979) also mentions that in more rugged environments, such as at Ka Lae in Ka‘ū, places where waves crashed against points of land were known as *kai maka lae*, and places where waves crashed into the bases of cliffsides were termed *kai kuehu*. Terms were also given to rocky places on the shoreline where waves broke within a crevice—*kai puhi*; where the sea ebbed up and down inside a crevice—*mimilo*, *mimiki*, or *‘a‘aka*; and for blowholes, which were known simply as *puhi* (ibid.). In locales such as Ka‘ū and the southern part of South Kona, the rocky shoreline limited resource areas where reef-bound marine life dwelled, including “squid, mullet, goatfish, parrotfish and the like” (Handy and Pukui 1998:223).

Kānaka Maoli also distinguished the various moods and surface characteristics of the ocean by name. For instance, calm and peaceful seas were *kai malina*, *kai pohu*, or *kai paeaea*; and areas where the sea was glassy and appeared to puddle on the surface were *kai kāhekaheka*, *kai ki‘o*, or *kai hāpuna* (Kamakau 1979). The famed proverbial sayings, “Ke kai malino o Kona” and “Kona, kai malino a Ehu” refers to the calm seas of the Kona District with the latter saying associating the calm seas with Kona’s ruling chief ‘Ehu (Pukui 1983:186,199). The calm sea of Kona, which produced “innumerable streaks of color” is described in the saying, “Kona i ke kai mā‘oki‘oki” which has been translated by Pukui (1983:199) to mean “Kona the sea that is cut up.”

There were also designations for contrasting parts of the *kai* based upon its color. Areas of the *kai* that were white were generally referred to as *kai kea*, with foamy, white seas being distinguished as *kai keʻokeʻo*. Kānaka Maoli further distinguished striated, variegated seas for which the Kona District was famed, as *kai māʻokiʻoki*, and sections that were richly red like *ʻalaea* (ocherous earth) as *kai ʻulaʻula* (red sea) and golden yellow like *ʻōlena* (turmeric) as *kai lenalena* (yellow sea). The ancient people also identified parts of the *kai* which were designated for certain activities. For instance, shallow parts of the sea where one could wade out into the shoal were known as the *kai hele kū*, and places where one could submerge and bathe were referred to as *kai ʻau kohana*. There were also places designated for diving—*kai luʻu,* as well as surfing—*kai heʻe nalu* or *kuaʻau* (Kamakau 1979).

Access to nearshore and offshore fisheries constituted an important component of the *ahupuaʻa* system. In detailing the nature of traditional fishers, Lyons writes:

> While the smaller ahupuaas had to content themselves with the immediate shore fishery extending out not further than a man could touch bottom with his toes, the larger ones swept around outside of these, taking to themselves the main fisheries much in the same way as that in which the forests were appropriated. (Lyons 1875:111)

In describing the intimate connection between the *ʻohana* the *ahupuaʻa* system, Handy and Pukui (1998:18) relate, "the *ʻOhana* as a functioning social mechanism operates within the *milieu* of the sea, shore, coastal and inland slopes and uplands, subject to weather, sun and moon." Regarding marine resource management, Kānaka Maoli carefully regulated resource extraction within the different designated marine zones (discussed above) to ensure the preservation of the physical, biological, and ecological integrity of the *kai*, as well as the perpetuation of the ancient *ʻohana* (family) based socio-economic system (Jokiel et al. 2011). As related by Handy and Pukui:

> . . . The fisherman needing *poi* or *ʻawa* would take fish, squid or lobster upland to a household known to have taro, and would return with his *kalo* (taro) or *paʻiʻai* (hard poi, the steamed and pounded taro corm). A woman from seaward, wanting some medicinal plant, or sugar cane perhaps, growing on the land of a relative living inland would take with her a basket of shellfish or some edible seaweed and return with her stalks of sugar cane or her medicinal plants. In other words, it was the *ʻohana* that constituted the community within which the economic life moved. (Handy and Pukui 1998:6)

Kuleana: The Establishment of Native Access to Natural Resources

The *hoaʻāina* (native tenants) and *ʻohana* (families) who lived on the land had rights to the gather forest and marine resources for subsistence and for tribute (Jokiel et al. 2011; MacKenzie 1991). As part of these rights, the *ahupuaʻa* residents were also required to supply resources and labor that supported the royal community of regional and/or island kingdoms as well as provide offerings to appease their multitude of *akua* (Malo 1951). These services were a *kuleana* (privilege and responsibility) that came with the tenancy within a given *ahupuaʻa*. The *ahupuaʻa* thus became the equivalent of a local community, with its own social, economic, and political significance, and it also served as a taxable base for the *aliʻi* during the *Makahiki* (festival beginning about the middle of October and lasting about four months, with sports and religious festivities and taboo on war) (Kelly 1956). During the annual *Makahiki* procession, the highest chief of the land sent select members of his retinue to collect *hoʻokupu* (tribute and offerings) in the form of goods from each *ahupuaʻa*. The *hoaʻāina* (native tenants) who resided in the *ahupuaʻa* brought their share of *hoʻokupu* to an *ahu* (altar) that was symbolically marked with the image of a *puaʻa* (pig). Kamakau describes some of the reasons for the annual *Makahiki* and notes the observance of *kapu* that restricted the consumption of certain vegetables and meats including fish:

> The Makahiki festival was a time to rest, and a time to make great feasts of commemoration (*ʻahaʻaina hoʻomanaʻo*) for life and health of the body, and for the help received from the gods. All manual labor was prohibited and there were several days of resting and feasting. Chiefs and people made manu joyful Makahiki feasts at the end of each year. The custom (*malama*) of feasting came from very ancient times; and from the time that chiefs became rulers of the kingdoms…
>
> They made kapu the last three months of the year. The Makahiki began (*e kauwelu ai*) in the month of Hilina, and at this time pork, coconut, and fish were placed under kapu; the eating of flesh foods (*iʻo*) was kapu during these months. (Kamakau 1964:19)

Ahupuaʻa were ruled by *aliʻi ʻai ahupuaʻa* or chiefs who controlled the *ahupuaʻa* resources; who, for the most part, had complete autonomy over this generally economically self-supporting piece of land (Malo 1951). *Ahupuaʻa* residents were not bound to the land, nor were they the property of the *aliʻi*. If the living conditions under a particular *ahupuaʻa* chief were deemed unsuitable, the residents could move freely in pursuit of more favorable living conditions

(Lam 1985). This structure safeguarded the well-being of the people and the overall productivity of the land, lest the chief lose the support and loyalty of his, or her, principal supporters. *Ahupua'a* lands were in turn, managed by an appointed *konohiki* or lesser chief-landlord, who oversaw and coordinated stewardship of an area's natural resources (ibid.). In some places, the *po'o lawai'a* (head fisherman) held the same responsibilities as the *konohiki* (Jokiel et al. 2011). Under this system, the *konohiki* had the right "to regulate the taking of fish and other marine life from the reefs and fishing grounds abutting the *ahupua'a*" (MacKenzie 1991:173). *Hoa'āina* also had a right to gather fish, which was, however, "subject to the right of the *konohiki* to manage and conserve the fisheries" (ibid.).When necessary, the *konohiki* took the liberty of implementing *kapu* (restrictions and prohibitions) to protect the *mana* of the area's resources from physical and spiritual depletion.

Many *ahupua'a* were further divided into smaller land units termed *'ili* and *'ili kūpono* (often shortened to *'ili kū*) and cultivated patches known as *kō'ele*, *māla*, and *kīhāpai* (Beamer 2014; Lyons 1875). *'Ili* were created for the convenience of the *ahupua'a* chief, and they served as the basic land unit in which the *hoa'āina* made a living; these land units were often retained by specific *'ohana* for long periods of time (Jokiel et al. 2011; MacKenzie 2015). As the *'ili* themselves were typically passed down in families, so too were the *kuleana* (responsibilities, privileges) that were associated with them. The right to use and cultivate *'ili* was maintained within the *'ohana*, regardless of any change in title of the *ahupua'a* chief (Handy and Handy 1991). Malo (1951), recorded several types of *'ili*, including the *'ili pa'a,* a single intact parcel, and the *'ili lele*, a discontinuous parcel dispersed across an area. Whether dispersed or wholly intact, the *'ili* land division required a cross section of the available resources, and for the *hoa'āina*, this generally included access to agriculturally fertile lands, and the coastal fisheries. While much of these same resource principles applied to another type of *'ili*, the *'ili kūpono*, these land units were politically independent of the *ahupua'a* chief. This *'ili kūpono* designation was often applied to specific areas containing resources that were highly valued by the ruling chiefs, such as fishponds (Handy and Handy 1991).

The *ali'i* who presided over the *ahupua'a* (*ali'i-'ai-ahupua'a*), in turn, answered to an *ali'i 'ai moku* (chief who claimed the abundance of the entire *moku or* district) (Malo 1951). Although *moku* (districts) were comprised of multiple *ahupua'a*, they were considered geographical subdivisions with no explicit reference to rights in the land (Cannelora 1974). This form of district subdividing was integral to Hawaiian life and was strictly adhered to. Collectively, the *ali'i* regardless of their rank, held a vested responsibility, and were obligated to ensure, "the beneficial use of the land for all of the people" (MacKenzie 1991:173). It is vital to note that this complex and highly established system evolved well-before the Western concept (and practice) of private property and codified laws was introduced to the Hawaiian Islands. As knowledge of place developed over the centuries and was passed down intergenerationally through example, direct teaching, and experience, detailed information of an area's natural cycles and resources became ingrained and well-understood. Decisions pertaining to the use and management of natural resources were based on generations worth of highly informed knowledge, and were sustainably adapted to meet the needs of a growing population.

This highly-complex land management system set the foundation for traditional customary rights of the Kānaka Maoli, all while mirroring the Hawaiian thought process, and the unique culture that coevolved with these islands. Their relationship to the land and sea was fortified by their spiritual beliefs and origin stories that tied them to the greater cosmos. As evidenced in the subsequent section, the ancient Kānaka Maoli did not agree on a single creation story. Their pluralistic outlook on their origins reveal their profound connection to the ocean. The ocean was a living deity who they called Kanaloa. The ocean was the pathway of the gods and people who traveled by way of the *wa'a* (canoe) and the very element that connected them to their ancestral homeland, Kahiki. The ocean was the seat of life from which the islands were fished, and pulled up from its depth. The ocean and its creatures shared a kinship connection to the chiefs and the people, and were incorporated in an ancient genealogical chant known as the *Kumulipo*. As ancient as some of these stories may be, they remain an integral component for understanding the deep reverence and connection Kānaka Maoli have to the their land and sea.

OCEANIC ORIGINS

The Kānaka Maoli were anchored through their ingrained philosophy of life to the *'āina* (land), *wai* (water), *lewa* (heavens), and the *kai* (ocean). These life-giving aspects of their natural environment were the foundation upon which they constructed their physical and spiritual world. Every natural element found within the Hawaiian world, whether on the land, in the sea, or in the heavens, was believed to be the physical embodiment of the *akua* (deities). The natural wonders of the universe were the source of life for the Kānaka Maoli, and were thus acknowledged, named, and deeply revered. Traditional legendary accounts describing the origins of the *Kanaka* (humans) are plentiful, and a review of these accounts reveals that the ancient people of these islands did not agree on a single creation story (Fornander 1916–1917). While Western scientists emphasize the geological formation of the Hawaiian Islands, traditional

accounts feature the ocean as the origin of the islands. The ocean is also described as the pathway of the gods, carrying them from their ancestral homeland of Kahiki to the shores of Hawaiʻi. As the current study area includes the nearshore waters of West Hawaiʻi, the most relevant of these accounts are summarized below.

The Great Fishermen, Kapūheʻeuanui

One such account concerns the genealogy of a Tahitian priest,ʻŌpuʻukahonua (lit. the budding earth), who established the "royal parents or ancestors of these islands," as there were, "ninety-five generations from him to Kamehameha the Great" (Fornander 1916–1917:20). According to this genealogical account (as told by Fornander 1916–1917:20), the islands "were found or obtained by the fishing of Kapuheeuanui," a great fisherman (*ka lawaiʻa nui*), who fished them up one-by-one:

> When Kapuheeuanui let down his fishing line into the sea from Kapaahu [Kohala] his line caught something that he thought was a fish and drew the line onto the canoe when, behold, it was a piece of coral. The priest Laulialamakua came along as Kapuheeuanui was disentangling his line from the coral and preparing to throw it away. Then the priest spoke to him, "Eh! Don't throw away that piece of coral, for that is a chief, a foreteller of events. Go thou and look for a pig and appease the god, and after prayer call its name Hawaiiloa, then throw it back into the sea, and it will grow up into an island." (ibid.)

Kapūheʻeuanui obeyed the commands of the priest and the next day, he went back out and again fished up another piece of coral. The priest Laulialamakua intervened and declared that this piece of coral be called Mauiloa. On the third day of fishing, Kapuheʻeuanui caught another piece of coral and showed it to the priest who named it Oʻahunuialaʻa. Day after day, Kapuheʻeuanui continued to fish up coral fragments all of which were named by the priest "until all the islands now comprising the group were successfully raised as corals." Fornander also narrates a chant describing the fishing up of the islands by the great fisherman Kapūheʻeuanui:

E Lono, e Lono-e! E Lonokaeho!	O Lono, O Lono, listen, O Lonokaeho!
Lonokulani alii o Kauluonana.	Lonokulani, chief of Kauluonana,
Eia na waaa kau mai,	Here are the canoes, get on board,
E hoi e noho ia Hawaiikuauli,	Come along and dwell in Hawaii-with-the-green-back,
He aina loaa i ka moana,	A land that was found in the ocean,
I hoea mai loko o ka ale;	That was thrown up from the sea,
I ka halehale poi pu a Kanaloa;	From the very depths of Kanaloa,
He koakea i halelo i ka wai,	The white coral in the watery caves
I lou i ka makau a ka lawaia,	That was caught on the hook of the fisherman;
A ka lawaia nui o Kapaahu	The great fisherman of Kapaahu,
A ka lawaia nui o Kapuheeuanui	The great fisherman Kapuheeuanui.
A pae na waa, kau mai,	The canoes touch the shore, come on board,
E holo ai i Hawaii, he moku;	Sail to Hawaii, an island,
He moku Hawaii,	An island is Hawaii;
He moku Hawaii na Lonokaeho.	An island is Hawaii for Lonokaeho to dwell on.
(Fornander 1916–1917:22-23)	

Fornander reported that this chant was recited by the Tahitian chief Makuakaumana when he and the 12th century priest Paʻao went back to Tahiti in search of a new chief for Hawaiʻi Island. When Makuakaumana and his company had reached the shores of Moaʻulanuiʻākea in Tahiti, Makuakaumana called out to Lonokaeho to sail to Hawaiʻikuauli, (a poetic name given to Hawaiʻi Island describing its verdant countryside) to become its principle chief. Lonokaeho declined the offer and instead arranged for the chief Pili to sail to Hawaiʻi to become its chief. This chant also tells of the islands being fished up from the depth of the ocean, from the realm of the great oceanic deity, Kanaloa, who is mentioned in the chant excerpted above. Kanaloa is also the subject of many legends discussed below.

Kanaloa, Deity of the Ocean

Kanaloa is one of the four male gods that were worshipped by both *makaʻāinana* (lit. people that attend the land) and *aliʻi* (chiefs) in Hawaiʻi and throughout Polynesia (Beckwith 1970; Malo 1951). The three other male gods—Kāne, Kū, and Lono, along with four female gods: Laʻilaʻi, Haumea, Hina, and Pelehonuamea, make up the pantheon of Hawaiian gods (Kanakaʻole Kanahele et al. 2009). In the islands of the South Pacific, Kanaloa is known by other names (Taaroa in Tahiti; Tangaloa in Samoa; Tanaoa in Marquesas; Tangaro in Aotearoa) and in some places he is considered the creator, and the god of the ocean (ibid.). In Hawaiʻi, his domain extended over the ocean and many

native Hawaiians today maintain the understanding that the ocean itself is Kanaloa. Kanaloa (the ocean) was considered the roadway for the navigator and served as the connection between the various islands across the vast Pacific Ocean; navigators and paddlers, who traveled at the mercy of the Kanaloa often invoked prayers to him for favorable weather and ocean conditions (ibid.).

Kanaloa is embodied in several ocean species including the elusive and polychromatic *he'e* (octopus) and *mūhe'e* (squid) (Handy and Handy 1991). The *he'e* form of Kanaloa was also applied to the area of healing and was used by a *kahuna lapa'au* (healing practitioner) to perform a healing ceremony called *he'e mahola* (Malo 1951). Malo (ibid.:109) expounds upon this ceremony writing, "[t]he *hee mahola* ceremony was through to be the thing to disperse (*hehee*) disease and bring healing to the body." Other important body forms of Kanaloa included the *koholā* (whale), specifically the *palaoa* (sperm whale), from which the *lei niho palaoa* (ivory tooth pendant) was carved and worn exclusively by Hawaiian *ali'i*. Although whales are typically considered deep sea creatures, recent studies have shown that whales contribute to important nutrient cycling for reef fish (Smith et al. 2013). Kanaloa is also embodied in other large marine mammals including the *nai'a* (dolphin), *niuhi* (tiger shark), *pololia* (jellyfish), and the *hāhālua* (manta ray) (Kanaka'ole Kanahele et al. 2009; Liliuokalani 1978).

Kānenui'ākea: The Creator of Heaven and Earth and the Arrival of Kāne, Kanaloa, and Haumea in Ke'ei, South Kona

A portion of the current study area, Ke'ei in South Kona is mentioned in a legendary account recorded by Kamakau (1968) that details the initial arrival of Kāne, Kanaloa, and Haumea to the Hawaiian Islands, where they were first glimpsed by two fishermen near Ke'ei. The arrival of these gods is described in both textual and chant form, with the latter comparing their arrival to swimming fish moving on the currents from Kahiki, their ancestral homeland. Kamakau (ibid.) also relates that Kānenui'ākea was considered the creator of the "heavens and earth." In describing the arrival of Kāne, Kanaloa, and their *kaikuahine* (sister) Haumea, Kamakau writes:

> …it is said, Kane, Kanaloa, and Haumea came from Kahiki and from the firmament (*mai ka lewa mai*). They were first seen by a couple of fishermen outside of Ke'ei, in South Kona. Kuheleimoana and Kuheleipo were the two fishermen who first saw these spirits (*po'e akua*) coming over the surface of the sea. When the two men saw these wonderful beings they knelt in profound respect, and they gave them white fish and pointed out the *'awa* plants mauka of 'Alanapo in Ke'ei. Those of us who study and understand clearly the prophetic chants (*mele wanana*) know that the name of Haumea was given to the woman who came with Kane and his companion because she was a woman of mysterious and recurrent births (*no ka mea o Haumea ka wahine hanau kupanaha a hanau wawa*). Here is a *mele* of the *po'e kahiko* that makes this clear:

Holo mai Kane mai Kahiki,	Here comes Kane from Kahiki,
Holo a i'a iloko o ke kai,	Coming like a fish in the sea,
Ke kekele 'au i ka moana;	Gliding through the currents of the ocean;
O Haumea ke kaikuahine	Haumea the sister
O Kanaloa ia me Kane	And Kanaloa are with Kane.
E ki'i e ka i'a kea i kai,	We get the white fish from the sea,
La'a i ku'emake o Kane,	That is sacred to the eyebrows of Kane,
La'ahia i ke kanawai,	Consecrated to him by his edict,
He mau lawai'a i ka moana,	We two fishermen on the ocean,
O Kuheleimoana O Kuheleipo,	Kuheleimoana and Kuheleipo,
E kaka ana i ka malie,	Who are deep-sea fishing in the calm,
I ka la'i ku pohu malino,	In the windless calm,
I na kai malino a 'Ehu.	In the calm seas of 'Ehu.
Hukia i ka 'upena luelue.	The bag net is drawn up.
E ho'i kakou i ka uka,	We return to shore,
E 'alana i ka pu 'awa hiwa;	And offer the choice 'awa;
Ha'awi i ke kaikuahine.	It is given to the sister.
Elua 'olua ko Haumea i ke keiki.	There are two of you, and Haumea conceives a child.
I hanau i kana hiapo,	She gives birth to her first-born,
O Ka'ulawena Konohiki Wananakalana.	Ka'ulawena Konohiki Wananakalana.

According to Kamakau, the child Kaʻulawena Konohiki Wananakalana (also known as Mapunaiaʻaʻala) was fathered by one of the Keʻei fishermen, Kuheleipo. In the Hawaiian cosmogonic chant, *Kumulipo* (discussed in further detail below), Mapunaiaʻaʻala was an ancestor of Māui, another noted demi-god who is celebrated in traditional lore for fishing the islands up from the depths of the sea (Beckwith 1951).

Māui Uses Manaiakalani to Fish the Hawaiian Islands Out of the Sea

Another account describing the oceanic origins of the Hawaiian Islands features the Pan-Pacific *kupua* or demi-god known as Māui, who among many other monumental life feats is said to have fished the Hawaiian Islands out of the depths of the sea using his supernatural fishhook called Manaiakalani, which was later cast up into the heavens. Westervelt writes:

> Maui went out from his home at Kauiki, fishing with his brothers. After they had caught some fine fish the brothers desired to return, but Maui persuaded them to go our farther. Then when they became tired and determined to go back, he made the seas stretch out and the shores recede until they could see no land. Then drawing the magic hook, he baited it with the Alae or sacred mud hen belonging to his Mother Hina…
>
> Down in the deep sea sank the hook with its struggling bait, until it was seized by "the land under the water."
>
> But Hina the mother saw the struggle of her sacred bird and hastened to the rescue. She caught a wing of the bird, but could not pull the Alae from the sacred hook. The wing was torn off. Then the fish gathered around the bait and tore it to pieces. If the bait could have been kept entire, then the land would have come up in a continent rather than as an island. Then the Hawaiian group would have been unbroken. But the bait broke—and the islands came up as fragments from the under world. (Westervelt 1910:26–28)

The *Kumulipo*

While the above accounts attribute the origin of the Hawaiian Islands to various *akua* (deities) and great fishermen who raised coral and islands from the depths of the ocean, the following account is a *mele koʻi honua*, or cosmogonic chant, known as the *Kumulipo,* which explains the origins of the Hawaiian universe in a different manner. This account describes the birth of various aquatic and terrestrial organisms found in the Hawaiian Islands. Containing over 2,000 lines, this chant was uttered by the high priest Puou in Kealakekua, Kona upon the birth of the 18th-century high chief Kaʻīʻīmamao, as a way to recognize and fortify the depth of his royal family's divine origin (Liliuokalani 1978). Various scholars and Hawaiian royalty including Queen Liliʻuokalani and her brother King David Kalākaua have attempted to translate this epic chant, with each translator offering their own interpretation. The *Kumulipo* anchors the Hawaiian world and its people to the ocean by way of the primal substance known to the Hawaiian people as *walewale* (slime). According to the *Kumulipo*, all animate and inanimate objects were *hānau* (born), including the *ʻuku koʻakoʻa* (coral polyp), which was recorded as the very first organism born in the ocean. The small and simple *ʻuku koʻakoʻa* is of vital importance to life, as it is the basic building block for all life in the sea. It is from the *ʻuku koʻakoʻa* that the *ʻākoʻakoʻa* (coral head) was born, thus forming the broader foundation for all other marine organisms that inhabit the nearshore reefs, where benthic species and other fish live, including the white list species that are the subject of the current study.

This lengthy chant is broken up into sixteen *wā* (eras). The recurring theme of duality appears in the first four *wā* in which each aquatic life form is paired with a terrestrial counterpart. The first *wā* describes a time of eternal darkness (*pō*) that passes progressively, through the union of male and female energies, ultimately giving birth to light (*ao*). It is in this first *wā* that organisms of the benthic zone are born. The second *wā* of the *Kumulipo* describes the birth of the fishes and their forest counterparts; the third *wā* describes the emergence of the winged creatures of both land and sea., and the fourth *wā* describes the birth of the amphibious creatures (Beckwith 1951). In her explanation of the pairs of aquatic and terrestrial counterparts, Martha Beckwith writes:

> The names are not invented for mere rhyme value…The punning of names have in some cases a practical magical function. For example, in plant medicine the first food to be taken after dosing with a special medicinal herb is the sea-growing thing whose name matches with it…Such is the nature of the language that these lists may be extended indefinitely. (Beckwith 1951:50–51)

It is not until the eight *wā* of the Kumulipo that the Kanaka Maoli, or the people of the Hawaiian Islands, are born. This birth order informs us of the Hawaiian thought process, which suggests that Kanaka Maoli derive from the same source as all other living creatures, and are therefore an integral part of the vastly complicated and fragile system of

life. The idea that Kanaka Maoli were born so long after the ocean helps provide context for understanding the reverence that they hold for the *kai* and all of its life forms. The *Kumulipo* also serves as a reminder that the well-being of Kanaka Maoli is dependent upon maintaining the delicate balance between all life forms, and that a symbiotic relationship exists between the land and the ocean. Although this accounts is set in Hawai‘i’s distant past, the messages and nuanced meanings remain deeply embedded in the spirits and minds of Native Hawaiians today.

For the purposes of the current study, in an effort to provide a more complete understanding of the cosmogony of marine life in the Hawaiian Islands, the entirety of the second *wā* of the *Kumulipo* is provided in the original Hawaiian with an English translation next to it. The Hawaiian version of this chant comes from a text written by King David Kalākaua that was published by Beckwith (1951:190–194). The English translation is derived from a version of the *Kumulipo* published by King Kalākaua’s sister, Queen Lili‘uokalani (Liliuokalani 1978:6–11). Both the Hawaiian and English versions have been transcribed and are presented below in their entirety. All fish names are presented in bold print for emphasis; while the white-list species have been underlined for ease of identification:

123. *Hanau kama a ka Powehiwehi*	The first child born of Powehiwehi (dusky night)
124. *Ho‘oleilei ka lana a ka Pouliuli*	Tossed up land for Pouliuli (darkest night),
125. *O Mahiuma, o Ma‘apuia*	For Mahiuma or Maapuia,
126. *O noho i ka ‘aina o Pohomiluamea*	And lived in the land of Pohomiluamea (shoughy hill of Mea);
127. *Kukala mai ka Haipu-aalamea*	Suppressed the noise of the growth of unripe fruit,
128. *O naha wilu ke au o Uliuli*	For fear Uliuli would cause it burst, and the stench
129. *O ho‘ohewahewa a kumalamala*	To disagree and turn sour,
130. *O pohouli a poho‘ele‘ele*	For pits of darkness and pits of night.
131. *O na wai ehiku e lana wale*	Then the seven waters became calm.
132. *Hanau kama a **hilu**, a holo*	Then was born a child (kama), ‘twas a **Hilu** and swam.
133. *O ka **hilu** ia pewa lala kau*	The **Hilu** is a fish with standing fins,
134. *O kau[l]ana a Pouliuli*	On which Pouliuli sat.
135. *O kuemiemi a Powehiwehi*	So undecided seemed Powehiwehi,
136. *O pouliuli ke kane*	For Pouliuli was husband
137. *O Powehiwehi ka wahine*	And Powehiwehi his wife.
138. *Hanau ka i‘a, hanau ka **Nai‘a** i ke kai la holo*	And fish was born, the **Naia** (porpoise) was born in the sea and swam.
139. *Hanau ka **Mano**, hanau ka **Moana** i ke kai la holo*	The **Mano** (shark) was born, the **Moana** was born in the sea and swam.
140. *Hanau ka **Mau**, hanau ka **Maumau** i ke kai la holo*	The **Mau** was born, the **Maumau** was born in the sea and swam.
141. *Hanau ka **Nana**, hanau ka **Mana** i ke kai la holo*	The **Nana** was born, the **Mana** was born in the sea and swam.
142. *Hanau ka **Nake**, hanau ka **Make** i ke kai la holo*	The **Nake** was born, the **Make** was born in the sea and swam.
143. *Hanau ka **Napa**, hanau ka **Nala** i ke kai la holo*	The **Napa** was born, the **Nala** was born in the sea and swam.
144. *Hanau ka **Pala**, hanau ke **Kala** i ke kai la holo*	The **Pala** was born, the **Kala** was born in the sea and swam.
145. *Hanau ka **Paka**, hanau ka **Papa** i ke kai la holo*	The **Paka** (an eel) was born, the **Papa** (crab) was born in the sea and swam.
146. *Hanau ke **Kalakala**, hanau ka **Huluhulu** i ke kai la holo*	The **Kalahala** was born, the **Huluhulu** was born in the sea and swam.
147. *Hanau ka **Halahala**, hanau ka **Palapala** i ke kai la holo*	The **Halahala** was born, the **Palapala** was born in the sea and swam.
148. *Hanau ka **Pe‘a**, hanau ka **Lupe** i ke kai la holo*	The **Pea** (starfish) was born, the **Lupe** was born in the sea and swam.
149. *Hanau ke **Ao**, hanau ke **Awa** i ke kai la holo*	The **Ao** was born, the **Awa** was born in the sea and swam.
150. *Hanau ke **Aku**, hanau ke **‘Ahi** i ke kai la holo*	The **Aku** (bonito) was born, the **Ahi** (same kind) was born in the sea and swam.
151. *Hanau ka **Opelu**, hanau ke **Akule** i ke kai la holo*	The **Opelu** (same as above) was born, the **Akule** was born in the sea and swam.
152. *Hanau ka **‘Ama‘ama**, hanau ka **‘Anae** i ke kai la holo*	The **Amaama** (mullet) was born, the **Anae** (large kind) was born in the sea and swam.
153. *Hanau ka **Ehu**, hanau ka **Nehu** i ke kai la holo*	The **Ehu** was born, the **Nehu** was born in the sea and swam.
154. *Hanau ka **‘Iao**, hanau ka **‘Ao‘ao** i ke kai la holo*	The **Iao** (used for bait) was born, the **Aoao** was born in the sea and swam.
155. *Hanau ka **‘Ono**, hanau ke **Omo** i ke kai la holo*	The **Ono** (large fish) was born, the **Omo** was born in the sea and swam.
156. *Hanau ka **Pahau**, hanau ka **Lauhau** i ke kai la holo*	The **Pahau** (striped flatfish) was born, the **Lauhau** was born in the sea and swam.
157. *Hanau ka **Moi**, hanau ka **Lo‘ilo‘i** i ke kai la holo*	The **Moi** was born, the **Loiloi** was born in the sea and swam.
158. *Hanau ka **Mao**, hanau ka **Maomao** i ke kai la holo*	The **Mao** was born, the **Maomao** was born in the sea and swam.
159. *Hanau ke **Kaku**, hanau ke **A‘ua‘u** i ke kai la holo*	The **Kaku** was born, the **A‘ua‘u** was born in the sea and swam.
160. *Hanau ke **Kupou** hanau ke **Kupoupou** i ke kai la holo*	The **Kupou** was born, the **Kupoupou** was born in the sea and swam.
161. *Hanau ka **Weke**, hanau ka **Lele** i ke kai la holo*	The **Weke** was born, the **Lele** was born in the sea and swam.
162. *Hanau ka **Palani**, hanau ka **Nukumomi** i ke kai la holo*	The **Palani** was born, the **Nuku Moni** was born in the sea and swam.
163. *Hanau ka **Ulua**, hanau ka **Hahalua** i ke kai la holo*	The **Ulua** was born, the **Hahalua** was born in the sea and swam.
164. *Hanau ka **‘Ao‘aonui**, hanau ka **Paku‘iku‘i** i ke kai la holo*	The **Aoaonui** was born, the **Pakuikui** was born in the sea and swam.
165. *Hanau ka **Ma‘i‘i‘i**, hanau ka **Ala‘ihi** i ke kai la holo*	The **Maiii** was born, the **Alaihi** was born in the sea and swam.
166. *Hanau ka **‘O‘o**, hanau ka **‘Akilolo** i ke kai la holo*	The **Oo** was born, the **Akilolo** was born in the sea and swam.
167. *Hanau ka **Nenue**, noho i kai*	The **Nenue** was born and lived in the sea;

168. *Kia'i ia e ka Lauhue noho i uka*	Guarded by the Lauhue that grew in the forest.
169. *He po uhe'e i ka wawa*	A night of flight by noises
170. *He nuku, he kai ka 'ai a ka i'a*	Through a channel; salt water is life to fish;
171. *O ke Akua ke momo, 'a'oe komo kanaka*	So the gods may enter, but not man.
172. *O kane ia Wai'ololi, o ka wahine ia Wai'olola*	Man by Waiololi, woman by Waiolola,
173. *Hanau ka **Pahaha** no i kai*	The **Haha** was born and lived in the sea;
174. *Kia'i ia e ka Puhala noho i uka*	Guarded by the Puhala that grew in the forest.
175. *He po uhe'e i ka wawa*	A night of flight by noises
176. *He nuku, he kai ka 'ai a ka i'a*	Through a channel; salt water is life to fish;
177. *O ke Akua ke momo, 'a'oe komo kanaka*	So the gods may enter, but not man.
178. *O kane ia Wai'ololi, o ka wahine ia Wai'olola*	Man by Waiololi, woman by Waiolola,
179. *Hanau ka **Pahau** noho i kai*	The **Pahau** was born in the sea;
180. *Kia'i ia e ka Lauhau noho i uka*	Guarded by the Lauhau that grew in the forest.
181. *He po uhe'e i ka wawa*	A night of flight by noises
182. *He nuku, he kai ka 'ai a ka i'a*	Through a channel; salt water is life to fish;
183. *O ke Akua ke momo, 'a'oe komo kanaka*	So the gods may enter, but not man.
184. *O kane ia Wai'ololi, o ka wahine ia Wai'olola*	Man by Waiololi, woman by Waiolola,
185. *Hanau ka **He'e** noho i kai*	The **Hee** was born and lived in the sea;
186. *Kia'i ia e ka Walahe'e noho i uka*	Guarded by the Walahee that grew in the forest.
187. *He po uhe'e i ka wawa*	A night of flight by noises
188. *He nuku, he kai ka 'ai a ka i'a*	Through a channel; salt water is life to fish;
189. *O ke Akua ke momo, 'a'oe komo kanaka*	So the gods may enter, but not man.
190. *O kane ia Wai'ololi, o ka wahine ia Wai'olola*	Man by Waiololi, woman by Waiolola,
191. *Hanau ka **'O'opukai** noho i kai*	The **Oopukai** was born and lived in the sea;
192. *Kia'i ia e ka 'O'opuwai noho i uka*	Guarded by the Oopuwai that lived in the forest.
193. *He po uhe'e i ka wawa*	A night of flight by noises
194. *He nuku, he kai ka 'ai a ka i'a*	Through a channel; salt water is life to fish;
195. *O ke Akua ke momo, 'a'oe komo kanaka*	So the gods may enter, but not man.
196. *O kane ia Wai'ololi, o ka wahine ia Wai'olola*	Man by Waiololi, woman by Waiolola,
197. *Hanau ka **puhi Kauwila** noho i kai*	The **Puhi kauwila** was born and lived in the sea;
198. *Kia'i ia e ka Uwila noho i uka*	Guarded by the Uwila that lived in the forest.
199. *He po uhe'e i ka wawa*	A night of flight by noises
200. *He nuku, he kai ka 'ai a ka i'a*	Through a channel; salt water is life to fish;
201. *O ke Akua ke momo, 'a'oe komo kanaka*	So the gods may enter, but not man.
202. *O kane ia Wai'ololi, o ka wahine ia Wai'olola*	Man by Waiololi, woman by Waiolola,
203. *Hanau ka **Umaumalei** noho i kai*	The **Umaumalei** was born and lived in the sea;
204. *Kia'i ia e ka 'Ulei noho i uka*	Guarded by the Ulei that grew in the forest.
205. *He po uhe'e i ka wawa*	A night of flight by noises
206. *He nuku, he kai ka 'ai a ka i'a*	Through a channel; salt water is life to fish;
207. *O ke Akua ke momo, 'a'oe komo kanaka*	So the gods may enter, but not man.
208. *O kane ia Wai'ololi, o ka wahine ia Wai'olola*	Man by Waiololi, woman by Waiolola,
209. *Hanau ka **Paku'iku'i** noho i kai*	The **Pakuikui** was born and lived in the sea;
210. *Kia'i ia e ka la'au Kukui noho i uka*	Guarded by the Laukukui that grew in the forest.
211. *He po uhe'e i ka wawa*	A night of flight by noises
212. *He nuku, he kai ka 'ai a ka i'a*	Through a channel; salt water is life to fish;
213. *O ke Akua ke momo, 'a'oe komo kanaka*	So the gods may enter, but not man.
214. *O kane ia Wai'ololi, o ka wahine ia Wai'olola*	Man by Waiololi, woman by Waiolola,
215. *Hanau ka **Laumilo** noho i kai*	The **Laumilo** was born and lived in the sea;
216. *Kia'i ia e ka [la'au] Milo noho i uka*	Guarded by the Milo that grew in the forest.
217. *He po uhe'e i ka wawa*	A night of flight by noises
218. *He nuku, he kai ka 'ai a ka i'a*	Through a channel; salt water is life to fish;
219. *O ke Akua ke momo, 'a'oe komo kanaka*	So the gods may enter, but not man.
220. *O kane ia Wai'ololi, o ka wahine ia Wai'olola*	Man by Waiololi, woman by Waiolola,
221. *Hanau ke **Kupoupou** noho i kai*	The **Kapoou** was born and lived in the sea;
222. *Kia'i ia e ka Kou noho i uka*	Guarded by the Kou that grew in the forest.
223. *He po uhe'e i ka wawa*	A night of flight by noises
224. *He nuku, he kai ka 'ai a ka i'a*	Through a channel; salt water is life to fish;
225. *O ke Akua ke momo, 'a'oe komo kanaka*	So the gods may enter, but not man.
226. *O kane ia Wai'ololi, o ka wahine ia Wai'olola*	Man by Waiololi, woman by Waiolola,
227. *Hanau ka **Hauliuli** noho i kai*	The **Hauliuli** was born and lived in the sea;
228. *Kia'i ia e ka Uhi noho i uka*	Guarded by the Uhi that grew in the forest.
229. *He po uhe'e i ka wawa*	A night of flight by noises
230. *He nuku, he kai ka 'ai a ka i'a*	Through a channel; salt water is life to fish;
231. *O ke Akua ke momo, 'a'oe komo kanaka*	So the gods may enter, but not man.
232. *O kane ia Wai'ololi, o ka wahine ia Wai'olola*	Man by Waiololi, woman by Waiolola,
233. *Hanau ka **Weke** noho i kai*	The **Weke** was born and lived in the sea;

234. *Kia'i ia e ka Wauke noho i uka*	Guarded by the Wauke that grew in the forest.
235. *He po uhe'e i ka wawa*	A night of flight by noises
236. *He nuku, he kai ka 'ai a ka i'a*	Through a channel; salt water is life to fish;
237. *O ke Akua ke momo, 'a'oe komo kanaka*	So the gods may enter, but not man.
238. *O kane ia Wai'ololi, o ka wahine ia Wai'olola*	Man by Waiololi, woman by Waiolola,
239. *Hanau ka* **'A'awa** *noho i kai*	The **Aawa** was born and lived in the sea;
240. *Kia'i ia e ka 'Awa noho i uka*	Guarded by the Awa that grew in the forest.
241. *He po uhe'e i ka wawa*	A night of flight by noises
242. *He nuku, he kai ka 'ai a ka i'a*	Through a channel; salt water is life to fish;
243. *O ke Akua ke momo, 'a'oe komo kanaka*	So the gods may enter, but not man.
244. *O kane ia Wai'ololi, o ka wahine ia Wai'olola*	Man by Waiololi, woman by Waiolola,
245. *Hanau ka* ***Ulae*** *noho i kai*	The **Ulae** was born and lived in the sea;
246. *Kia'i ia e ka Mokae noho i uka*	Guarded by the Mokae that grew in the forest.
247. *He po uhe'e i ka wawa*	A night of flight by noises
248. *He nuku, he kai ka 'ai a ka i'a*	Through a channel; salt water is life to fish;
249. *O ke Akua ke momo, 'a'oe komo kanaka*	So the gods may enter, but not man.
250. *O kane ia Wai'ololi, o ka wahine ia Wai'olola*	Man by Waiololi, woman by Waiolola,
251. *Hanau ka* ***Palaoa*** *noho i kai*	The **Palaoa** (sea-elephant) was born and lived in the sea;
252. *Kia'i ia e ka Aoa noho i uka*	Guarded by the Aoa that grew in the forest.
253. *He po uhe'e i ka wawa*	A night of flight by noises
254. *He nuku, he kai ka 'ai a ka i'a*	Through a channel; salt water is life to fish;
255. *O ke Akua ke momo, 'a'oe komo kanaka*	So the gods may enter, but not man.
256. *O ke ka'ina a* ***palaoa*** *e ka'i nei*	The train of the **Palaoa** (walrus) that swim by,
257. *E kuwili o ha'aha'a i ka moana*	Embracing only the deep blue waters,
258. *O ka* ***opule*** *ka'i loloa*	Also the **Opule** that move in schools,
259. *Manoa wale ke kai ia lakou*	The deep is as nothing to them.
260. *O* ***kumimi****, o ka lohelohe a pa'a*	And the **Kumimi** (a crab) and Lohelohe (a locust) cling together
261. *O ka'a monimoni i ke ala*	To the rolling motion of their cradle
262. *O ke ala o Kolomio o miomio i hele ai*	On their path so narrow, so slim, to move,
263. *Loa'a Pimoe i ke polikua*	Till Pimoe (a mermaid) is found in the depth of her cave,
264. *O Hikawainui, o Hikawaina*	With Hikawainui, and Hikawaine
265. *O pulehulehu hako'ako'a*	Amongst piles of heated coral
266. *Ka mene 'a'ahu wa'awa'a*	That were thrown in piles unevenly,
267. *O holi ka poki'i i ke au ia uliuli*	So thin and scraggy in the blue tide.
268. *Po'ele wale ka moana powehiwehi*	Surely it must be dismal, that unknown deep;
269. *He kai ko'ako'a no ka uli o Paliuli*	'Tis a sea of coral from the depth of Paliuli,
270. *O he'e wale ka 'aina ia lakou*	And when the land recedes from them
271. *O kaha uliuli wale i ka po—la*	The east is still in darkness of night,
272. *Po—no*	'Tis night

As reflected in the origin stories previously described, the Kānaka Maoli ordered all living things in the world. The ocean and its creatures were living resources of divine origin capable to living and reproducing without the aid of man. Their dependency on thriving but finite resources of the Hawaiian Islands and the adjacent oceanscape, coupled with an ever growing population, required that the Kānaka Maoli, form the beginning, develop systems, practices, and cosmology that would maintain the ecological and spiritual integrity of the islands' finite resources. Over time, what developed was sophisticated and highly integrated set of stewardship practices that were codified in the socio-political system, and interwoven with their spiritual beliefs.

TRADITIONAL RESOURCE MANAGEMENT PRACTICES

The ancient and ingrained philosophy of life of the Native Hawaiian people, or Kānaka Maoli, was reinforced through cultural norms, beliefs, values, and practices that tied them to their environment in a very intimate and profound way. Evident in traditional resource stewardship practices are several underlying components: having a personal and reciprocal relationship with the resources; the belief that all things are interconnected; exercising self-control; having the staunch support of a socio-political system that valued the management and beneficial use of natural resources; and uncodified laws that imposed serious consequences for violators. This lifestyle helped maintain natural, spiritual, and social orders that were actualized as place-based cultural practices. In describing the intimate relationship that exists between the Hawaiian people and the *'āina* (land) and the *kai* (ocean), Hawaiian historian and cultural specialist, Kepā Maly writes:

> In the Hawaiian context, these values—the "sense of place"—have developed over hundreds of generations of evolving "cultural attachment" to the natural, physical, and spiritual environments. In any culturally sensitive discussion on land use in Hawai'i, one must understand that Hawaiian

> culture evolved in close partnership with its' natural environment. Thus, Hawaiian culture does not have a clear dividing line of where culture ends and nature begins.
>
> In a traditional Hawaiian context, nature and culture are one in the same, there is no division between the two. The wealth and limitations of the land and ocean resources gave birth to, and shaped the Hawaiian world view. The *ʻāina* (land), *wai* (water), *kai* (ocean), and *lewa* (sky) were the foundation of life and the source of the spiritual relationship between people and their environs. (Maly 2001:1)

The *ʻōlelo noʻeau* (proverbial saying) "*Hānau ka ʻāina, hānau ke aliʻi, hānau ke kanaka*" (Born was the land, born were the chiefs, born were the commoners), conveys the belief that all things of the land, including *kanaka,*were literally born, and are thus connected through kinship links that extend beyond the immediate family (Pukui 1983:57). *ʻĀina*, or land, was perhaps most revered, as another *ʻōlelo noʻeau* notes, "*He aliʻi ka ʻāina; he kauwā ke kanaka,*" which has been translated by Pukui (1983:62) as "[t]he land is a chief; man is its servant." The lifeways of early Kānaka Maoli, which depended upon the finite natural resources of these islands, necessitated the development of sustainable resource management practices. Over time, what developed was an adaptable management system that integrated the watershed, freshwater, nearshore fisheries, all of which are connected through the many unique ecosystems that extend from the mountains to the sea (Jokiel et al. 2011). As evidenced by their understandings and use of this island environment, Kānaka Maoli were masters of exploring, utilizing, and maximizing the wide array of island resources. However, included in any form of traditional land use was the practice of *mālama*, meaning as "to take care of, tend, attend, care for, preserve, protect, beware, save, maintain; to keep or observe, as a taboo…" (Pukui and Elbert 1986:232). The nuanced practice of *mālama* was a shared responsibility that was reinforced at a personal, familial, and social level throughout the society. In traditional Hawaiian society, all persons who exercised their right to utilize a resource were also expected to follow social and customary rules and rituals, one of which included the ritualistic gifting of *hoʻokupu* to the many *akua*, who in their elemental form imparted abundance and fertility to the land and sea.

Hoʻokupu & *Pule*: Reciprocity as a Means to Maintaining Spiritual Balance and Abundance

While the people held the responsibility of tending to the land and sea, the *aliʻi* held the prerogative of caring for, and looking after, the solidarity of the land and people (Malo 1951). Maintaining a reciprocal relationship with the *kini akua* (the multitude of gods) and *ʻaumākua* (ancestral gods), however, was traditionally a task undertaken by all classes of people. This was accomplished through ritualistic processes, including *pule* (prayers), giving *hoʻokupu* in the form of physical offerings, and also maintaining *heiau* (temple) rituals (ibid.). While there were many *heiau* types, each dedicated for a specific purpose, those devoted specifically to the occupation of fishing included the *koʻa* and *kūʻula*, both of which are discussed in more detail in the ensuing paragraphs. Maintaining balance with the gods was a practice vital to the life of the Kānaka Maoli. Failure to provide an adequate tribute to the gods was believed to disrupt the solidarity of the land and people, thereby provoking the gods to unleash their elemental powers onto upon them. Early Missionary, William Ellis described how fish were used to appease *akua* associated with the volcanic activity of Hawaiʻi Island. Ellis writes:

> The whole island was considered as bound to pay them tribute, or support their heiaus, and kahu (devotees;) and whenever the chiefs or people failed to send the proper offerings, or incurred their displeasure by insulting them or their priest, or breaking the tabu (sacred restrictions) of their domains in the vicinity of the craters, they filled Kirauea [Kīlauea] with lava, and spouted it out, or, taking a subterranean passage, marched to some one of their houses (craters) in the neighbourhood where the offending parties dwelt, and from thence came down upon the delinquents with all their dreadful scourges.
>
> If a sufficient number of fish were not taken to them by the inhabitants of the sea-shore, they would go down, and with fire kill the fish, fill up with pahoehoe (lava) the shallow places, and destroy all the fishing grounds. (Ellis 1917:186)

In the Kekaha region of North Kona, historical accounts describe the destruction of great fishponds by Pelehonuamea, the fiery goddess of lava. Historical accounts describe Pelehonuamea, who after having been denied fish by the local fishermen, consumed the massive Pāʻaiea fishpond that belonged to Kamehameha. This fishpond was said to have extended for some three miles along the Kona coast from Kaʻelehuluhulu to Wāwāloli, at the boundary of ʻOʻoma Ahupuaʻa (Maguire 1926).

Kilo: Astute Observation of the Natural World

Kilo or perceptive observation of the natural world was perhaps one of the most fundamental stewardship tools used by the Kānaka Maoli. The vast knowledge acquired through the practice of *kilo* enabled them to observe and record the subtlest changes, distinctions, and correlations in their natural world. Examples of their keen observations are evident in Hawaiian nomenclature, where numerous types of rains, clouds, winds, stones, terrestrial and oceanic environments, flora, and fauna—many of which are geographically unique and distinct—have been named. These names are recorded in centuries-old traditions such as *oli* (chants), *mele* (songs), *pule* (prayers), *inoa ʻāina* (place names), and *ʻōlelo noʻeau*, which were transmitted orally from one generation to the next. The Kānaka Maoli knowledge of the natural environment was further reinforced through other traditional practices and arts including, but not limited to, *lawaiʻa* (fishing) and *mahiʻai* (farming), both primary occupations, *hula* (traditional dance), and *lapaʻau* (traditional healing).

Kapu and *Noa*: Harvest Restrictions

As discussed above, the dependency on a thriving, but finite, set of natural resources led the Kānaka Maoli to develop a sophisticated and comprehensive system of land stewardship in the Hawaiian Islands that was reinforced culturally through a strict adherence to terrestrial and marine management practices that were governed, and enhanced, by the dual concepts of *kapu* and *mana*. Kānaka Maoli believed that all things natural, places, and even people, especially those of high rank, possessed a certain degree of *mana* or "divine power" (Pukui et al. 1972; Pukui and Elbert 1986:235). The concept of *mana* is believed to be derived from the *kini akua*, or the multitude of Hawaiian gods, who were embodied in elemental forces, including the *kai* (ocean), the land and its natural resources, and certain material objects and persons as well (Crabbe et al. 2017). Buck (1993) expands upon this concept, noting that *mana* was associated with "the well-being of a community, in human knowledge and skills (canoe building, harvesting) and in nature (crop fertility, weather etc.)."

To ensure the *mana* of the resources, certain places, and people remained protected from over-exploitation and defilement, *kapu* of various kinds were implemented and strictly enforced. According to Elbert and Pukui (1986:132) *kapu* are defined as "taboo, prohibitions; special privilege or exemption..." Kepelino (1932) notes that *kapu* associated with the gods applied to all social classes, while the *kapu* associated with the chiefs were applied to the people. As the laws of *kapu* dictated social relationships, they also provided "environmental rules and controls that were essential for a subsistence economy" (Else 2004:246). Standing in juxtaposition to the concept of *kapu* is the concept of *noa*, translated as "freed of taboo, released from restrictions, profane, freedom" (Pukui and Elbert 1986:268). Some *kapu*—particularly those associated with maintaining social hierarchy and gender differentiation—were unremitting, while other *kapu*, such as those placed on natural resources were applied and enforced according to seasonal changes.

The application of *kapu* to natural resources ensured that such were resources remained unspoiled and available for future use. When the *aliʻi* or the lesser chiefs (including *konohiki* and *poʻo lawaiʻa*) determined that a particular resource was to be made available to the native residents, a decree was proclaimed indicating that *kapu* had been lifted, thereby making it *noa*. Although transitioning a resource from a state of *kapu* to *noa* allowed for its use, native residents were still expected to practice sustainable harvesting methods and pay tribute to the ruling chief and the gods and goddesses associated with that resource. *Kapu* were strictly enforced and violators faced serious consequences including death (Jokiel et al. 2011). Details about the *kapu* system and its use as a marine resource management strategy were described by early visitors and missionaries to the islands, including Scottish surgeon and naturalist Archibald Menzies, and British Missionary, William Ellis. Menzies was a surgeon and naturalist on board the *H.M.S. Discovery*. He visited Hawaiʻi Island on three separate occasions in 1792, 1793, and 1794 and recorded many observations of Hawaiian cultural in his journals, which were published in 1920. Ellis on the other hand, arrived first to Honolulu in 1822, and then returned to Hawaiʻi Island later in 1823, where he and other missionaries toured the island to identify potential locations for future mission stations.

Menzies, in his journal entry for February 24th, 1793, provides some insights into the traditional *kapu* system as it related to fishing practices, recording that a man had been put to death in South Kona, near Nāpoʻopoʻo Beach, for breaking a fish-related *kapu*. In the entry he writes:

> Close to the foot of the marae [heiau], some of the natives pointed out to us the grave of a man that had been put to death about a fortnight before on account of breaking the kapu, which was simply this: The bay had been tabooed some days on account of a large shoal of fish that appeared on the coast, at which time this unfortunate man was seen going across the entrance of it in a small canoe. He was immediately pursued, and when brought on shore, they first broke the bones of his arms and

> legs, and afterwards put an end to his miserable existence by stabbing his body with their pahoas [daggers]. (Menzies 1920:72)

Ellis too, recorded details about the traditional repercussions of breaking a *kapu*, which he referred to as "tabu," writing in the 1820s that:,

> The flesh of hogs, fowls, turtle, and several other kinds of fish, cocoa-nuts, and almost every thing offered in sacrifice were *tabu* to the use of the gods and the men; hence the women were, except in cases of particular indulgence, restricted from using them. . . Particular fruits, animals, and the fish of certain places, were occasionally *tabu* for several months from both men and women (Ellis 1831:387).

Ellis continues that, "when the fish of a certain part are tabued, a small pole is fixed in the rocks on the coast, in the centre of the place, to which is tied a bunch of bamboo leaves, or a piece of white cloth" (ibid.:389). In relating some of the consequences of breaking a *kapu*, Ellis tells of the wife of Alapai, an *ali'i* of Waimanu, "who was afflicted with an affection of the spine, which prevented her walking without support," who told them, "she had incurred the displeasure of the gods by eating a fish that was *tabu*, or sacred, and that the disease which rendered her a cripple was her punishment" (ibid:375).

Violators of *kapu* who managed to escape death, either sought refuge at a *pu'uhonua* (a designated place of refuge), or were sometimes freed by the word of certain chiefs (Kamakau 1992). At the *pu'uhonua*, after completing the proper rituals, the violator was absolved of his, or her, crime and allowed to reintegrate back into society. One such *pu'uhonua* was located at Hōnaunau in Kona, and was described by Ellis during the 1820s as follows:

> Adjoining the Hare of Keave [Hale o Keawe] to the southward, we found a Pahu tabu (sacred enclosure) of considerable extent, and were informed by our guide that it was one of the pohonuas [*sic*] of Hawaii, of which we had so often heard the chiefs and others speak. There are only two on the island; the one which we were then examining, and another at Waipio, on the north-east part of the island, in the district of Kohala.
>
> These Puhonuas were the Hawaiian cities of refuge, and afforded an inviolable sanctuary to the guilty fugitive, who, when flying from the avenging spear, was so favoured as to enter their precincts.
>
> This had several wide entrances, some on the side next the sea, the others facing the mountains. Hither the manslayer, the man who had broken a tabu, or failed in the observance of its rigid requirements, the thief, and even the murderer, fled from his incensed pursuers, and was secure.
>
> To whomsoever he belonged, and from whatever part he came, he was equally certain of admittance, though liable to be pursued even to the gates of the enclosure.
>
> Happily for him, those gates were perpetually open; and as soon as the fugitive had entered, he repaired to the presence of the idol, and made a short ejaculatory address, expressive of his obligations to him in reaching the place with security. (Ellis 1917:126–127)

The importance of fishing related *kapu* in traditional Hawaiian society, and the necessity for them, has been described by Manuia Maunupau, a native of O'ahu and practitioner of traditional Hawaiian fishing methods, who was born in 1872 and spent his formative years fishing with his father, Maihui, in North Kona. Advocating for all those who fish the waters of Hawai'i to maintain their *kuleana* and have respect for the resources, he states:

> The ancient Hawaiian did everything he could to preserve the fishing ground. No fishing ground can be preserved unless precautions such as the Hawaiians observed are taken. This is true not only of aku and ahi fishing but of every other kind of fishing. The Hawaiians had a kapu on alongshore fishing in certain places when deep sea fishing was open. The kapu places were marked with coconut leaves. In the case of inshore fishing, one place was kapu for a month; then this area was opened and the next was kapu. At certain times of the year, certain seaweeds were kapu, because when fish food was preserved by this means, the shore fishing was saved for the people. There used to be plenty of fish in Hawaiian waters, but these have to a great extend disappeared because constant fishing has wiped them out. The fish are gone for good unless we have closed and open seasons for different kinds of fishing. The government is trying to place certain restrictions on fishing. If the ancient form of kapu used by the old-time Hawaiians could be revived in these new governmental restrictions, we should again have plenty of fish, provided the restrictions were observed as were the kapus in the old days.

> The old Hawaiian fisherman was a skilled and selected person. He had knowledge of, and respect for, the traditions and customs of fishing. He was careful to observe these customs, because through them, fishing was preserved for the coming generations, and his children were trained in the skill they would need as they became fishermen. Fishing in those days was not a matter of getting all the fish and moving on to another fishing ground. The Hawaiian fisherman was much too clever to do this, and he respected the traditions of his people too much to do it. Laws today cannot help to preserve the fish in Hawaiian waters, unless in addition to the laws, we have a feeling of respect for them and observe them because we see that they are beneficial. (Maunupau in Handy et al. 1981)

Maunupau's sentiments are still echoed today amongst native fishing practitioners and should serve as a valued reminder of the importance of maintaining Hawai'i's precious fishing grounds. Another component of the traditional Hawaiian approach to marine resource management was maintaining designated fishing grounds, known as *ko'a*, where non-current swimming *i'a* (fish) congregated, fed, and slept.

Ko'a

Ko'a fishing has a long standing history in West Hawai'i as a valued cultural practice. Even since the introduction of modern fishing technologies, fishing for *'ōpelu* using *ko'a* remains a living cultural expression deeply anchored in familiar cultural mores. Accounts describing *'ōpelu* fishing utilizing *ko'a* are well recorded in historical literature. Designated fishing grounds known as *ko'a*, often identified as either a depression or a mound on the floor of deep parts of the ocean, were places guaranteed to yield a great quantity of fish for *po'e lawai'a* who fished there. However, in order to preserve the long-term integrity of the *ko'a, po'e lawai'a* would only fish them selectively, ensuring that they did not overharvest them, lest they would be spoiled forever (Handy et al. 1981). Some *ko'a* were species-specific and bore the corresponding names of the species found at them, such as *'ahi* (*ko'a hī 'ahi*), *'ōpelu (ko'a 'ōpelu),* and *kāhala* (*ko'a hī kāhala*) (Kamakau 1976). Maunupau, the old Kona fisherman quoted above (in Handy et al. 1981:105), characterized *ko'a* as "an area in which fish were always found." He related that regarding *aku ko'a* in particular:

> It was a depression in the bottom of the ocean and was particularly deep. The Hawaiians knew just where to go to find fish. They did not fish just anywhere over the ocean, but only in those places where fish were always found. They found good fishing grounds, located them by certain marks, and never missed the place. The koa is not so important in aku fishing because aku swim with the current, but it is very important in deep sea fishing. However, the fisherman who knows where the koa is can always go there and get his fish. Today a person can watch from shore and see schools of aku going in a certain direction and disappearing at a certain spot. This is a koa. The fish either go to that hole and sleep or they simply remain there. At any rate, they may be found there the next day. The experienced Hawaiian fisherman of the present does not fish outside the koa. (ibid.)

As expressed by Ka'elemakule, within Kekaha in North Kona, fishing for *aku*, *'ahi*, and *'ōpelu* was commonly practiced at the famed *ko'a* of Hale'ōhi'u:

> . . . Among the important fishing practices of Kekaha, that I was taught in my youth were *aku* fishing, *ahi* fishing, and fishing for *opelu* with nets. These were the important fishing customs that I was taught...
>
> Fishing for these fish was done at the *ko'a 'ōpelu ('ōpelu* fishing station or grounds), that was not too far out. And beyond that, was the *ko'a* for *aku* and *'ahi* fishing. The *ko'a* for these fish (the *'ahi* and *aku),* was the famous *ko'a lawai'a* (fishing ground) of Kekaha, known by the name, "Hale'ōhiu." (Ka'elemakule in Handy et al. 1981:223)

Similarly, Issac W. H. Kihe also wrote about the famed fishing *ko'a* between Keāhole Point in North Kona and 'Upolu Point in Kohala. Kihe, who often used the pen name Ka Ohu Haaheo i na Kuahiwi Ekolu, authored a series of articles that were published in the Hawaiian language newspaper, *Ka Hōkū O Hawai'i* between September 13th, 1923 and August 28th, 1924. An excerpt is taken from his October 11th, 1923, article in which Kihe described the location and names of these fishing *ko'a*:

> *Aia i mua o keia lae ma ka aoao maloko he ale hohonu a ma ia wahi e kahe mai ai ka wiliau me ka Ikaika a pii maluna o ua pohaku nei a kahi aku la me he waikahe ala no kekahi muliwai a loaa aku la na ko'a hi-aku, hi-ahi, kahala, opakapaka, a pela wale aku.*
>
> *O kekahi oia mau ko'a lawaia, o Paoo, o Opae, o Kahakai, o Kahakina, o Kahawai, o Kapapu, o Kanahahe, o Kaluahine, o Kanukuhale, o Kahoowaha, o Honu, o Muliwai, kiei i ka lepo o Haena i Kohala…* (Kihe 1923:1)

> Located in front of this point, on the inner side of the deep billows, where the current flows with force, ascending up over this rock and flowing out like a flood from a river mouth until reaching the fishing grounds for *aku*, *ahi*, *kahala*, *ʻōpakapaka*, and other such fish.
>
> Some of these fishing grounds were named Pāoʻo, ʻŌpae, Kahakai, Kahakina, Kahawai, Kapapu, Kanahahe, Kaluahine, Kanukuhale, Kahoʻowaha, Honu, Muliwai peering towards the land of Hāʻena in Kohala…

Although *ʻōpelu* fishing could be conducted in shallow waters, they were perhaps, more prevalent at offshore *koʻa* where they could be found in great abundance. In this manner, *ʻōpelu* were traditionally caught by net or by line using various types of bait including *ʻōpae ʻula* (a tiny endemic red shrimp). Within Kona, *ʻōpelu* were caught by the hundreds along the coastline of Kalaemanō (National Park Service Ala Kahakai National Historic Trail 2007). John Kaʻelemakule, Sr., who wrote a series of articles that were published in the Hawaiian language newspaper *Ka Hoku o Hawaii* between 1928 and 1930 describing life along the North Kona coast, related that fishing for *ʻōpelu* was of great importance to the Hawaiians, particularly within Kona, where this type of fish served as one of the primary sources of sustenance. Kaʻelemakule describes the practice and nuances of *ʻōpelu* fishing in the Kekaha region of Kona at a *koʻa ʻōpelu* called Kaloahale in Awalua during the calm season:

> *ʻŌpelu* fishing was another one of the important practices of these islands in ancient times; it was perhaps the foremost of the practices in the streaked sea *(kai māʻokʻioki)* of Kona. It became the type of fishing that contributed to the livelihood of the fishermen and their families... For *ʻōpelu* fishing, two men are adequate in going on the canoe to the place of the *koʻa ʻōpelu* which has been known since the days of the ancient people. It is at a place where one can look below and see the fish, that he prepares to feed the *ʻōpelu.* The man at the front of the canoe is the fisherman, the one who is prepared for this manner of fishing, he leads in all things for this kind of fishing.
>
> There in front of the fisherman was set out the bait of the *ʻōpelu,* that is the *ʻōpae ʻula* (red shrimp) and sometimes other baits as well. He'd give the man at the back of the canoe the bait, this man would do whatever the fisherman told him to. The man in the back had a stone weight, the black dirt, and the coconut sheath in which the *ʻōpae ʻula* or other bait would be placed and folded in. This would be wrapped with cordage and let down into the water about 2 or three fathoms deep, then the man would jerk the cord and the bait would be released. The water would be blackened by the dirt, and this would help the fisherman see the *ʻōpelu* eating in the water. . .When many *ʻōpelu* were seen, he would have the man feed the fish again and lower the net into the water. While the *ʻōpelu* were eating, the net was drawn up, and as the fish tried to swim down, they were caught in the net... While I was a youth living at my beloved land of Mahaiʻula, I fished for *ʻōpelu.* I went with my foster father, Kaʻaikaula, to fish for *ʻōpelu* at the *koʻa ʻōpelu (ʻōpelu* fishing ground) called "Kaloahale," it was directly seaward of the black sand shore of Awalua. . .
>
> ...When the calm weather returned to the land of Kekaha, that was the time that one saw the *lehua* blossoms return to the sea [a poetical description of the people from the uplands who dwelt in the area of growth of the *lehua* trees, and who returned to the shore for fishing in good weather]. It was then, that I would also see the fleets of canoes traveling from one extremity to the other upon the sea of my beloved land. At those times, people were also seen looking for *aku,* the fruit of the sea. It was at this time that I entered into the business of trading the fine dried fish of the land, taking them to Kawaihae and sending them to Honolulu. I continued this work for some time, moving forward without any problems befalling me. As a result, I accumulated quite a bit of money, which I kept hidden in one of the caves of the land. . .
>
> When my new house was completed, Poke, my foster mother, named the house "Kalāhikiola." We spoke about this and I desired to have a song for our house on the day of the feast for moving into the house. . .As we prepared for the feast to enter the house, there were not many things that would be set out, but they were things which we Hawaiians were accustomed to. It was *poi; kālua* (roast) pig; *poi palau* (taro pudding); and things of the ocean, like the *ʻōpihi* (limpets), *limu* (seaweeds), *wana* (urchins); and the fat *awa* (milkfish) that came from the fishpond of Makalawena *(awa momona o ka loko iʻa o Makalawena).* . . (Kaʻelemakule in Maly and Maly 2003:224)

Theodore Kelsey, who spent his entire life recording Hawaiian traditions, further elaborated on the significance of the *ʻōpelu* to the *kanaka*, who regarded the fish as sacred (ibid.). This belief appears to have originated during the arrival of the 12th century Tahitian priest, Pāʻao, who while on his journey to Hawaiʻi encountered dreadful weather. Hapai (1920) relates that in an effort to placate the *akua* and calm the ocean, Pāʻao tossed his *aku* and *ʻōpelu* overboard,

which almost immediately cleared the weather, making for a safe journey. Pāʻao then called the fish back to his boat and upon his arrival to Hawaii Island, he liberated the *aku* and the *ʻōpelu* in nearshore waters (ibid.). Titcomb (1972) relates that "at Kalae in Kaʻu, there was a special *heiau* called Kalalea for the *ʻopelu.*" Kelsey also describes a sacred feeding ceremony conducted by *poʻe lawaiʻa* during a span of four months in Kona, when the *ʻōpelu* were offered as tribute:

> By far the most important of the fishes thus fed was the sacred *ʻopelu*, which in turn with the *aku*-fish was tabued in ancient times for six months of the year. Next to the *ʻopelu* came the *nenue*, which congregated close inshore. For a few days it might be fed previous to catching it with net, fish-trap, or hook. The bait, cooked in an underground oven for the purpose, was a sea-moss known as *limu-ʻakiʻaki.* The *kala*-fish, found in the same locations as the *nenue,* was also fed at times. It was caught in basket-traps, using *limu-kala* sea-weed for bait. To a very limited extent eels were fattened on crushed *manini* or other fish. Fed on crabs, at times, were such charming pets as devil-fish. Sharks (*mano*), regarded as ancestral guardians known as ʻaumakuas, were sometimes reared from infancy. Like faithful dogs they would follow their masters while in or upon the ocean. Many a tale is told of how faithful sharks saved the lives of their keepers by bearing them ashore on their backs. A most interesting case of feeding, is such it may be called, was the insertion of pebbles into the mother-of-pearl bivalves known as *papaua* (pah-pah-ooʻ-wuh), which when matured were known as pas. The pebbles caused the shells to increase in size and strength for use as trolling-spoons, also known as pas, for catching *aku*-fish. The land of Kona, Hawaii, was particularly renowned for its excellent pas.
>
> Opelus, after the abrogation of the old tabu-system, were not fed and caught at any time. No indeed, there were special periods for these purposes. In Puna, Hawaii, the season of feeding and catching combined lasted from October through December. In Kona, where *ʻopelu* fishing assumed considerable proportions, the fish were fed from May to August. From August to December they repaid the hospitality of their hosts.
>
> At the opening of the *ʻopelu*-feeding season in Kona an interesting ancient ceremony, probably performed in the same manner in other localities, took place just before sunset on the night previous to setting forth. This was to secure the favor of the fish-god. To this deity, accompanied by weird chanting and prayer, were offered a cup of the divine *ʻawa,* a small sacred black pig cooked in an *imu,* and consecrated red fish, red *tapa,* and a red *malo* or loin-cloth.
>
> Imagine a fleet of graceful outrigger canoes paddled by stalwart brown fishermen, gliding swiftly, just before sunrise, over the tranquil sea, the beautiful variegated sea of Kona (Kona *kai malino, kai maʻokiʻoki*). With them, in gourd calabashes (*ipu pohue*), or open-mouthed food-containers of *lauhala (poho lauhala)* they bear a tempting repast for the *ʻopelus*. Rap! Rap! Rap! They strike the outsides of their canoes with their paddles, chanting impressively, perchance, the while. In this interesting manner fish were called to meals in olden days. A man in each canoe would rap a few handfuls of food, together with a flat stone for a sinker, in a piece of brown coconut-fibre cloth that grows at the base of the long crowning leaves. The parcels were then lowered into the sea to a depth of say two fathoms, to which the fish were to become accustomed, and released by a jerk of the line so that they showered downward in tasty morsels. Cloth and stone were then hauled in for another load. *ʻOpelu* breakfast was served. Toward sunset many of these fish-stewards provided supper for the ʻopelus. In most localities a few days of such stewardship were deemed sufficient. (Kelsey in Maly and Maly 2003:224)

While *koʻa* themselves were established as underwater fish habitats, they also had a connection to the land, for the locations of fishing *koʻa* were identified using markers on the shore. In some cases, these markers were geological features, such as *puʻu* (hills), but the markers could also be single stones or piles of rocks intentionally placed along the shore to coincide with the underwater location of the *koʻa*:

> Perhaps the most important stones in ancient times were the *kuʻula* and *koa* stones of the fishermen. *Koa* stones—either natural stone outcrops or stone piles used for marking and finding fishing grounds—could be located near fishing grounds or simply used to triangulate their location. Some *koa* were nothing more than piles of stones built up in the ocean by members of a fishing family. Such *koa* might be markers for a natural fishing ground or serve to attract a fish colony. (Gutmanis 1991:26)

Some of these markers also served as fishing shrines where Kānaka Maoli made offerings and recited prayers either hoping to secure a good catch, or expressing gratitude for the sea's bounty. Elbert and Pukui (1986) explain that these types of structural *ko'a* were utilized in ceremonies that would cause the fish to multiply. Malo relates the following details regarding how *kanaka* used two points on the land to triangulate the location of deep sea *ko'a*:

> These koa-lawaia were so deep under water that the eye failed to perceive them, nor could the fish be seen when swimming over them, nor when they seized the hook. In order to find them, it was necessary to take one's bearings from the land. Two bearings were required; and where these were found to intersect, there was the koa, and there the fisherman let down his hook or his net. (1951:211)

In the late 19th century publication *Hawaiian Fisheries and Methods of Fishing*, Beckley elaborates on how *kanaka* used their deep understanding of the Islands' terrain, both beneath the sea and on land, for fishing:

> . . . Every rocky protuberance from the bottom of the sea for miles out, in the waters surrounding the islands, was well known to the ancient fishermen, and so were the different kinds of rock fish likely to be met with on each separate rock. The ordinary habitat of every known species of Hawaiian fishes was also well known to them. They often went fishing so far out from land as to be entirely out of sight of the low lands and mountain slopes and took their bearing for the purpose of ascertaining the rock which was the habitat of the particular fish they were after, from the positions of the different mountain peaks. (1883:10)

Locating underwater *ko'a* was only one part of a successful catch. In order to ensure that they would return with food, *po'e lawai'a* had to combine their knowledge of each particular *i'a* sought with their understanding of the most practical materials, methods, and *palu* (bait) for catching them. They also had to observe very specific *kapu* that were dependent upon their particular *akua*, and spiritually express their intent and thankfulness through rituals conducted both prior to, and after, fishing. A *po'e lawai'a*'s success could be enhanced through the spiritual guidance provided by an *akua* that dwelled within a *ko'a* stone, which was sometimes associated with a *kū'ula* (discussed in the following section).

Kū'ula

A *kū'ula*, meaning "red Kū," is "any stone god used to attract fish, whether tiny or enormous, carved or natural, named for the god of fishermen;" (Figure 15) it is also a "heiau near the sea for worship of fish gods;" and a "hut where fish gear was kept with kū'ula images so that gear might be impregnated with kū'ula mana, usually inland and very taboo" (Pukui and Elbert 1986:187). Maunupau, who was intimately familiar with the various *ko'a* and their respective *kū'ula* situated along the Kona coastline, particularly those associated with Hale'ōhi'u, relates that "the fishermen of old Hawaii believed that they needed some supernatural power to aid them in their undertaking, and hence religion and fishing were closely connected by ceremonies and customs" (in Handy et al. 1981:106). Maunupau provides the following details about *kū'ula*:

> . . . In the olden days, every heiau or temple had in it a fish god or kuula. Each fisherman had his own kuula. Perhaps it might be a stone or image he had pulled up in the ocean, and which he regarded from then on as his kuula, or it might be the family god or aumakua. The kuula was supposed to bring luck and success in fishing. (ibid:105.)

In describing the purpose of the *kū'ula*, Kihe (1924:4) relates that "…*aia maia wahi he kuula, oia hoi, he wahi hooulu i'a a maia wahi e hanaia ai na hana hoomana hooulu i'a, a hoolaupa'i a hoomomona hoi i ka i'a*…[located at this place was a *kū'ula*, that is, a place to increase the fish and at the place is where ritual occurred to increase the fish, and multiply and fatten the fish…]." Large *kū'ula* were often "set up on promontories along the sea shores, or near streams and ponds…small *kū'ula* were carried to sea in the fishing canoes to attract fish" (2001:151). Some *kū'ula* were contained within *heiau* and "set in circular enclosures, nearly always built of limestone or coral," (ibid.). An altar (*ko'a*) consisting of a platform of stone placed before the *kū'ula*, was where the offerings were placed, and:

> Within the enclosure of the large shrine, sometimes called a heiau *ko'a*, an *imu* was kept. Here pigs were cooked and eaten, along with other feast foods, as part of the ceremony of dedicating a new fishnet. Also within the area was a *lele* altar where bananas were offered. These may be a tribute to Kanaloa who is associated with bananas. (These fruits were never carried to sea by fishermen.)
>
> The customs seem to have differed among the fishermen as to the number of fish that would be left on the fishing shrine when they returned from a successful catch. This is understandable since the fishermen prayed to and respected their own family *'aumakua* as well as Kū'ula.

> Upon returning from the sea some fishermen went to the *ko'a* with two fish in their right hand for the male *'aumākua* and two in their left hand for the female *'aumākua*. They addressed the gods and placed the fish on the altar. After the gods had received the "essence" (*aka*) of the offering the fishermen were free to take the fish away and add them to the catch for distribution and use.
>
> Maunupau wrote that the first fish caught was marked by cutting off its tail. It was placed in the bow of the canoe and was *kapu*. When ashore the fishermen placed this fish on the *kū'ula* for his *'aumakua*. (ibid.151–152)

The cycle of giving back to the *akua* was accomplished through regulatory tribute associated with the *kū'ula*. There are contrasting accounts as to how this was accomplished, but Maunupau relates that "the first fish caught was marked with a tail or fin mark and saved as an offering to the kuula" (Honolulu Star-Bulletin 1931). Similarly, Keli'ipio and Nakuina (1900:111), writing during the late 19th century, expanded upon this practice:

> The first fish caught by fishermen, or any one else, was marked and dedicated to Kuula. After this offering was made, Kuula's right therein being thus recognized, they were free from further oblations so far as that particular variety of fish offered was concerned. All fishermen, from Hawaii to Niihau, observed this custom religiously. When the fishermen caught a large supply, whether by the net, hook or shell, but one of a kind, as just stated, was reserved as an offering to Kuula; the remainder was then free to the people.

Offerings at the *kū'ula* were made immediately upon the return of the canoe to the shore:

> As soon as the fishing fleet reached the shore, the head fisherman stepped ashore holding an aku fish in each hand and went to the heiau of Ku'ula where he offered prayer; and when he had finished this worship of the god, he threw down the fishes for the male aumakua on one side and those for the female on the other. (Kamakau in Titcomb 1972:44)

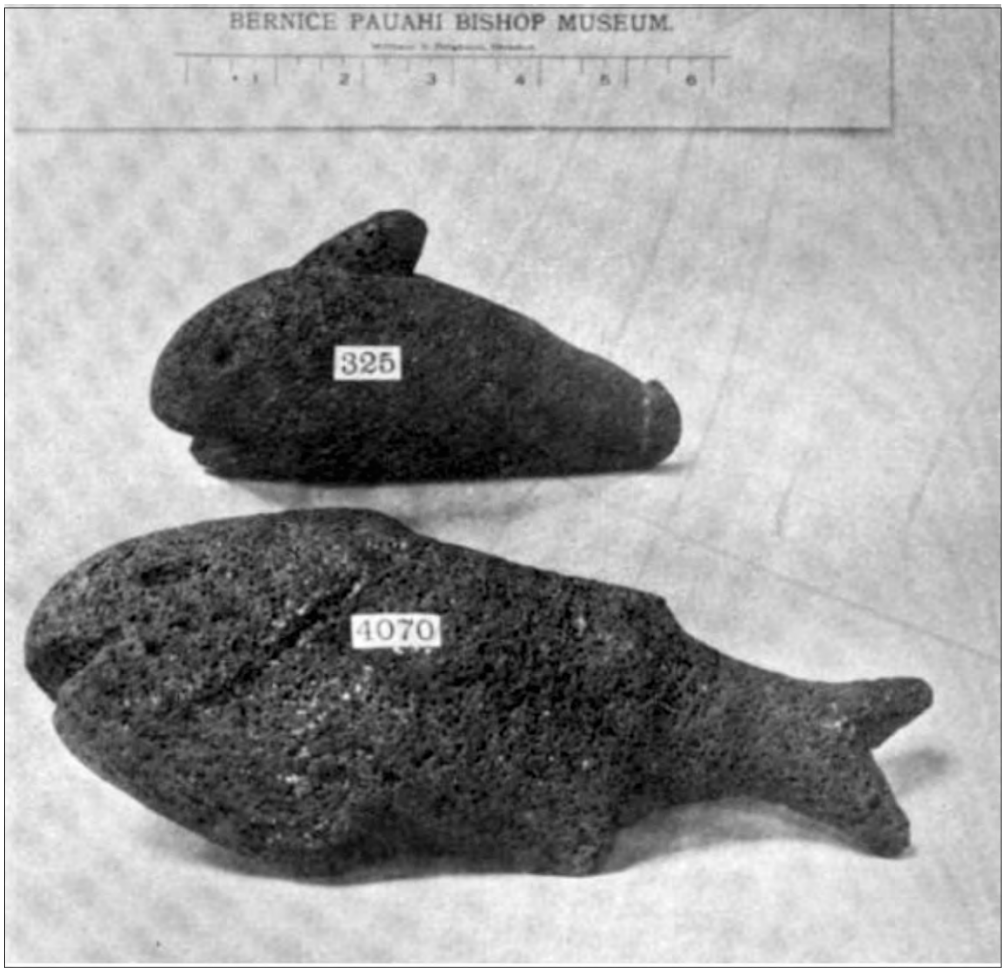

Figure 15. *Kū'ula* stones (Brigham 1902:94)

Kū‘ula (lit. red Kū) bear the name of Kūka‘ilimoku, an *akua* traditionally associated with war. Fishermen often prayed, and still pray, to Kūka‘ilimoku and his wife Hina (Beckwith 1970:11). Kūka‘ilimoku, as the ruler over all of the male gods, had dominion over Kū‘ulakai, an *ali‘i* and *akua* of Hānā, Maui, who himself controlled "all the gods of the sea" (ibid.:19). Valeri (1985:76) relates that Kū‘ulakai married Hinapukui‘a ("Hina gathering seafood"), whose dominion was over the shoreline, and to them was born their son ‘Ai‘ai ("eats food"). Fishing stones dedicated to Hina and ‘Ai‘ai were once utilized by the ancient fishers of Hawai‘i. The *mana* of Hina was said to control certain fish, namely the *aku*, *akule*, *‘ō‘io*, *moi*, *a‘u*, and the *manini* (Fornander 1919–1920). Fornander relates that things that were reddish in color were considered sacred to Kū. Therefore, in addition to *‘aumākua*, *kū‘ula* stones were imbued with the spirit of their namesake Kū‘ulakai as well as Kūka‘ilimoku. The following account, compiled by June Gutmanis (from George Ai, Louis Aila, Ned Burgess, Arthur K. Cathcart, Ah Sam Cheong, Thomas Maunupau, Kalahikiola Naluelua, Henry Young, and Maryknoll Kalahikiola Sotkaeff), details how *kū‘ula* stones acquired the spirits within them. This account explains the mutually beneficial relationship between *kū‘ula* and their *po‘e lawai‘a* caretakers:

> *Ku‘ula* stones were believed to contain a spirit that attracted fish and helped fishermen. They could be either naturally shaped stones or slightly worked. According to tradition, the naturally shaped stones contained a spirit, either placed there by the gods or there of its own choice. A man-made *ku‘ula* was believed to receive its spirit only after appropriate prayers and offerings had been made. The *ku‘ula* could be either of black- or light-colored stone; some said that the dark stones were male and the light ones female.
>
> A naturally formed *ku‘ula* might be found by a fisherman realizing that the stone contained a spirit. Other times, it was believed, a stone chose a fisherman for its *kahu* (caretaker). It might come to him in a dream, saying, "I am cold, come and get me." The fisherman would ask, "What do you say? Where are you?" The stone would then describe just where it was and how to find it, what to bring as an offering, and when to come for it. Sometimes the stone would not reveal what it wanted the first time it appeared in a dream. It might take days, weeks, or even months before the stone revealed its whereabouts. If the stone was female and the dreamer a man, the stone might even flirt with him.
>
> The dreamer would search for the stone, carefully following all the directions given by the *ku‘ula*. When found, the stone would have the mouth of a fish. It when then be taken home and put in a *kapu* (taboo) place where nothing could disturb it. Only the guardian chosen by the stone could handle it. It was believed that if others handled it and the stone did not wish them to, it would become hot like fire.
>
> Those who had *ku‘ula* stones believed that caring for them was as serious as caring for a baby. The guardian would ask the *pohaku* (stone) what it wanted. The answer would come in a dream or vision. The *ku‘ula* had to be fed three meals a day. If even one meal were missed, the guardian could be in for trouble. It also needed clothing—a *malo* (loincloth) that could be wrapped around the stone or used as a blanket. The *malo* had to be kept very clean.
>
> According to tradition, if the stone was well cared for and all of the requirements met, its guardian would profit richly. It was said that the more you gave the stone, the more fish you would catch. Lights, laughter, and activity would bless the home of the caretaker.
>
> Sometimes the *ku‘ula* would vanish. Like a little child it would go out to play and disappear. But apparently it always knew when it was time to come home and would then reappear.
>
> A person in need of help would traditionally make offerings to the stone and wait. It might take days or even months, but when the stone was ready, it would give the location of a school of fish. It would also tell what time of day the fish would appear and what line or net and bait to use. When caught, the fish were to be shared with everyone. Pregnant women customarily received double the share of others. (Gutmanis 1991:26–28)

As Gutmanis goes on to relate, an important aspect of the keeping of *kū‘ula* was that they were transferred from one generation to the next:

> A *ku‘ula* could be used for generations. When the guardian had grown old, the stone would tell him who the next caretaker should be. It would know which child in the family should carry on the tradition. It was believed that the stone could "fall in love" with anyone.

> Sometimes the *ku'ula* would be given to a member of the family, but the guardian would not tell the chosen person the purpose of the stone. One night the stone would come to its new caretaker and reveal its name, its work, and how to care for it. It could be within a few days or it might take years.
>
> Belief in the *ku'ula* and *koa* stones continues. The traditions surrounding them are still practiced by some, and the recipient of such a stone must care for it. Its powers are unknown and untapped. The stone may be a source of power for good, and, if treated with respect, one that will reward its guardian richly. (Gutmanis 1991:26–28)

Thus, the continued care and worship of *kū'ula* by Hawaiian *po'e lawai'a* was a quintessential spiritual practice and heritable custom that endures as a tangible connection to the past. Drawing upon the knowledge of the ancient *po'e lawai'a*, whose spirits remain tied to the depths of the *kai* and the treasured *kai lawai'a* (fishing grounds), it is clear that the Kānaka Maoli revered all marine life and holistically managed the marine resources. Since becoming a *po'e lawai'a* was a privilege, each fisher felt a deep respect for the ocean's cosmic connection with the heavens and the earth, and while it was their job to provide food for their *'ohana* and *ali'i* on land, they made it their *kuleana* to protect and perpetuate the ancient fishing grounds. Although the *'ike* (knowledge) of Kānaka Maoli extended from the mountain tops to the depths of the ocean, for the purposes of the current study, the remaining discussion will focus on the traditional fishing methods, beliefs, and cultural practices associated with the nearshore fisheries that are within the study area vicinity.

Loko I 'a: Fishponds

Another method by which the Kānaka Maoli were able to sustainably support the population of these islands was through the creation of a distinctly Hawaiian aquaculture system, known as *loko i'a* (fishponds). *Loko* is the general term used to refer to any pond, lake or pool of water and *i'a* referring to the fish that were raised therein (Pukui and Elbert 1986). With respect to the study area, such features are concentrated primarily within the Kona and South Kohala portion of the WHRFMA. While the initial origins of *loko i'a* remain largely unknown, traditional lore associates this engineering feat with Kū'ulakai (Fornander 1919–1920; Valeri 1985). Kū'ulakai is said to have built a large fishpond next to his home that was filled with fish (ibid.). These fish were considered the bodies of Kū'ulakai, his wife Hinapukui'a, and their son 'Ai'ai, all of whom were important fishing gods (Fornander 1919–1920).

In their 1975 study, Apple and Kikuchi identified five primary types:1) *loko kuapā*, characterized by its seawall (*kuapā*) in which at least one *makahā* (sluice gate) was built; 2) *loko pu'uone* (or *loko hakuone*), identifiable by its natural elongated sand barrier that enclosed a body of water; 3) *loko wai*, a body of fresh water typically found inland from the shoreline; 4) *loko i'a kalo* (or *loko lo'i kalo*), a fishpond that utilized an irrigated taro plot; and 5) the *loko 'ume'iki*, a fish trap recognizable by its numerous stone-flanked lanes that allowed fish to move into or out of the trap with the ebb and flow of the tide. With the exception of *loko wai* and *loko i'a kalo*, which were inland freshwater ponds, all remaining fishponds were constructed within the littoral zone and were nourished from a mixture of freshwater (*wai*) and seawater (*kai*) (Keala et al. 2007).

Although *loko i'a* varied in shape and size, they were a component of the total food production system in Precontact times and their primary purpose, as purported by Apple and Kikuchi (1975:6), was to make "fresh food, available in quantity at call…" Keala et al. (2007) elaborate on this, noting that fishponds "…were used to provide a reliable, convenient, and every-ready supply of fresh seafood for the ruling ali'i (chief) and the royal court." During Precontact times, and even into the early Historic period, all *loko i'a* and their products were strictly controlled by the ruling class. In relating the importance of *loko i'a* to Hawaiian nobility and the indirect benefits to the general populace, Apple and Kikuchi write:

> Access to these ponds and their products was limited to the elite minority of the native population-- the chiefs and priest. Prehistoric ponds and pond products appear to have been taboo to the vast majority of Hawaiians and to have yielded them no direct benefit. However, indirect public benefit came from ownership by the chiefs of exclusive food sources. Royal fishponds and their terrestrial equivalents, the royal gardens (Kō'ele), insured less demand on the commoners' food production resources. Every fish taken from a royal fishpond left its counterpart in natural habitat available to lesser chiefs and commoners. Ownership of one or more fishponds was one of the ultimate, high-status symbols in the status-conscious Hawaiian culture. (Apple and Kikuchi 1975:2)

Traditionally, herbivores, specifically the *'ama'ama* (mullet; *Mugil cephalus*) and *awa* (milkfish; *Chanos chanos*) were the primary species raised with *loko i'a*. While grown primarily for food, these two species were part of a grouping of fish that were traditionally known as *pua'a kai*, literally translated as "sea pig," which were used as a substitute for pig offerings (Pukui and Elbert 1986:345). Other species of fish that were considered *pua'a kai* included

the *āhole* (*Kuhlia sandvicensis*), *humuhumunukunukuapuaa'a* (*Rhinecanthus* sp.), *kūmū* (*Parupeneus porphyreus*), and *pualu* (*Acanthurus* sp.). Tribute to the respective gods was an important component of maintaining a fishpond and detailed in the account concerning the great fishpond of Pā'aiea which was consumed by Pele after being denied fish from the head fisherman (Maguire 1926).

Although fishponds and its products were closely guarded by the ruling *ali'i*, and practically off-limits to the common people, they provided for a sustainable and ever-ready supply of fish for the massive royal courts that were established along the coast of the current study area. While constructing a fishpond was an enormous undertaking, requiring the labor of many individuals, maintaining it did not require as much labor, unless the fishpond was impacted by severe weather or war (Apple and Kikuchi 1975). The use of fishponds was another component of the traditional marine management strategies employed by the Kānaka Maoli that helped reduce pressure on the nearshore resources, while at the same time providing a sustainable source of food.

TRADITIONAL HAWAIIAN NEARSHORE FISHING TECHNIQUES

Kānaka Maoli were tremendously adept *po'e lawai'a* (fishers) who were intimately connected to the *kai* and its underwater environment. They were innately adapted to its dynamic moods and were sensitive to the ocean's ever-changing conditions and, as a result, they developed a plethora of methods which they used to harvest its bounty wherever they lived. Fishing methods varied greatly within *nā papakū o ka moana* (the strata of the ocean), with "a different method in shallow water, and in deep water, and a different method again in the fishing grounds midocean" (Fornander 1920:174). While smaller reef fish, *limu*, shellfish, echinoids, and crabs could be gathered from shallow nearshore waters and along the rocky shoreline of the study area, to access the *kai lawai'a* within the open ocean, *kanaka* used *wa'a* (canoes) and specific fishing techniques designed to reach deep-sea fish. The larger deep-water fish species that were "treasured most for subsistence" included *'ahi*, *aku*, *a'u*, *mahimahi*, *nai'a*, *kumu*, *'ōpelu*, *pānuhunuhu*, *hala hala*, *uhu*, and *ulua* (Handy and Pukui 1998:223). Typically, deep-sea fishing was conducted during the summer months when particular types of *i'a* were more plentiful. Handy and Pukui (ibid.:176) also describe gender base division of labor associated with harvest zones of the ocean, noting that "offshore, reef and along-shore fishing was the function of men, while the collecting of shellfish, sea urchins, crabs and the like, and seaweed was done by women and children."

Traditional shallow water and intertidal marine zones identified by Malo (1951) and elaborated on by Fornander (1920) and Kamakau (1979) included the *'ae kai*, also referred to as *lihi kai* (water's edge), the *pāhola*, also known as the *hohola* or *pālaha* (where the water spread about), the *pu'eone*, (sand dunes), also the *po'ina nalu*, *po'ina a kai,* or *po'ina kai* (where the waves break). There were also places specifically designated for the catching of small black crabs known as the *kai 'elemihi* and *kai haha pāpa'i*, and for the gathering of cowry, or *leho* (*kai 'o leho*). Similarly, *uhu* (parrotfish) were gathered in the shallow waters known as *kai kākā uhu* with dip nets such as the *'upena pōuouo*, *'upena kākā uhu*, or *'upena kākā 'ōpule* often lured by another *pākali* (decoy) *uhu* (Kahā'uelio 2006). Pole fishing (*kā mākoi*) was conducted in shallower waters when the *kai paeaea* (calm seas) occurred (Kamakau 1979).

Fishing required careful preparation of not only the fishing tools, but also deliberate composure of the mind, body, and spirit to properly attune with nature (Handy et al. 1981). Careful protocol was observed in each step of the preparation for fishing from the shaping and lashing of *makau* (hooks) or *pā* (lures),to the sewing and weaving of *'upena* (nets) and *hīna'i* (baskets), to the shaping of *'ō* (spears), to the storing of the different fishing apparatuses, to the observation of *kapu* by members of the *'ohana* and the required silence prior to an expedition (ibid.). While the harvesting of nearshore marine resources was a year-round endeavor, offshore fishing was typically done when the sea was calm (Handy and Pukui 1998).

The methods used for fishing were dependent upon the type of fish, or intertidal species, that was sought. Some methods required nothing more than a gentle, but swift hand and a watchful eye, while other methods required specialized fishing apparatuses that were crafted from a blend of natural materials including, but not limited to, processed plant fibers, shell, bone, wood, stone, and yellowed foliage. Some fishing methods was done on an individual basis, but as demonstrated below, the traditional practice of near-shore fishing at times involved all able-bodied persons regardless of age or gender. Some of these methods are described by the honorable Daniel Kahā'ulelio, who recognized the immeasurable value of preserving, sustaining, and sharing generational knowledge of ancient Hawaiian fishing practices passed down from his *mākua* and *kūpuna*. After being approached by the editor of *Ka Nūpepa Kū'oko'a*, Kahā'ulelio consented to pen a series of columns detailing Hawaiian fishing methodology, the first of which was published on February 24th, 1902. Subsequent to his passing, Kahā'ulelio's articles, originally written in Hawaiian, were translated into the English language by Mary Kawena Pukui. Kahā'ulelio's comprehensive narratives offer precious insight into traditional methods of marine resource procurement, many of which are filled with personal recollections.

Twentieth-century scholar and *limu* expert, Isabella Abbott, in drawing from an assortment of manuscripts from early works of J. F. G. Stokes, W. T. Bringham, and native scholars like Kamakau, also compiled a great deal of information on traditional fishing methods that is summarized here. Her work focused more on the ethnobotanical uses of plants in Hawaiian culture, and was published in her book, *Lāʻau Hawaiʻi Traditional Hawaiian Uses of Plants*. The descriptions of near shore fishing methods recorded by Abbott are presented below.

In the late 1960s, Thomas S. Newman (1970) compiled information about nearshore fishing methods, which he published in his dissertation titled *Makai—Mauka: Fishing and Farming on the Island of Hawaii in A.D. 1778.* Newman (ibid.:49), who attempted to "reconstruct sea exploitation practices for specific time periods" compiled information from late 18th and 19th-century accounts. Newman relied almost exclusively on the works of Emma Metcalf Beckley (1883) and John Cobb (1902). Accordingly, 20th-century sources were omitted from his synopsis as, according to Newman (1970:49), these sources failed to provide "(1) demonstratable authority on the subject and (2) a careful delineation of the time period reflected in their descriptions." Cobb (1902), who worked for the United States Fish Commission, spent three months in 1901 gathering data on commercial fisheries in Hawaiʻi, which included observational research, interviews with local fisherman, and analysis of government documents newspapers and other pertinent records. Emma Metcalf Beckley Nakuina was an early Hawaiian female judge who presided over water rights cases. She also wrote extensively about Hawaiian culture and folklore (Hopkins 2012). Newman, in his work, provides a graphic (Figure 16) that shows the maritime econiches in Hawaiʻi during the 19th century. The nearshore fishing methods compiled by Newman are elaborated on in the ensuing paragraphs.

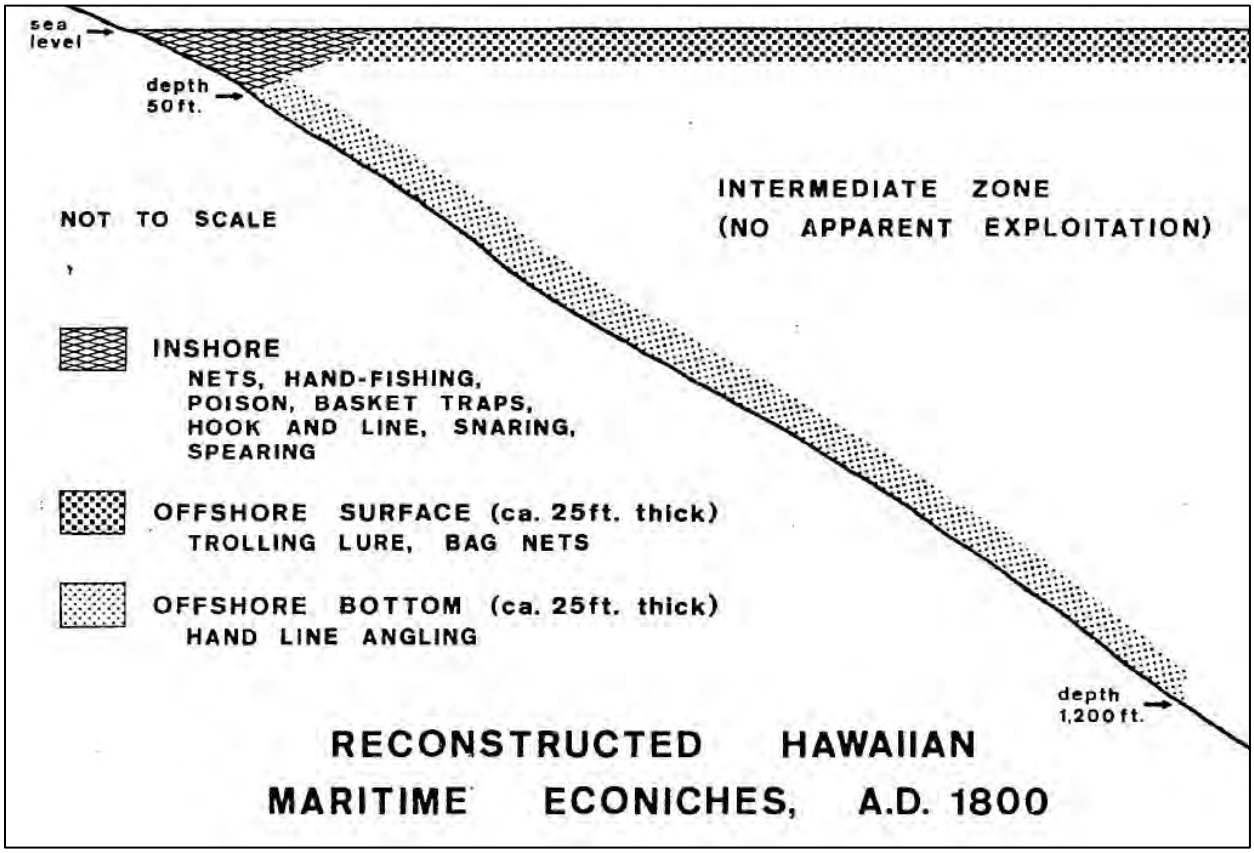

Figure 16. Diagram showing Hawaiian maritime econiches during A.D. 1800 (Newman 1970:92).

Basket Traps

Broadly known as *hīna'ī*, basket traps (Figure 17) were created from the roots of climbing *'ie'ie* (*Freycinetia arborea*) plant and crude versions of *hīna'ī* were sometimes made from the vines of the *'āwikiwiki* (*Canavalia galeata*) (Abbott 1992). Abbott (ibid.:84) also relates that both "men and women alike laid traps in the reef shallows for small-to medium-sized fish such as *hīnālea*." *Hīna'i* were of various shapes and sizes and some were baited and weighted down with a sinker (see Figure 17). *Hīna'i* were also employed when catching freshwater stream fish including *'ōpae* (shrimp) and *'o'opu*, which was a practice done almost exclusively by women. Relating to basket traps, Newman (1970:52–53) related the following:

> Relatively few basket traps were made and most were used by women to catch 'opae, hinalea, kala, and 'ui'ui. The traps were woven from fresh vines or flexible branches into box-shaped designs. In one common technique, a simple basket was lowered to the bottom in shallow water, often with a bait of pounded shrimp inside and when fish entered the trap, the woman watching nearby would dive to bring the trap to the surface. A more sophisticated version had a conical woven entry protruding into the interior where it terminated in an opening only large enough for a fish to squeeze through. The trap, baited with seaweed, ripe bread- fruit or papayas, cooked pumpkins or sweet potatoes, was lowered to the bottom, and when the fish entered by the conical entry they were unable to find their way back again.

Figure 17. Example of *hīna'i* (Kahā'uelio 2006:192).

Hand Collecting

Hand collecting, which often required nothing more than a swift hand and watchful eye and a storage vessel, was utilized to catch a variety of nearshore species. In describing the method of hand collecting, a practice that was done by scouring and or diving the nearshore areas, Newman writes:

> Collecting by hand was practiced in shallow water, both on the surface and by diving. Some types of fish were caught by hand in shallow pools as well as by divers in underwater caves while other food items collected by hand included crabs, lobsters, eels, sea urchins, sea cucumbers, shellfish,

> octopi, shrimp, and seaweed. Much of this type of exploitation was practiced at night, particularly for mobile fauna. No items of material culture were used except for fiber containers in which the organisms were placed, and perhaps the torches used at night to mesmerize fish (Newman 1970:51).

Hook and Line

Although the hook and line method of fishing was conducted in offshore waters, it was also employed in the nearshore waters, sometimes being attached to a long wood pole. Abbott (1992:83) notes that "hooks were mainly fabricated from non-plant materials—pearl shell, turtle shell, ivory, and bone—but hardwoods like *ʻalaheʻe* and *koaiʻe* (*Acacia koaia*) also played a minor part." Abbott (ibid.) notes that "…wood served only for the shaft of the two-part hook, the second part being a sharp tip made of bone or another substance that would hold a fine edge." The fibers from the hardy *olonā* (*Touchardia latifolia*) were the choice material for fishing lines. To camouflage the white fibers, fishing lines as well as nets were often dyed a reddish brown by immersing it in a dye bath made of pounded *kukui* (*Aleurites mollucana*) bark (Langlas 2003). Along the high cliffs of the Puna District of Hawaiʻi Island, native residents employed a methods known as *kau lāʻau* to catch large *ulua* (jacks). This method required a relatively long and straight *ʻōhiʻa* (*Metrosideros polymorpha*) pole, which was extended off the cliff with its base fastened into a crevice. The baited hook and line was then hung from the *ʻāmana* (Y-shaped cross piece) that was located at the tip of the pole down where it was suspended just above the water (ibid.). In some cases the fisher, using just a baited hook and line, simply cast the rig into the ocean from the shore. In describing the use of a hook and line attached to a pole, Newman (1970:62) explains:

> Sub-surface angling was done with a pole and line in shallow water and with hand lines for deep-water bottom fishing…Some were attached directly to the hook, while the palu [chum] bait was merely rubbed on the hook; often a bag of bait was lowered near the baited hooks and released underwater.

Newman also describes a slightly more complex hook and line contraption called *kākā*. In describing how this technique was carried out, he writes:

> Kākā Technique:-- Deep-water bottom fishing used a rig of multiple hooks attached by short leaders to the main 3/8th incl (1.7 cm.) fish line at intervals close to the bottom. Each short line with the hook attached was supported by a section of coconut midrib lashed perpendicular to the main fish line which served to keep the multiple hooks separated from one another and from the main line. (ibid.)

Lures

Fishing lures crafted from a combination of stone, shell, wood, and plant fibers were a popular method utilized in offshore trolling, as well as in the nearshore waters. While mother-of-pearl shell was the primary material used for trolling lures, which were attached to a line a dragged behind a canoe and used to catch offshore pelagic species, near shore lures were far more specialized, and often used to capture octopus. Octopus lures were known as *lūheʻe* (Figure 18) and in describing their composition, Abbott (1992:86) notes:

> In the pre-contact era, octopus was a very highly regarded food, and besides spearing these animals in their holes, Hawaiian fishermen caught them from canoes using two kinds of lures. The simple of the pair consisted of a hood of wood or bone lashed to a stick, a stone attached as a sinker, and a tuft of *tī* leaves to camouflage the hook. The second lure included all these elements but also incorporated the colorful, shiny shell of a Mauritius or tiger cowry (*leho*), bound back to back with the sinker. Since an octopus puts up a good fight, these lures were ruggedly built, tied with *olonā* cordage and perhaps secured with *kēpau* as well.
>
> Similar lures have been made and used throughout Polynesia since time immemorial and, in the hands of a skilled fisherman, are very effective. The octopus (today commonly referred to in Hawaiʻi as "squid") is a keen-eyed animal generally curious about objects introduced into its environment, and it feeds on cowries, so a *leho* lure presented it a double temptation as the fisherman slowly dragged it, cowrie side up, along the bottom.

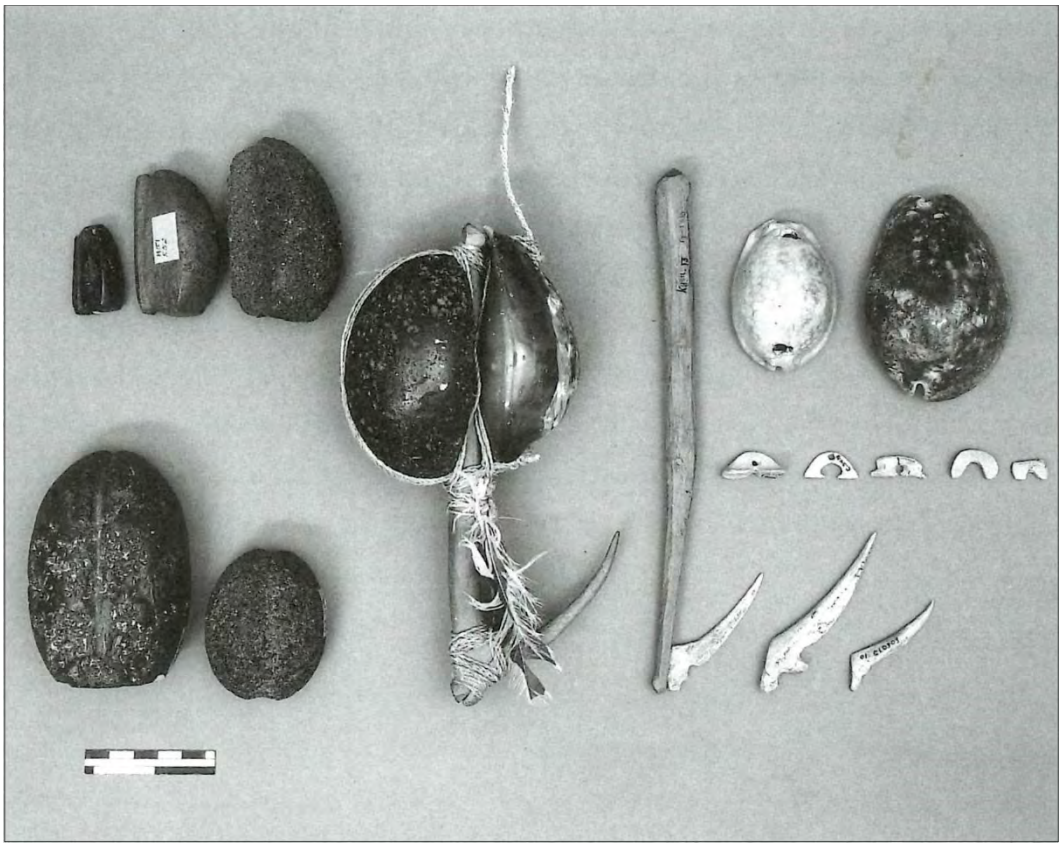

Figure 18. Complete *lūheʻe* (center) and associated components (Kahāʻuelio 2006:70).

Netting

ʻUpena (nets) of various shapes, mesh width, and sizes were widely used for traditional nearshore and offshore fishing. The fibers of *olonā* (*Touchardia latifolia*) were the primary material from which nets and fishing lines were made. *Olonā* required careful cultivation and could only be grown in the wetter upland areas. For the fishers who relied on these valued fibers, procuring such material necessitated exchange with those of the uplands—a hallmark activity of the *ahupuaʻa* system (Abbott 1992). Traveling along the coastal areas, it is common to see fishers perched low on the rocky reef with long cone shaped nets dangling around their bodies and hands. This type of cast net, although known in Hawaiian as *ʻupena hoʻolei*, was introduced by Asian migrants during the 19th century (Mitchell 2001). Elbert and Pukui (1986) list some thirty or so names that were used to distinguish net types. Abbott (1992), however, states that the myriad of nets that were traditionally employed can be categorized into four primary types: *ʻupena kuʻu* (gill nets); *ʻupena paloa* (seine nets); *hukilau* (long seine nets), and scoop nets. The amount of culture-historical information available regarding traditional net fishing suggests that these methods were perhaps one of the most popular fishing methods utilized by Kānaka Maoli for the capture of both near and offshore fish species. The different types of nets and netting strategies traditionally used for fishing are described in further detail below.

ʻUpena kuʻu (gill nets)

In describing the *ʻupena kuʻu* (Figure 19) Abbott writes:

> *ʻUpena Kuʻu* (gill nets)*:* These larger nets, with mesh up to three centimers (one inch) in diameter, were set upright in the water to carch schools of fish such as *ʻōpelu*, and *ʻakule*, species related to the mackerel. They worked by entangling the fills of the swimming fish and ranged from as short as seven meters (twenty-three feet) to ten times that length. (Abbott 1992:83)

Newman (1970:53-54) also provided a late 19th century description of gill nets, noting:

> Gill nets were designed to entangle the fish in a net with a fairly large mesh instead of merely trapping them within an encircling small mesh net wall as was done with seines and bag nets. Gill nets were manufactured in different sizes according to the type of fish to be caught and the habitat

to be exploited, ranging in length from about 55 feet (17 meters) to over 1,200 feet (366 meters), in depth from seven feet (2 meters) to 25 feet (8 meters), with mesh size from one-half to seven inches (1.2 to 17.7 cm.).Three basic techniques were used in gill netting:

1. letting the net remain stationary and allowing the fish to entangle themselves in the mesh;
2. driving the fish into a stationary net; or
3. moving the gill net to encircle the fish and then scaring them into the entangling mesh.

Stationary gill nets were often placed at high tide across shallow openings in the coral reef at night to entangle any fish navigating the fish run. Nets used in this fashion usually had a mesh of two to two and one-half inches (5 to 6 cm.).

Drawn gill nets were used to either completely encircle fish or to arc a half-circle around them before the fish were scared into the net by fishermen beating and splashing he water from within the circle or across the open end of the semi-circle. Sometimes, the nets were·drawn up on the shore after the fish were meshed but at other times, the fish were taken out of the nets and put into canoes.

Lobsters were caught in a special gill net, with a seven-inch (18 cm.) mesh, by placing the net completely around a rock cluster and leaving it in place all night to entangle the lobsters as they came out of the rock cairn.

Gill nets used for specific fish included:

1. a net measuring some 1,200 feet (366 meters) in length, 25 feet (8 meters) in depth, with a mesh of four inches (10 cm.) used to encircle a school of akule, and
2. a gill net some 540 to 900 feet (165 to 275 meters) long, 12 to 18 feet (4 to 5 meters) deep with a three to four inch (8 to 10 cm.) mesh used just outside the reef or breakers to encircle larger fish such as the ‘o‘io.)

Figure 19. Girl with gill net, pre-1900s (Hawai‘i State Archives Call No. PP-34-8-008).

'Upena pāloa (seine nets)

In describing the *'upena paloa* Abbott writes:

> *'Upena Paloa* (seine nets) were similar nets, but usually longer, with a large midportion or "bag." Rather then capturing fish by entangling them in the mesh itself, seines encircled the prey. Like gill nets, they were held upright in the water, their upper edged suspended from floats made of *hau* wood, the lower portions weighted with stone sinkers. Using large gill nets and seines was a community operation, involving a large number of people, numerous small canoes, and a lot of cooperation. (Abbott 1992:83-84)

Adding to Abbott's discussion about the *'upena ku'u*, Newman (1970:55) relates the following:

> A Hawaiian seine was a net deployed in the water and moved horizontally, trapping fish by impounding them within a complete circle formed by the net, or between the net and the shoreline. The fish were not normally entangled in the mesh as with a gill net, but rather were kept within a small circle by the net wall where they could be scooped out with small bag nets or dragged bodily onshore, net and all. A bag net was often used in conjunction with a seine and this combination will be discussed later. Seines varied in length from about six to over 350 feet (2 to 107 meters) in length, with the common large net measuring some 150 to 350 feet (46 to 107 meters) in length, about 10 feet (3 meters) in depth, with a mesh width of several inches. The net size and mesh type seem to have been dependent upon the particular types of fish to be caught and the habitats to be exploited.

Hukilau/Lau (long seine nets)

In detailing the use of long seine nets, which she referred to as *hukilau*, Abbott explains:

> *Hukilau* nets were used to capture smaller fish in shallow waters, usually in sandy-bottomed bays. The *hukilau* nets were shorter versions of the seine, with *tī* leaves tied along the top to alarm the fish and drive them into the center of the net. Setting a *hukilau* net, too, was a large, cooperative endeavor but with much of the work done by waders rather than from canoes. (Abbott 1992:84)

While Abbott refers to the large seine nets as *hukilau*, Kahā'ulelio (2006) uses the term *lau* to describe large seine nets, and notes that *hukilau* was a specific cooperative fishing method that involved the use of a *lau* net. Kahā'ulelio (ibid.) describes several cooperative fishing methods, which was done under the direct supervision of a *po'o lawai'a* (head fishermen) and employed the effort of men, women, and children (Figure 20). Kahā'ulelio (2006:3) notes that "these people became the owners and shareholders in this kind of fishing." Although a great deal of labor and knowledge was involved in the preparation and execution of this method, it provided an abundance of reef fish such as *'ōpule*, *moi li'i*, *palapala*, *kūmū*, *weke*, *kala*, *manini*, *moano*, *uhu*, *'ō'io*, *hilu*, *'a'awa* and others that were divided to feed multiple *'ohana* (families). The type of fish caught, however, was dependent upon the nature of the area in which this type of fishing was performed. This method, known broadly as *lau*, is described by Kahā'ulelio as having two distinguishing types. The primary types, which included the methods known as *lau nui*, *lau lele*, *lau kapalili*, and *lau 'apo'apo*, utilized large draglines and were "done outside of the surf line, or where there was no surfline" (ibid.:3). The lesser types, which included the methods known as *lauahi*, *lau 'ōhua*, *lau 'ōhia liko*, *lau kō 'upena pahu*, and the *lau kō pua li'ili'i*, utilized drag nets and were "done within the reef" (ibid.).

Kahā'ulelio (ibid.) describes the *lau* nets as being sewn together from at least three distinct nets that contained a different mesh width. These nets were traditionally crafted from the fibers harvested from *wauke* (*Broussonetia papyrifera*) and *olonā.* Once the net was crafted, men, women, and children were ordered to the uplands to gather yellowed foliage of plants such as *tī* or *mai'a* (banana), along with dried *wiliwili* (*Erythrina sandwicensis*) wood, or dried gourds, for use as floats that were attached to the dragline and knotted with *tī* leaves.

In detailing the general nature of how the *lau* method was conducted, Kahā'ulelio (ibid.) explains that with the *lau nui* method the net, which was attached to the dragline was loaded onto a canoe along with divers who took the net out to a depth of about fifteen fathoms. At the command of the *po'o lawai'*a (head fisherman), and with the aid of several other canoes, the divers carefully placed and arranged the net in the ocean and watched as the men in the canoe slowly paddled the canoes and net closer to shore. Explaining how the *lau* net was moved into shore, Kahā'ulelio writes:

> At that place, fifteen fathoms in depth, which I had mentioned before, the *lau* is let down to about half of the depth and is moved evenly up to a depth of four or five fathoms or less. The drag line goes almost to the sea floor but it doesn't completely touch, lest it snag on the corals or catch in hollows. When the stone anchors of the *lau* canoes are set, the men begin to pull the *lau* lines, six

> or seven men per canoe. When the sun shines directly down on the line, the shadows of the *lau* drive the fish shoreward to the place where the lines are being drawn. (2006:5)

As the net was drawn closer to shore, the *po'o lawai'a* and divers continued to monitor and adjust the net. The *po'o lawai'a* then determined where to lay the *papa* net, which measured roughly six to seven fathoms in length. While the *lau* net was used to usher the fish closer to shore, the *papa* net was used to catch the fish that were brought in. As the fish came closer to shore, the *papa* net was placed at the opening end of the *lau* net. The divers continued to watch as the fish entered into the *papa* net, and when it was time the *po'o lawai'a* called for the lifting of the net into the canoe. Kahā'ulelio (ibid.:7) writes that "at this excited time, like a garden laden with flowers, such are the colors of the fish then as they surge excitedly to and fro, eager to find a way out." Kahā'ulelio (ibid.:7, 9) adds that "the canoe to hold the fish draws near and the man the head fisherman placed on that canoe is hard-hearted, cross and stingy so that people don't crowd about and their hands plow in, bringing misfortune to the group."

Kahā'ulelio (ibid.) goes on to describe the lesser types of *lau* fishing, one of which was *lau kapalili* (see Figure 20). Executed in a manner similar to the *lau nui* method, the *lau kapalili* technique utilized a much smaller net and was carried out in sandy areas and lagoons. The net was dragged shoreward and the people dragged the net from the shore to the beach, where the fish flapped (*kapalili*) on the sand.

Figure 20. *Lau kapalili* method of net fishing ca. 1930 (Kahā'uelio 2006:18).

The *lau ahi* fishing method was carried out during dark nights with no wave action. The net was drawn shoreward within the surf break into a sheltered bay. Kahā'ulelio (ibid.) describes the *lau 'ōhua* method as being carried out primarily by children and women, noting that the men aided only in drawing the *lau* net to shore. The fish caught using this method included juvenile wrasses such as the *'ōhua pa'awela* and *'akilolo*.

The *lau 'ōhua liko* method utilized a fine mesh net that measured roughly a fathom in length. The small mesh size allowed for the capturing of small shrimp and other small fish that lived around a heaped up cairn of rocks known as an *imu* or an *ahu*. The name used, however, varied from place to place. This method was typically employed in the early morning during low tides. Kahā'ulelio (ibid.) notes that when mosquito netting became available during the Historic Period it was also used in the *lau 'ōhua liko* method. The fine mesh net was placed around the stone cairn and people removed the stones one by one until none remained. The fleeing fish and shrimp were caught in the net then placed into a small pail and later consumed.

The *lau kō pua* method was done by children and adults during the wettest time of the rainy months when the streams were swollen, and the ponds near the beach would break open to the sea. This influx of freshwater attracted schools of tiny fish that were ushered into the sandy shore by children using yellowed banana leaves. The children

and adults then picked up the small fish either by hand, or during the Historic Period by using mosquito netting. The captured fish were placed into a calabash and eaten later. In reflecting upon more recent fishing regulations of the 20th century, Kahāʻulelio (ibid.:13) laments that "because laws have been made about catching such small fish, this type of fishing is no longer seen."

The final of the lesser type of *lau* fishing detailed by Kahāʻulelio (ibid.:13) is the *lau kō pahu ʻanae*, which he describes as the "easiest kinds of fishing." This method was used to catch *ʻanae* and required the labor of four men, two of which kept control of the bag net while the other two controlled the *lau* dragline. The men worked in unison to bring the dragline and net together to draw in a school of *ʻanae*. This method was sometimes repeated four or five times, and as many as eighty or more fish could be caught.

Scoop Nets

The final net types recorded by Abbott (1992) are hand held scoop nets (Figure 21), which she describes as follows:

> …scoop nets with handles and sometimes with closure mechanisms served a variety of purposes, including catching fish attempting to leap out of seine or *hukilau* nets. These small, one-person nets were also employed to catch crabs and freshwater shrimp (*ʻōpae*), the latter being a speciality of women. Scoope net handles and closure were frequently made from the endemic shrub *ʻūlei* (*Osteomeles anthyllidifolia*), whose spreading branches can be easily bent into loops. The ends of the piece were lashed together with corn to form the handles of the net. (ibid.:84)

Newman (1970) also details the use of scoop nets, but he instead refers to them as "bag nets" with two specific types: hand held ones, and those that were manipulated by attached ropes. Newman's description of these nets reads thusly:

> Bag nets were made into an enclosed purse with only one open end; or alternately were flat pieces of netting that were closed into a self-contained bag by manipulating attached flexible sticks in a particular manner to seal it. Although bag nets were extensively used in conjunction with seines, there was a great diversity of bag nets used alone, and these seem to have been quite specialized by type of fish to be caught. An initial ordering of these different types may be made on the basis of use technique: (1) hand held, and (2) manipulated by attached ropes.
>
> Hand Held Bag Nets:--The hand-held bag nets were fine meshed small nets fitted on a flexible wooden hoop which held the mouth open, used for dipping out fish trapped by an encircling sein net; for scooping up fish at night in very shallow water areas, usually by torchlight which mesmerized the fish; or by being held across the opening of an underwater hole by a diver while the fish hiding inside were herded into the net with a stick.
>
> Rope Manipulated Bag Nets and Baits:--Bag nets manipulated by attached ropes were often used with some form of bait to draw the fish into the net. Common baits were cooked pumpkin, squash, sweet potatoes, kukui and coconut meat; raw mashed bananas, papaya, breadfruit or taro; pounded up fish, sea urchins, shrimp or eels; whole small fish such as nehu, ʻiao, and akule; or a special mixture called palu which was based on the cooked ink bag of the octopus pounded into a paste with ingredients added such as the juices of various plants, salt, spices, kerosene, tobacco juice, liquor, or Perry Davis Pain Killer. These different baits were often mixed with sand, to make the bait sink, and then placed in the water near as well as inside the bag net to attract fish. Some of these baits are obviously the result of European diffusion. When the fish, usually ʻopelu, were inside the bag, it was lifted to the surface by the attached ropes. (Newman 1970:56-57)

Figure 21. *Kanaka* with scoop net ca. 1925 (Cobb 1905:716).

Poisoning

The use of plant-based poisons for fishing in Hawai‘i involved the use of two primary agents, the *‘auhuhu* (*Tephrosia purpurea*) and *‘ākia* (Wikstroemia sp.). These agents, which can still be found within the study area today, “were crushed, either with a mortar and pestle or with rocks found by the shore,” and then scattered in tide pools, “and in a few minutes the small fish that were present would float to the surface and could be picked up.” (Abbott 1992:86). Abbott emphasizes that:

> This effect did not last more than twenty or so minutes, depending on the size of the tide pool and the speed with which fresh seawater entered in and diluted the toxin. Any fish that were washed out of the pools or overlooked in the gathering would recover and swim away, since the toxins merely stupefied the fish rather than killing them outright. In this sense, these old “poisons” more closely resembled modern fish anesthetics than the chemical rotenone, another plant derivative used to catch fish, from which fish do not recover. No data suggest that *‘auhuhu* or *‘ākia* toxins are transferred to humans through consumption of fish caught in this way. (Abbott 1992:86)

In relating his knowledge of plant-based poisons, which also describes the use of *‘auhuhu* (written by Newman as *ahuhu*) and *‘ākia*, Newman writes:

> Although fish poisoning was made a misdemeanor by legislation in 1850 (Jordan and Evermann 1902:365), it was still reported by Cobb in 1902. Poisons used were of plant origin and made of pounded ahuhu (Tephrosia purpurea) and ‘akia (Diplomorpha sandwicensis) to be inserted into underwater caves; the fish were not affected as a human food by it [*sic*]. For obvious reasons there are no data available on poisoned fish in the 1900 commercial market. (Newman 1970:51)

Newman also cites Campbell (1967), who described fish poisoning in the same manner as Cobb for the late nineteenth century, but notes that he stated that the fish were instantly gutted after being poisoned to keep the poison from affecting the quality of the flesh. Cobb (1902), on the otherhand, states that the poison did not affect the flesh.

Snaring

The use of snares is described by Newman as a nearshore fishing method employed only on Hawai‘i Island. In referencing the writing of Cobb (1902), Newman relates:

> Cobb notes that he only saw snares being used on Hawaii Island and not on any of the other major islands. He says that eels and lobsters were the primary objects of snaring. A noose on a pole was placed in front of an eel hole, bait placed outside and when the eel stuck its head outside the hole to get the bait, the noose was drawn tight and the eel brought to the surface with the pole. A noose attached to a long pole with a forked end was also lowered near bait and the line slipped under the tail of a lobster.(Newman 1970:51–52)

Abbott also describes snares being used to catch sharks using the *kūpalupalu manō* (shark chumming) method. Abbott notes that this method

> …was practiced only by *ali‘i* and only as a form of sport. The game sought—*niuhi*, “man-eating” sharks—were not eaten, although some other sharks were used as food. The snare was made of *hau* rope and baited with human flesh or decomposed pig. To successfully snare a shark and bring it to shore was considered to increase one’s *mana* (spiritual force). (Abbott 1992:86)

Spearing

Traditional *‘ō i‘a* or *pōluhi* (fish spears; Figures 22 and 23) used for catching fish were crafted from several types of hardwood species such as *kauila* (*Alphitonia ponderosa*), *uhiuhi* (*Caesalpinia kavaiensis*), and sometimes *koai‘e* (*Acacia sp.*), while spears used to catch the elusive *he‘e* (octopus) were made from *alahe‘e* (*Psydrax odorata*), *‘ūlei* (*Osteomeles anthyllidifolia*), *‘a‘ali‘i* (*Dodonaea viscosa*), and *uhiuhi* (Abbott 1992). Fish spears typically ranged in length from one to two meters; those used to catch *he‘e* were much longer, ranging anywhere from two to four meters in length (ibid.). Kahā‘ulelio (2006) reports that spear fishing was done either by swimming, or from canoes. Abbott (1992:86) relates that spears “saw heavy service in night-time torch fishing as well as during daylight hours… and were especially useful for picking up sea urchins with venomous spines (*wana*)…” Newman (1970:52) provides the following description of Hawaiian spear fishing, which during the Historic period also included the use of iron tipped spears:

> Fish spears were about six feet long (2 meters), made of a very hard wood tipped with an iron point, and used underwater by a diver who positioned himself on the bottom and impaled fish on the spear as they came close. It was possible to spear more than one fish per dive by allowing them to slip down the spear after they were pierced. Above surface use of spears was restricted to spearing turtles, octopi, ‘o‘opu-hue, and fish mesmerized by torchlight at night in shallow water. No mention was made of spears propelled by slings or elastic bands, such as the “Hawaiian sling,” and these are undoubtedly of twentieth century origin.

While the above-described traditional cultural fishing practices of trapping, hand-collecting, using hook and line, trolling with lures or using octopus lures, netting, poisoning, snaring, and spearing reflect the tangible methods used by *po‘e lawai‘a* to harvest marine resources, the following section will explore Hawaiian fish nomenclature, which then leads into a discussion of cultural uses of the “white-list” species. The Kānaka Maoli connection to the sea, and all its lifeforms, is further reinforced by ways in which fish were categorized, named, and used.

Figure 22. Spear fishing ca. 1890 (Kahāʻuelio 2006).

Figure 23. *Kanaka* diving into ocean with spear (Grosvenor 1909:11).

HAWAIIAN FISH NOMENCLATURE

Keen awareness of the natural world, coupled with their high degree of dependency upon marine resources, culminated over time in a complex naming system for Hawaiian marine resources that conveyed not just descriptive information, but other important cultural information as well. Hawaiian fish nomenclature mirrors other aspects of traditional Hawaiian society, where detailed naming practices helped to categorize the seemingly endless varieties of small reef fishes. Hawaiian fish nomenclature has endured to this day through its constant use—a practice that speaks to both the cultural value of fish, and the importance of intergenerational transmission of knowledge. Titcomb (1972:51) relates that "some names of fishes show the relationship of Hawaiians to other Polynesians, and are therefore very old," but that "many names are peculiar to Hawaii." Fish names were maintained through direct use, as well as through the creation of chants that served as a memory aid (ibid.).

According to Malo (1951) all products of the ocean and in freshwater streams and rivers, whether mobile or not, were considered *i'a* (fish). For instance, the various species of *limu* (seaweed) were included in the category of *i'a* (ibid.). Likewise, Titcomb (1972) conveys that the term *i'a* was applied to vertebrates and invertebrates alike, even "those that were utterly useless as food and of no importance in any other way." Titcomb further relates that Hawaiians gave two names to most fish, one designating the kind (or species), the other designating a group characteristic. The names usually chosen for fish were descriptive of the colour, structure or habitat, such as "(1) colour: *lelo* (reddish), *mele* (yellow), *uli* or *uliuli* (blue, also means green, dark-coloured, that is, the colour of the deep blue sea), *kahauli* (dark-striped), *kea* (white); (2) form: *po'onui* (large-headed), *waha nui* (large mouthed); (3) a special characteristic: *makaonaona* (bright-eyed); *moe* (sleeping), *holo* (travelling), *ka'aka'a lā'au* (stick rolling), *pili ko'a* (coral clinging) (ibid.:50-51). This traditional system of nomenclature is exemplified in the naming of wrasses, which were known broadly as *hīnālea*, and triggerfish known as *humuhumu* (Pukui and Elbert 1986).

Qualifiers describing prominent traits were sometimes added after the general name to identify specific species. This rule was, however, not universally applied as indicated by other examples, which include surgeonfishes (inclusive of tangs and unicorn fish, identified by their sharp protuberances). In this case, individual species were known by specific names such as *manini* (*Acanthurus triostegus*; convict tang), *kala* (*Naso unicornis*; unicorn fish), *kole* (*Ctenochaetus strigosus*), *mā'i'i'i* (*Acanthurus nigrofuscus*), and *palani* (*Acanthurus dussumieri*) (ibid.).

Similarly, names were given to distinguish the growth stages of fish, with the terms *'ōhua* or *'āhua* being used to refer to the schooling of juvenile fish, especially the young of reef fish such as *hīnālea*, *humuhumu*, *kala*, *kūpou*, *manini*, *pualu*, and *uhu* (Pukui and Elbert 1986). Fish that were cultivated in fishponds, including the *'ama'ama* or mullet, were the subject of close observation, and the names given to these fish were based on size, with *pua* being used to refer to fish that were a finger length, and *kahaha* being used to refer to fish that had reached hand length (Titcomb 1972).

While *i'a* was broadest term used to refer to all sorts of marine species, fish that dwelled on the coral reefs were termed *i'a o ke ko'a* (lit. fish of the reef), while those that lived in deeper waters were referred to as *i'a o ke kai uli* (lit. fish of the deep sea) (ibid.). Kānaka Maoli also distinguished and named the anatomical features of fish, both the exterior features as well as the principal internal organs. Titcomb (1972:54) provides a list of the anatomical terms that were given to the various parts of the fish, which is reproduced below in Table 2.While some fish names were widely used across all marine territories, Titcomb states that:

> In spite of conscious effort to hand down knowledge, names for some fish names did vary from island to island, and even from one part of an island to another. This may be due in part to faults of memory, though memories were trained to astonishing capacity, and in part to a conscious wish to call a fish by what seemed a more appropriate name. (ibid.:49)

Understanding how Kānaka Maoli categorized and named the various marine species provides insight into understanding the cultural value and uses were ascribed to them. The following section discusses the specific cultural uses of the forty fish species on the white-list for the WHFRMA.

Table 2. List of Hawaiian anatomical terms given various parts of the fish (from Titcomb 1972:54).

Hawaiian Term	*English Equivalent*	*Hawaiian Term*	*English Equivalent*
nuku, or *nukunuku*	nose	*kualā*	dorsal fin (same for soft dorsal)
lae	frontal region over eye	*unahi*	scales
alo	chest	*unahi kalakala*	the rough scales from mid-body to tail of certain fishes-scutes
alo piko	belly	*kakala*	knife-like cartilage near the tail (as in the surgeon fishes)
mahamaha	gill plate	*hi'u*	tail
api	gill opening	*pewa*	tail fin
pihapiha	gills	*umiumi*	barbels (same term as is used for beard of a man)
halo	gill fin	*kiwi*	the "unicorn" of the *kala* fish

CULTURAL USES OF THE "WHITE LIST" SPECIES

In an effort to identify any traditional cultural uses, practices, and beliefs associated with the forty fish species on the "white-list," the authors of this report began by identifying and compiling the Hawaiian name(s) associated with each of them (Table 3). To verify the accuracy, and to address any discrepancies in traditional naming practices, the Hawaiian names were cross-referenced using various primary and secondary sources, which are cited in the ensuing paragraphs. Once all known Hawaiian names were identified and correlated, additional cultural information was gathered for each of the forty species from various primary and secondary sources written in both the Hawaiian and English languages. The information compiled from these sources summarizes the continued cultural uses of these fish throughout the Precontact and Historic periods. Compiling the Hawaiian names for reef fish was approached with much caution and careful consideration, as the Hawaiian names for the fish in the written literature include many inconsistencies, as well as conflicting naming information. Many fish, especially wrasses and butterflyfishes were traditionally known by multiple names, some of which were qualifiers for specific characteristics. Additionally, Kānaka Maoli gave names to the different growth stages of certain fish, which further adds to the difficulty of understanding the conflicting nomenclature. Where known, the growth stage names are discussed below under the relevant fish subheading, but are not included in Table 3. The Hawaiian fish names presented in Table 3 should not be considered an exhaustive list, as it may not capture regional names, or names used locally by certain families or individuals.

Despite the challenges mentioned above, a significant amount of information was found with respect to traditional subsistence practices, beliefs, customs, and general cultural uses of the white-list species. Additionally, the origin status of each fish species—whether they are indigenous, endemic, or invasive—was categorized (see Table 3). This information from collected from Hoover (2007) and the Marine Life Photography database compiled by Keoki and Yuko Stander (www.marinelifephotography.com). Obviously. more culture-historical information is available for the indigenous and endemic fish species, than for invasive species, which arrived to these islands more recently.

Acanthurus achilles (*pākukui*, *pākuikui*, *pāku'iku'i*)

The Achilles tang (*Acanthurus achilles*), or *pāku'iku'i*, is a feisty surgeonfish that measures from six to eight inches long (Titcomb 1972). This fish is described by Hoover (2007:141) "as blueish black with an orange-red teardrop-shaped patch over the scalpel and a white-edged orange-red bar on the tail fin." Its fins are trimmed with white and white stripes are also observed near the mouth and under the eye (ibid.). The spelling and pronunciation of the Hawaiian names for this fish, which include *pākukui*, *pākuikui*, and *pāku'iku'i*, vary. Pukui and Elbert (1986:306) note that this fish was considered "good eating" and Titcomb (1972) adds that this fish was "always cooked" and was "excellent when broiled." An excerpt from a riddle published in the Hawaiian language newspaper *Ka Nūpepa Kū'oko'a* reads "…*Pakuikui, he wahi i'a ono i'o ano kupono keia kalele leo ana Halale ke kai i ka lehelehe*," which translates to "pakuikui, a truly delicious fish and is just right with a lip smacking sauce" (Kuhelemai Jr. 1907).

Table 3. "White-list" species with known Hawaiian name(s) and status.

Scientific Name	*Hawaiian Names*	*Common Name*	
Acanthurus achilles	*pākukui, pākuikui, pāku'iku'i*	Achilles tang	Indigenous
Acanthurus dussumieri	*palani*	eyestripe surgeonfish	Indigenous
Acanthurus nigricans	unknown	goldrim surgeonfish	Indigenous
Acanthurus nigrofuscus	*mā'i'i'i, mā'i'i*	brown surgeonfish, lavender tang	Indigenous
Acanthurus olivaceus	*na'ena'e*	orangeband surgeonfish	Indigenous
Acanthurus thompsoni	species of *kala*	Thompson's surgeonfish	Indigenous
Anampses chrysocephalus	species of *hīnālea*	psychedelic wrasse	Endemic
Canthigaster jactator	unknown	whitespotted Toby	Endemic
Centropyge fisheri	unknown	Fisher's angelfish	Indigenous
Centropyge potteri	unknown	Potter's angelfish	Endemic
Cephalopholis argus	unknown	peacock grouper, *roi*	Invasive
Chaetodon kleinii	*kīkākapu, kapuhili, lauhau, lauwiliwili*	blacklip butterflyfish	Indigenous
Chaetodon miliaris	*kīkākapu*	milletseed butterflyfish	Endemic
Chaetodon multicinctus	*kīkākapu*	multiband butterflyfish	Endemic
Chaetodon quadrimaculatus	*lauhau*	fourspot butterflyfish	Indigenous
Chaetodon tinkeri	*kīkākapu, kapuhili, lauhau, lauwiliwili*	Tinker's butterflyfish	Indigenous
Cirrhilabrus jordani	species of *hīnālea*	flame wrasse	Endemic
Cirrhitops fasciatus	*piliko'a*	redbarred hawkfish	Endemic
Coris gaimard	*hīnālea 'akilolo*	yellowtail Coris	Indigenous
Ctenochaetus hawaiiensis	species of *kole*	chevron tang	Indigenous
Ctenochaetus strigosus	*kole, kole makaonaona*	goldring surgeonfish	Endemic
Dascyllus albisella	*'ālo'ilo'i*	Hawaiian Dascyllus	Endemic
Forcipiger flavissimus	*lauwiliwili nukunuku 'oi'oi*	forcepsfish	Indigenous
Gomphosus varius	*hīnālea 'i'iwi*	bird wrasse	Indigenous
Halichoeres ornatissimus	*lā'ō*	ornate wrasse	Endemic
Hemitaurichthys polylepis	*kapuhili*	pyramid butterflyfish	Indigenous
Lutjanus kasmira	unknown	bluestripe snapper, *ta'ape*	Invasive
Macropharyngodon geoffroy	species of *hīnālea*	shortnose wrasse	Endemic
Melichthys niger	*humuhumu 'ele'ele*	black Durgon	Indigenous
Naso lituratus	*umaumalei, kala umaumalei*	orangespine unicornfish	Indigenous
Ostracion meleagris	*pahu, moa*	spotted boxfish	Indigenous
Paracirrhites forsteri	*hilu, hilu piliko'a*	blackside hawkfish	Indigenous
Pseudanthias hawaiiensis	unknown	Hawaiian longfin Anthias	Endemic
Pseudocheilinus octotaenia	species of *hīnālea*	eightline wrasse	Indigenous
Pseudocheilinus tetrataenia	species of *hīnālea*	fourlined wrasse	Indigenous
Pseudojuloides cerasinus	species of *hīnālea*	smalltail wrasse	Indigenous
Sufflamen bursa	*humuhumu lei, humuhumu umaumalei*	lei triggerfish	Indigenous
Thalassoma duperrey	*hīnālea lauwili*	saddle wrasse	Endemic
Xanthichthys auromarginatus	species of *humuhumu*	gilded triggerfish	Indigenous
Zebrasoma flavescens	*lā'ī pala, lau'ī pala*	yellow tang	Indigenous

The *pākuʻikuʻi* is also noted in a chant that appears in the epic saga of Hiʻiakaikapoliopele. The chant associates this fish with Hawaiʻi Island—an island celebrated for its black sands, black pigs, black garments, and the black *pākuikui*. The chant also draws a correlation between the *pākukui* and the *kukui* tree (*Aleurites moluccana*) that grows on land. The portion of the chant that describes the celebrated features of Hawaiʻi Island reads:

Kū i Hawaiʻi ke one	The sand is there at Hawaiʻi
He one ʻeleʻele ke one	The sand is black volcanic sand
He ʻaʻahu ʻeleʻele ka ʻaʻahu	Black garments are the attire
He puaʻa hiwa ka puaʻa	The pig is a black one
He ʻeho ka maʻi, he kukui ka lāʻau.	The sickness is a tumor, the kukui is the remedy.
Hoehaʻa ka uku na Haumea	Haumea's reward is uncertain
Hānau kukui aliʻi, hoʻopumehana i ka poli o Papa	Born is the chiefly kukui, warming Papa's bosom
Hānau ka iʻa, ʻo ka ***pākuikui***	Born is the fish, a **pākuikui**, a nibbling fish
Lilo i kai, kiaʻi ʻia e ke kukui noho i uka	Swept to sea, guarded by the kukui of the uplands
Hānau ka iʻa, o leho hua kukui	Born is the kukui-shell cowry
Lilo i kai, kiaʻi ke kukui i ka uka	Swept to sea, the kukui guards in the uplands
Hānau ka iʻa o ka uka, huahua kukui	Born is the fish of the uplands, fruitful kukui
Lilo i kai, hoʻokanaka kākou i uka nei.	Swept to sea, we populate these lands.
(Hoʻoulumāhiehie 2006a:67)	(Hoʻoulumāhiehie 2006b:64–65)

The *pākuʻikuʻi* is also noted in the second *wā* of the *Kumulipo*, which describes this fish as being the offspring of the *ʻaoʻaonui* (Beckwith 1951; Liliuokalani 1978). The *ʻaoʻaonui*, according to Elbert and Pukui (1986:27), is a juvenile *kūpīpī* (another tyoe of reef fish; *Abudefduf sordidus*). The *Kumulipo* chant also relates that the land counterpart of the *pākuʻikuʻi* is the *laukukui* or *kukui* tree (*Aleurites moluccana*) (Beckwith 1951; Liliuokalani 1978).

Acanthurus dussumieri (*palani*)

The eyestripe surgeonfish (*Acanthurus dussumieri*), commonly known as *palani*, is a popular reef fish that ranges from six to twelve inches in length (Titcomb 1972). *Palani* is characterized by its bright blue tail and underbody, with distinct yellow markings on the dorsal fin, tail, and a yellow band over the eye (Hoover 2007). Its caudal spine is bright white (ibid.). Titcomb (1972:138) reports that "some say that *maiko*, or *maikoiko* is the name of the young; other [*sic*] say *maiko* is a distinct fish.". The *palani* is also noted in the *Kumulipo* as being the fish that bore the *nuku momi*, which is described by Elbert and Pukui (1986:272) as "a variety of jackfish (*Caranx melampugus*)." Titcomb (1972:139). further details the color and markings of the *palani* as having "… a dull bluish olive color, with brassy and bluish markings and shades, a blue line along base of dorsal fin; caudal fin bluish with blackish olive spots."

Palani, meaning "to stink, smell sour or rancid" (Pukui and Elbert 1986:309), is a well-recognized trait of this fish that is documented in *moʻolelo* and *ʻōlelo noʻeau*. One such *ʻōlelo noʻeau* reads, "Hauna ke kai o ka palani," translated as "The *palani* makes a strong smelling soup." (Pukui 1983:59). Pukui (ibid.:59) indicates that this saying was used in reference to "a person of unsavory reputation [who] imparts it to all he does." Titcomb notes that despite its strong odor, the *palani* was a popular fish to eat and was most delightful when broiled (the best method to remove the odor) or cooked in a calabash. If the *palani* was eaten raw, the skin was always removed. In describing a traditional custom for removing the pungent smell, Titcomb referenced a practice that was reported by Lily Akuna, an informant from the Puna District. Akuna notes:

> To remove the odor from such fish as the *palani*, *kala*, or *puwalu*, which are good to eat but have a rank odour, lay the fish across the palms of both hands with the head resting in the left hand and the tail in the right. Inhale over the fish from left to right, and expel the breath violently. Turn the fish over and repeat. (Titcomb 1972:30)

The mythical origin of this fish's foul smell is detailed in the *moʻolelo* of Keʻemalu (also referenced as Keamalu), published in the January 3, 1917 version of the Hawaiian language newspaper, *Ka Hōkū O Hawaiʻi* and retold by Titcomb (1972). In relating this story, Titcomb writes:

> As she floated around in the ocean she recalled what her grandmother, Hina, had told her, that she had an ancestor among the fishes of the sea, named Palani-nui-mahaoʻo. She called to him an in a short time she found herself on her ancestor's back, being borne shoreward. As she was taken back to shore, she was seized with such a desire to urinate that she was unable to control herself and so she urinated on her ancestor. Her ancestor became very angry and left her out at sea. It is said that

> was how the *palani* got its strong odour. When she found herself deserted she chanted a chant of derision to this ancestor… (Titcomb 1972:139)

Handy and Handy (1972:262) named several types of fish, including *palani*, which were commonly raised in fishponds. These fish were raised particularly for ceremonial use, or were reserved for *ali'i*, and "were kept in the pond to breed," while the offspring were raised tame so that they could be removed easily from the pond by hand. During spawning seasons certain fish, one of which included the *palani* were prohibited from being caught or consumed. Additionally, *palani* were considered *kapu* to men (Titcomb 1972). In the March 8, 1923 issue of *Ka Nūpepa Ku'oko'a*, an article titled "*Ka Ho'opakele Ana I Nā I'a*," (Unknown 1923) offered insight into the traditional beliefs and Kānaka Maoli practices regarding the *palani* and other similar fish. Presented is a portion of this article concerning *palani* that was translated by Titcomb:

> Fish such as the manini, the kole, the uhu, the kumu and the **palani** and the kala and many others went into sea pools to live until the tiny fish were grown. No kapus were imposed on them at the spawning season. The mullet, squid, aku, opelu and other fish bore their young in a place that was not sheltered…They were made kapu when the spawning season was near until the months for this duty were over. (Titcomb 1972:14)

Acanthurus nigirican

Dwelling within the surge zone to about thirty feet, the goldrim tang is noted for its black body that bears small white markings below the eyes and behind the mouth (Hoover 2007). Bright yellow stripes are observed on the fin, caudal spine, as well as its dorsal and anal fins (ibid.). The review of historical literature conducted for this study did not reveal any specific Hawaiian name or any specific cultural information related to this species.

Acanthurus nigrofuscus (*mā'i'i'i, mā'i'i*)

Mā'i'i, shortened from *mā'i'i'i*, is a small reef fish commonly referred to as the brown surgeonfish or lavender tang (*Acanthurus nigrofuscus*). The name *mā'i'i'i* is also applied to a taro variety (Pukui and Elbert 1986). Its color varies from dark brown to light grayish brown with a lavender-colored tinge (Hoover 2007). Dull orange spots are also present below the eyes (ibid.). In the *Kumulipo*, the *mā'i'i* is noted as the parent fish of the *'ala'ihi*, which according to Elbert and Pukui (1986:17) is the name given to "various species of squirrelfishes of the family Holocentridae." According to Titcomb (1972), some accounts state that the *mā'i'i* is the name given to the juvenile *pualu* (sometimes spelled as *puwalu*) (Pukui and Elbert 1986:347), another species of surgeonfish (*Acanthurus xanthopterus and A. Mata*), but others argue that *mā'i'i* is its own variety of surgeonfish. Traditionally, the *mā'i'i* was considered a good eating fish that could be eaten both raw and cooked, but was best when broiled (Titcomb 1972).

Acanthurus olivaceus (*na'ena'e*)

The orangeband Surgeonfish (*Acanthurus olivaceus),* also referred to as *na'ena'e* meaning "quick, alert" (Pukui and Elbert 1986:258), is grayish-brown in color with an orange band trimmed with a purple streak that extends along its body. Kent (1986) reports that *na'ena'e* resides on the outer ends of the reef where waves and a sandy beach are present. The name *na'ena'e* is also applied to a native daisy known for its small yellow, orange, purple, or white flower (Pukui and Elbert 1986).

Anampses chrysocephalus, Cirrhilabrus jordani, Macropharyngodon Geoffroy, Pseudocheilinus octotaenia, Pseudocheilinus tetrataenia, Pseudojuloides cerasinus (*hīnālea*); *Coris gaimardi* (*hīnālea 'akilolo*); *Gomphosus varius* (*hīnālea 'i 'iwi*); *Thalassoma duperrey* (*hīnālea lauwili*);

Hīnālea, occasionally shortened to *ālea*, is a name broadly applied to various species known commonly as wrasses. These fish, distinguished by their elongated bodies, can range in size from three to ten inches long (Hoover 2007; Titcomb 1972). Its colors and attributes vary according to species. Hoover (2007:158) relates that "the general Hawaiian name hīnālea is applied to most, but not all; many of the smaller wrasses have no known Hawaiian names." Elbert and Pukui (1986:71) explain that "*hīnālea* may be qualified by the terms *'ele'ele*, *līpoa*, *lolo*, *nī'au*, *nuku 'i'iwi*, *nuku 'i'iwi 'ula*, *nuku 'i'iwi uli*, *nuku loa*, [and] *nuku loa 'ele'ele*." The *hīnālea* are found primarily in shallow waters, but are also known to live in waters that are as deep as seven to eight fathoms (Titcomb 1972). Their behavior, and the areas in which they dwell, are described in the *'ōlelo no'eau,* "*naueue ka hi'u o ka i'a lewa i ke kai*," literally translated as "the tails of the fish that move in the sea tremble" (Pukui 1983:250). Pukui (ibid.) goes on to explain that this expression was said of fish, such as the *hīnālea*, whose tails can be seen bending as they seek hollows in the corals

for hiding during the cold month of Welehu (approximately Novemember). *Hīnālea* are also described in ethnographic literature as having sharp protuberances (Malo 1951).

Specific traditional fishing methods are associated with these fish, including one described by Kahāʻulelio (2006) as *melomelo*, which involved the use of a carefully curated stick used to attract fish (Figure 24). This method, decribed below, was effective in catching various fish including the *palani*, *mahamea*, *ʻōpelu*, *māʻiʻiʻi*, *humuhumu*, and *hīnālea:*

> It was a smooth, black stick, as long as from the knuckles to the armpit. It was made black. It had a small knob at the top, around which the line was tied. The stick was constantly toasted over the fire and rubbed with the oil of dried coconuts. The rubbing was done with a piece of *kapa* made of *mamaki* until it shone; then it was wrapped and laid away in the trunk. If we were to smell it, it was heavily fragrant. The canoe went out before sunrise, just outside of the breakers. There were two of us who used to go, my father and I, with a net having meshes two fingers in width, ten fathoms long, and three wide. As soon as the stick was let down, these fishes gathered to the spot: the *palani, mahamea, ʻōpelu, māʻiʻiʻi (palapala), humuhumu,* ***hīnālea*** and so on. The net was lowered from the back of the canoe, then with a cord of the net held fast in the hand, my father leaped overboard and swam. I, in turn, held the *melomelo* stick. He swam around the canoe, where he came to the sticks that held the nets open. He tied them together and went on board the canoe, where he watched the fish circling around the stick. He jumped back into the water and pulled the support sticks until they met. All the fish were caught and we turned shoreward. My father called this kind of fishing a "morning meal," a "cure for hunger," and when the chiefs wanted fish, it was no trouble to get them. (Kahāʻuelio 2006:111)

Figure 24. Assortment of *melomelo* sticks (Kahāʻuelio 2006:114).

Other traditional fishing methods used to catch *hīnālea* included the use of *hīna'i*, or basket traps woven from plant-based fibers. One such basket trap was called *hīna'i ho'olu'ulu'u* (a diving basket), which was made from the vines of the *'āwikiwiki (Canvalia galeata*). The method of using the *hīna'i ho'olu'ulu'u* is described in the book *Hawaiian Fishing Traditions* as follows:

> The hīna'i ho'olu'ulu'u [diving basket], used in catching hīnālea (a small species of Julis), is a small basket made from the vines of the 'āwikiwiki (a convolvulus) and is made anew from day to day as wanted. A light framework of twigs is first tied together and then the 'āwikiwiki vines, leaves and all, are wound in and out round and round till the baskets is of the requisite size, three or four feet around and about one and a half feet deep. Shrimp pounded and enclosed in coconut fibre [*sic*] is occasionally placed at the bottom of the basket for bait, but usually the scent of the bruised and withering 'āwikiwiki leaves seems to be sufficient to attract the hīnālea. Women attend to this kind of fishing. They wade out to suitable places, generally small, sandy openings in coral ground or reef, and let the baskets down suitably weighted to keep them in position. The weights are attached in such a way as to be easily detached. Each woman then moves some distance away from her basket, from where she can watch the fish enter it.
>
> When all the fish in sight have entered, the woman takes the basket up, transfers the fish to a large, small-mouthed gourd, and moves the basket to a fresh place. This kind of fishing can only be done on calm, sunny days at low tide. Since the introduction of the weeping willow, the hīna'i ho'olu'ulu'u are sometimes made from willow twigs. Such baskets can be used over and over again. Men sometimes take such hīna'i and using wana (sea urchin) for bait, with the top of the shell broken to expose the meat, place them in comparatively deep water, piling stones around them to keep them in place. The men leave them for a day or two, and if the place is a good fishing ground, the baskets will be full by the time the men return. (Manu et al. 2006:95)

Manu et al. (2006) also describe the use of *kūkulu 'upena* (standing nets) and *ke kāmākoi*—a fishing pole made of bamboo or *hau* (*Hibiscus tiliaceus*) measuring about eighteen feet long—for catching *hīnālea*. The *ke kāmākoi* method was used from the nearshore reefs where the fisher could cast a hook and line attached to the fishing pole into the sea from the shore. Another method employed traditionally for catching *hīnālea* was poisoning. '*Upena holahola* was the name given to a net that was used in conjunction with certain piscicidal plants that were crushed and placed around a *hīnālea* fish hole. The toxins released from the crushed plants diffused throughout the water thereby paralyzing the trapped fish and causing the *hīnālea* to float to the surface into the *holahola* net (ibid).

Considered a popular fish of the Hawaiian diet, *hīnālea* are referenced in many *mo'olelo*. One origin story of this fish is associated with a female *'e'epa*, or mystical being, who after being angered by two other supernatural beings for helping her unfaithful husband, tore her enemies to pieces and transformed the torn pieces into the *hīnālea* (Kamakau in Titcomb 1972). In the February 8, 1911, issue of *Ke Au Hou*, a Hawaiian language newspaper, John H. Wise published a *mo'olelo* that describes the importance of the *hīnālea* for the conception of a child. In these instances *hīnālea* were used as offerings to the *akua*, or gods, responsible for conceiving a child, namely Kū and Hina. The ceremony involved two *hīnālea* fish that were wrapped in *ti* leaves and cooked on coals. The first fish belonged to Kū, and a chant would be uttered to grant the woman an offspring. If a son was desired the chanter would mention the duties of a man. For a daughter, the duties of a woman would be mentioned. The second *hīnālea* was for Hina, Kū's wife, who was associated with the moon. Chants and prayers were to Hina were given in the same manner as the first fish (Wise 1911).

Hīnālea are also noted in the account of 'Ai'ai, who was the son of Kū'ulakai and Hinapukui'a, both of whom were key fishing deities worshiped by the ancient fishers of Hawai'i Nei (Fornander 1919–1920; Valeri 1985). Fornander (1919–1920) relates that in 'Ai'ai's attempt to replenish the fish that were taken from the sea by his parents—after being threatened by Kahoalii, a chief of Hāna, Maui—he seeks the help of his friend Pilihawawa. To restore the fish in the sea, 'Ai'ai orders his friend of weave a basket for catching *hīnālea*. After the basket was woven, it was taken to the rocky shore at which point 'Ai'ai summoned the help of his parents by chanting a song that called forth the young *hīnālea* and *'ōpule* fish. After hearing the calls of her son, Hina ordered her husband Kū to send fish to their son, and as a result droves of fish came onshore, some of which were collected by Pilihawawa. Kū'ulakai then sent in the surf which carried the fish back into the sea.

Manu et al. (2006) also relate another story of the *hīnālea* that appears in the account of Kalamainu'u, a *mo'o* (lizard) goddess. While on O'ahu, Kalamainu'u enticed a young *ali'i*, Puna'aikoa'e, and lured him to her cave on the island of Moloka'i. Drawn by the beauty of Kalamainu'u, Puna'aikoa'e became her obedient captive and remained in the cave until one day he longed for freedom and to be amongst other people again. Puna'aikoa'e overheard the cheers

of people down below and became intrigued asking Kalamainuʻu about what he heard. She explained that it was the sounds of people celebrating their victories in the *Makahiki* games. He then asked if he could leave the cave to see the festivities for himself, to which she consented. While mingling with the people, Punaʻaikoaʻe met a man by the name of Hinale, who was the brother of Kalamainuʻu. As they conversed, Hinale discovered that Punaʻaikoaʻe was Kalaimainuʻu's lover and immediately began plotting to free Punaʻaikoaʻe from his sister. As Punaʻaikoaʻe began to carry out his escape from Kalamainuʻu, the *moʻo* goddess learned that the plan had been initiated by her brother, Hinale, and she sought revenge. When Hinale discovered that his sister was after him, he fled to the ocean where he transformed into a *hīnālea*. Kalamainuʻu followed after him, but eventually lost Hinale. She then learned from a hermit crab how to entrap her brother, so she followed his instructions and constructed a basket trap made from the *ʻinalua* (*Cardiospermum halicacabum*) vine. After several attempts, Kalamainuʻu eventually captured her brother in the trap, which "has been the method of catching hīnālea ever since" (Manu et al. 2006:53).

The story titled *The Wind Gourd of Laʻamaomao* (Nakuina 2005) also makes reference to *hīnālea* and notes that it was the preferred fish to cut through the bitterness of the drink known as *ʻawa* (kava). This account relates how *hīnālea* were kept in small sea pools, and collected at the request of a chief. In the preamble to this story, Pākaʻa who was the beloved servant of Keawenuiaʻumi, a chief of Hawaiʻi Island, was unjustly cast out of the king's court and replaced by two new, but inept, servants named Hoʻokeleipuna and Hoʻokeleihilo. These two servants knew very little about the chief's likings, and overtime Keawenuiaʻumi became aware of their incompetence. Longing for his beloved servant, Keawenuiaʻumi and his entourage set out in search of Pākaʻa, who by this time had relocated to Molokaʻi with his wife and son, Kūapākaʻa. After the king's arrival on Molokaʻi, Kūapākaʻa invoked a mystical storm through the use of the sacred wind gourd of Laʻamaomao, which thwarted the king's plan to return to Hawaiʻi Island. To win the compassion of Keawenuiaʻumi, and to gain back his role in the king's court, Pākaʻa taught his son everything he knew about the chief, including his fondness for consuming *hīnālea* after downing a cup of *ʻawa*, his favorite beverage. The portion of the story describing the use of *hīnālea* is presented below (all mentions of *hīnālea* are presented in bold text for emphasis):

> When night fell and everyone was at ease, Keawenuiaʻumi reminisced: "My love for Pākaʻa wells up in me. On evenings like this, my kauwā would bring me my cup of ʻawa and live **hīnālea**, and the intoxication would take effect; I would sit enjoying the intoxication of the ʻawa until I fell asleep; then I would sleep soundly all night long. How I miss Pākaʻa!"
>
> Kūapākaʻa heard these words of the aliʻi and reported to his father: "Kā! My haku desires some ʻawa. He spoke of his love for you; when you were his kahu, you brough him his ʻawa. He misses it."
>
> Pākaʻa took out an ʻawa preparation bowl and a cup, some grass for straining the ʻawa, a piece of dried ʻawa root, and portions of ʻawa root already chewed, which he tied into bundles. He put everything into a piece of trimmed kapa, which he took out of the wind gourd of Laʻamaomao,, and told his keiki, "Take this dried ʻawa to your aliʻi and show it to him. If he tells you to chew it, look for a dark place and hide the dried ʻawa there, then strain this portion of already chewed ʻawa into the bowl. He'll be impressed with how quickly you've prepared the ʻawa for him. That's they way I did it when I was with him. After pouring the ʻawa into the cup, serve the ʻawa to him, then run quickly to the beach to get the live **hīnālea** we put into the small pond, and give them to your haku as pūpū to cut the bitterness of the ʻawa."
>
> When the aliʻi saw the large dried ʻawa root, he told the keiki, "You must chew my ʻawa." The keiki turned away to a corner of the room and dropped the dried ʻawa root there, then poured water into the preparation bowl and put into it the ʻawa Pākaʻa had already chewed. He strained the juice out of the chewed ʻawa with the grass, then poured the juice into the cup and gave the cup to the aliʻi. Then he ran to the beach and returned with two **hīnālea** wriggling about in his hands. He put them on a dish and placed the live **hīnālea** before the aliʻi. (Nakuina 2005:68–69)

Hīnālea ʻakilolo

The *hīnālea ʻakilolo* commonly known as yellowtail Coris (*Coris gaimardi*), ranges in size from five to twelve inches long and varies in color. This name is also applied to the shortnose wrasse (*Macropharyngodon geoffroyi*), and sometimes the bird wrasse (*Gomphosus varius*), which is also known more properly as *hīnālea ʻiʻiwi*, or *hīnālea nuku ʻiʻiwi*. There are, however, visible differences between these varieties, as *hīnālea ʻakilolo* are predominantly green in color with a blue underbody, brownish tints towards the tail, and greenish-blue fins, while the *hīnālea ʻiʻiwi* is predominantly blue (Titcomb 1972). *Hīnālea ʻakilolo* are also gray in color with white spots on their back and underbody. The *hīnālea ʻakilolo* is noted in the *Kumulipo* as being the offspring of the *ʻōʻō*, a fish whose specific type

is unspecified, but may be a name of a "type of swordfish" (Beckwith 1951; Liliuokalani 1978; Pukui and Elbert 1986:290). The word *'akilolo*, literally translated as "brain biting," (Pukui and Elbert 1986:14) was used by *kahuna* (priests) as a *pani*, or closing medicine, for someone suffering from a head sickness or disease. This variety was also a highly favored delicacy for eating because of its sweet taste. It was traditionally "eaten with salt, dried, broiled over coals or wrapped in *ti* leaves and then baked or broiled" (Titcomb 1972:78).

Hīnālea lauwili

The *lauwili* variety of *hīnālea* (*Thalassoma duperrey*) is said to have been named in reference to the famed dryland tree termed *wiliwili* (*Erythrina sandwicensis*)—a tree whose flowers are of a bright orange hue. Often mentioned in *mo'olelo* and referenced in traditional fishing practices as "the proper fish to eat as an aftertaste to *'awa* [a mildly narcotic drink made from the chewed *Piper methysticum* plant]*"* (Titcomb 1972:77). This variety is said to be the most commonly observed of the *hīnālea* species. *Hīnālea lauwili* are small coral reef fish that are very abundant in Hawaiian waters. The scales of the fish were hard to remove so it was usually skinned, before or after cooking, or broiling, but was mostly favored when eaten raw. This type of fish was also good for *i'a ho'omelumelu*, which is the practice of removing the entrails, head, tail, and spine, followed by scraping off the scaly skin, then dressing it with condiments (ibid.).

Canthigaster jactator

Hoover (2007) reports that there are twelve known species of pufferfish that inhabit Hawai'i's waters of which three are endemic, including the Hawaiian whitespotted Toby (*Canthigaster jactator)*. The common name, Toby, originated from Australia is commonly used to identify these diminutive puffers that measure less than four inches long and have a slightly elongated snout. The *C. jactator* is the most common Toby in Hawai'i and is frequently seen in pairs. It is brown with white spots with a light green fluorescent color on the head and snout. These fish can be found in active reef areas or in "dead silty places where little else seems to live" (ibid.:109).

Tobys do not have any known specific Hawaiian names, but are sometimes referred to generally as *makimaki,* "a term apparently not used in ancient times," and possibly a variation of the word *make*, meaning death (Hoover 2007:107). Other names traditionally used for pufferfish were *'o'opu hue*, possibly an alteration of *ōpūhue (*calabash, gourd*)* or *kēkē* (potbelly). However, the review of historical literature conducted for this study did not reveal any Hawaiian name or cultural information specifically related to *C. jactator*.

Centropyge fisheri; Centropyge potteri

Species of the genus *Centropyge*, popularly known as angelfish, typically have a large backward-pointing spine on the gill cover. Of the five species in Hawai'i, three are endemic, however, there are no known Hawaiian names for any of these species. The Fisher's angelfish (*Centropyge fisheri*), is a small orange-brown fish trimmed in iridescent blue with a translucent tail. These fish are typically found in finger coral (*Porites compressa*) at depths of 80 feet. Known to be quick moving, they tend to stay close to cover and are not frequently seen, but are found along the West coast of Hawai'i Island (Hoover 2007).

The well-known endemic Potter's angelfish (*Centropyge potteri*) is the most frequently spotted angelfish in Hawai'i. This species has a rusty orange color on its head and back, which transitions to a bluish black on the rest of the body. The body is "covered with irregular vertical gray-blue lines" with blue and black horizontal stripes on the rear fins (ibid:3). The males tend have more of a blue color than that of its female counterpart. These fish live in pairs or in small groups, and dwell in the clear water under ledges and on reef slopes with hollow spaces. The review of historical literature conducted for this study did not reveal any specific Hawaiian name or any specific cultural information related to this species.

Cephalopholis argus

More commonly known as the *roi*, or peacock grouper, this fish was introduced to Hawai'i from French Polynesia in 1956 to enhance local fisheries. *Roi* are known to contain a ciguatoxin which can be dangerous to human health when consumed. Because of this, these fish are a non-targeted species for local fishermen, which as a consequence has led to a significant population increase in the years since they were first introduced (Hoover 2007). It has become a dominant predator species in the main Hawaiian Islands, and is known to have negative ecological impacts on other endemic and culturally valued species (Dierking 2007). In recent years, efforts to minimize *roi* populations have led to statewide events often dubbed "*roi* round-ups," where local spear fishers are encouraged to catch and remove as many *roi* from the reefs as possible. Hoover (2007) notes that this fish is identifiable by its bright blue spots and dark blue spotted fins, the primary base color of this fish changes as it matures from dark brown to a lighter tan color with

distinct light colored bans that extend vertically along the back half of the body. Because this species was so recently introduced to Hawaiian waters, the review of historical literature conducted for this study did not reveal any specific Hawaiian name or any specific cultural information related to it.

Chaetodon kleinii and *Chaetodon tinkeri,* (*kīkākapu*, *kapuhili*, *lauhau*, *lauwiliwili*); *Chaetodon miliaris* and *Chaetodon multicinctus* (*kīkākapu*); *Chaetodon quadrimaculatus* (*lauhau*); *Forcipiger flavissimus* (*lauwiliwili nuku ʻoi ʻoi*); *Hemitaurichthys polylepis* (*kapuhili*)

Members of the genus *Chaetodon*, are broadly referred to as butterflyfish and are usually yellow or white in color with distinct markings (Kent 1986; Titcomb 1972). They grow to about six inches in length, and are distinguished by their compressed bodies (ideal for navigating narrow reef spaces) and small pointed mouths. Butterflyfish are known by a number of Hawaiian names including *kapuhili, kihikihi*, *kīkākapu, lauhau, lauwiliwili, lauhau wiliwili,* and *nukunuku* (Titcomb 1972). While sometimes eaten, butterflyfish appear to have been more commonly caught and used for certain rituals and ceremonies. Specific information related to four types of butterflyfish found in the culture-historical literature, *kapuhili*, *kīkākapu*, *lauhau* and *lauhau wiliwili*, is presented below.

Kapuhili

The term *kapuhili* has been translated by Elbert and Pukui (1986:133) as "…many taboos inherited from chiefly ancestors or from the gods; person with many taboos." Titcomb reports on an account written by S. K. Kamakau in 1845 while he served at the Lahainaluna seminary on Maui that describes how these fish received their distinct marks. In this account, *kapuhili* is the name of the person, or perhaps the deity, who marked each fish with their distinct colors. Kamakau notes:

> These islands of Hawaii were created by Kumuhonua (whose wife was Haloiho). He slept and when he awoke, the earth turned and this was called an earthquake.
>
> At that time the duty of each creature had not been apportioned, nor were names given to each…So all things were gathered together—animals, birds, crawling things, winged things that fly through the air, and man. The work of each was assigned…It was as Molea in Hamakua that all the fishes gathered, the big fish and the little fish. It was there that all the fishes were marked, and streaked ones, the red ones, the white ones, the yellow ones and all the kinds found in the ocean. **Kapuhili** was the overseer who marked them. The unmarked fish were spotted simply by having ashes sprinkled over them. Then the proper names were given to each variety of all the fishes in the ocean. (Titcomb 1972:48)

Kīkākapu

The name *kīkākapu* is used to describe "various species of butterfly fishes of the genera *Chaetodon* and *Cheilodactylus*" and may be further qualified by terms such as "*alo lua* and *koʻa*" (ibid.:148). Titcomb (1972) relates that *kīkākapu* were also considered sacred, and makes reference to a chant presented in the account of Kihaapiʻilani, a 16th century chief of Maui (Fornander 1880). The portion of the chant referencing the *kīkākapu* (name bolded for emphasis) reads thusly:

He kakau kiko onio i ka lae,	With striped marks on the forehead,
Ke kiko o ke ***ki-kakapu****,*	Marks of the **kikakapu**,
O ka ia kapu hilia au awahia.	The sacred fish with the bitter gall.
(Fornander 1916–1917:241)	(Fornander 1916–1917:240)

Kīkākapu are also noted in a name chant composed for Kauikeaouli (Kamehameha III) that is duly titled *Mele no Kauikeaouli*. The portion of the *mele* that references both the *kīkākapu* and *kapuhili* (names bolded for reference) is presented below:

Ke kakau kiokii onio i ka lae	The forehead was marked with variegated stripes,
He kikoi kapu,	Indicating high kapu;
O ke ***kikakapu*** *o ku ia* ***kapuhili***	The **kikakapu** was substituted for **kapuhili**,
Au wahiawahi ia lani.	The time that chief ended.
(Fornander 1919–1920:485)	(ibid.)

The use of *kīkākapu* to signify one's intent to challenge a group of people is described in an account titled, *Kaʻao no Kaipalaoa, ke Keiki Hoʻopapa* (Legend of Kaipalaoa, the Hoʻopapa Youngster) (Fornander 1916–1917). As a preamble to this story, Fornander writes that Kaipalaoa was from Waiākea in Hilo and that his father, Halepaki, was

killed by Kalaniali‘iloa, the *kapu* chief of that island who was also very skilled in *ho‘opāpā*—a traditional art of riddling and debate—after traveling to Kaua‘i. Kalaniali‘iloa was so accomplished at *ho‘opāpā* that the fence that surrounded his house was made entirely of the bones of those who he had defeated. To avenge his father's death, Kaipalaoa sought to master the art of *ho‘opāpā* and compete against Kalaniali‘iloa. To develop his skills, Kaipalaoa traveled first to the home of his aunt in Kohala, where she taught the young boy everything she knew about this art. Kaipalaoa continued to refine his skills, and eventually made his way to Kaua‘i where he landed his canoe in Hanalei. While at Hanalei, the boy came across two of the king's canoes that were filled with fish. The boy inquired of the king if he could have some fish, to which the king consented. The boy then grabbed two fish, an *oililepa* and a *kīkākapu*, and after an exchange of words with the king, Kaipalaoa continued on his way towards Wailua, where the *kapu* chief Kalaniali‘iloa lived. In writing about the portion of the story that describing the use of the *kīkākapu* (name bolded for emphasis), Fornander relates that:

> From this place he continued on to Anahola; thence on to Kealia and then on to Wailua where Kalanialiiloa resided, where was his bone fence, almost completed, built from human bones. When he arrived at the place he looked and saw the bones of Halepaki his father; they were still fresh, the bones not yet being bleached. At sight of this the boy bowed in sorrow and wept. After his weeping he approached the flagstaff and pushed it down and put up the oililepa, one of the fish brought along by him. He then next took the kapu stick and pushed it down and put up in its place the other fish, the **kikakapu**. By this action of the boy, it was meant as a challenge to the people that he saw come to meet them in a wrangling contest. When Kalanialiiloa and his instructor saw the action of the boy, they knew at once that he was challenging them to a contest of wits, so a messenger was dispatched to meet the boy showing the challenge was accepted. (Fornander 1916–1917:576)

Lauhau and Lauhau wiliwili

The term *lauhau* has been translated as "brightly colored butterfly fish (*Chaetodon quadrimaculatus* and *C. umimaculatus)*" and may also be "qualified by the terms *kapuhili*, *kīkākapu*, *maha uli*, *nuku ‘i‘iwi* or *nuku ‘iwi*, and *wiliwili*" (Elbert and Pukui 1986:195). The milletseed butterflyfish (*C. miliaris*) ranges in length from one to six inches and is pale yellow in color with a black band on the forehead and near the tail (Titcomb 1972). Black to blueish colored blotches also string downward on the body of the fish (ibid.). This variety of fish is known as *lau wiliwili* or *lauhau wiliwili*, meaning "*wiliwili* leaf," because its shape is believed to resemble the endemic *wiliwili* tree. The fourspot butterflyfish (*C. quadrimaculatus*) is termed *lauhau*. A characteristic of the *lauhau* is described in the *‘ōlelo no‘eau*, "*he lauhau, he i‘a hōkake kāheka*," which has been translated as "it is a lauhau, the fish that creates disturbances in sea pools" (Pukui 1983:80). Pukui (ibid.) goes on to elaborate on this saying, noting that it was in reference to "…a boisterous person." Manu et al. (2006) describe how *lauhau* were caught using the *kūkulu ‘upena* method, or a standing net, which was cast from the shore. They indicate that the types of fish commonly caught in the *kūkulu* nets were *‘ālo‘ilo‘i* (*Dascyllus albisella*), *hīnālea*, and *lauhau*.

With respect to its value as a food fish, Titcomb (1972:97) reports that there was some disagreement as some informants reported that this fish was "bony, not worth eating" while others contend "sweet flesh, broiled on charcoal immediately, without scaling or cleaning." Titcomb adds that the *lauhau* was used in the *ho‘omelumelu* style of preparation. Elbert and Pukui (1986:246) define *melu* as "…slightly decomposed, then salted and seasoned with kukui-nut relish, chili peppers, etc." This *ho‘omelumelu* preparation of fish was also applied to *hīnālea* (ibid.).

Cirrhitops fasciatus (*piliko ‘a*)

The redbarred hawkfish (*Cirrhitops fasciatus*) is also known as *piliko‘a* (lit. clinging to coral) (Titcomb 1972). It is marked with five grayish red to brick red bands of color, separated by white stripes that extend along the width of the body (Hoover 2007). White spots are also observed near the face, which diffuse down the length of the body (ibid.). Titcomb (1972:124) notes that *piliko‘a* were sometimes grouped with *‘o‘opu kai* (sea gobies), but that they were "not true *‘o‘opu*."

Ctenochaetus hawaiiensis (*kole*) and *Ctenochaetus strigosus* (*kole, kole makaonaona*)

The black surgeonfish (*Ctenochaetus hawaiiensis*), or Chevron tang is a species of the *kole* famly. *Kole* (meaning "raw" or "red") are also called *ukole* or *pākole*. They range in size from four to six inches and are reddish-black in color (Pukui and Elbert 1986:162; Titcomb 1972). The *kole makaonaona* (*Ctenochaetus strigosus*), characterized by its yellow-ringed eyes, are the more popular eating variety. The eyes of this variety were described as beautiful and the name *kole maka onaona*, bright-eyed *kole*, was often applied to them (Pukui and Elbert 1986). *Kole* are often found traveling in schools, sometimes associating with the *pāku‘iku‘i*, or Achilles Tang (*Acanthurus achilles*), and are

very abundant in Kona on Hawai‘i Island. This fish has very small scales, but is known to have tough, thick skin. This trait has been poetically described in the *‘ōlelo no‘eau,* “*he nanea no ka lawai‘a kole*,”, meaning “it is interesting to fish for *kole*” (Pukui 1983:91). Pukui (ibid.) further explains that the Eglish word “story” was Hawaiianized to “*kole*,” and that this proverbial saying uses *kole* as a metaphor for describing the excitement of getting together to share stories. This fish is also noted in the *mo‘olelo* of Hi‘iakaikapoliopele, during the description of Hi‘iaka’s journey from Kohala to Puna, when she was accompanied by Lohi‘au and Wahine‘ōma‘o, and the people they encountered fed them ocean delicacies that included the “sweet-eyed kole fish” (Ho‘oulumāhiehie 2006b:331).

Although the *kole* is known as being tough-skinned, it is considered a favorite fish to eat raw. *Kole* was also important for traditional practices and customs relating to the home, as it was believed to *hole*, or strip, the house of unwanted spiritual energy (Titcomb 1972). As documented by Titcomb, if a home that was under construction needed to be rid of “evil influences,” *kole* or *‘āholehole* (*Kuhlia xenura;* Hawaiian flagtail) were placed under the east-facing house post prior to it being set (ibid.:60).

In the March 8, 1923 issue of *Ka Nūpepa Ku‘oko‘a*, an article titled *Ka Ho‘opakele Ana I Nā I‘a*, offers insights into the traditional beliefs and practices related to catching *kole* and other similar fish. Presented below is a portion of this article concerning *kole* (bolded for emphasis), translated by Titcomb:

> Fish such as the Manini, the **kole**, the uhu, the kumu and the palani and the kala and many others went into sea pools to live until the tiny fish were grown. No kapus were imposed on them at the spawning season. The mullet, squid, aku, opelu and other fish bore their young in a place that was not sheltered…They were made kapu when the spawning season was near until the months for this duty were over. (Titcomb 1972:14).

Dascyllus abisella (*‘ālo‘ilo‘i*)

The common name for the *‘ālo‘ilo‘i* is the Hawaiian Dascyllus (*Dascyllus Abisella*). Titcomb (1972) describes the *‘ālo‘ilo‘i* as a “bright and sparkling” demoiselle fish that is brown in color with large white scales extending along the width of the body. Titcomb (1972:64) presents a brief narrative from Kepelino, a Native Hawaiian cultural historian, who described the colors of the *‘ālo‘ilo‘i* as being of “two colours, like mixed paint over the entire body, reddish-brown and black in equal degree.” The middle dorsal area of the body is lighter in color with whitish scales on the dorsal fin, while the rest of the fins are darker in color (ibid.). *‘Ālo‘ilo‘i* typically range from five to eight inches long and have a flat body (Malo 1951; Titcomb 1972). The young stages of the fish are called *‘a*, or *‘a‘a* and are also referred to as *‘a‘akimakau* (bait nibbling), which “is a term for a variety or perhaps an alternative name” (ibid:63). The *‘ālo‘ilo‘i* is referenced in the *‘ōlelo no‘eau*, “*he ‘ālo‘ilo‘i, ka i‘a waha iki o ke kai*,” literally translated as “an ‘ālo‘ilo‘i, a fish of the sea that has a small mouth” (Pukui 1983:63). Pukui (ibid.) relates that this was “said of one who always has little to say.” *‘Ālo‘ilo‘i* were considered “a tasty fish,” and were preferred “eaten raw or cooked on hot ashes” (Titcomb 1972:63–64). A method of collecting *‘ālo‘ilo‘i* for consumption was done by using the *kūkulu ‘upena*, or a standing net, which was cast from shore. The types of fish commonly caught in these nets were, *‘ālo‘ilo‘i*, *hīnālea* (wrasses), and *lauhau* (butterflyfish) (Manu et al. 2006).

Halichoeres ornatissimus (lā‘ō)

The Ornate Wrasse (Pinkface), referred to in Hawaiian as *lā‘ō*, is a small slender fish that ranges from five to six inches in length. Bright in color, *lā‘ō* are distinguished by their salmon hue and iridescent green stripes that extend across the face (Hoover 2007). The dorsal, anal, and tail fins are blueish with green spots and stripes. Juvenile *lā‘ō* are dark reddish brown with light green stripes and brown spots. The review of culture-historical literature conducted for this study did not reveal any specific cultural information related to this species.

Lutjanus kasmira

Introduced initially from the Marquesas to the Hawaiian Islands in 1958 for commercial fishing purposes, *Lutjanus kasmira*, more commonly known as *ta‘ape*, or bluestriped snapper, has not fared well in Hawai‘i’s fish consumer market. These fish, which tend to school in great numbers, are often regarded by local fishermen as pest. The name *ta‘ape* is a Tahitian name that is commonly used in Hawai‘i (Hoover 2007). *Ta‘ape* are easily identified by their predominately yellow body and four blue stripes that extend along the length of the body (ibid.). Given that it arrived in Hawaiian waters so recently, there are currently no known Hawaiian names for this fish nor any traditional cultural uses, other than it being eaten at times.

Melichthys niger (*humuhumu ʻele ʻele*) and *Sufflamen bursa* (*humuhumu lei, humuhumu umaumalei*)

The *humuhumu*, meaning "to sew, stitch," is a general name used to refer to many different varieties of trigger fish, including (but are not limited to) the *humuhumu ʻeleʻele*, or the Black Durgeon (*Melichthys niger*), and the *humuhumu lei or humuhumu umaumalei,* or the Lei Triggerfish (*Sufflamen bursa*) (Titcomb 1972:79). The *humuhumu ʻeleʻele*, is recognizable by its predominately black colored body with blue iridescent stripes on the head and white stripes at the base of its dorsal and anal fins (Hoover 2007). The *humuhumu lei*, on the other hand, is grayish-brown and white, but washed with a yellow color on its back (ibid.). The *humuhumu lei* is said "to have a bad odour" (Titcomb 1972:79).

In providing information on the preparation of *humuhumu*, Titcomb (1972) notes that the skin is tough and hard. She adds that when being prepared, the skin was removed and the flesh salted, and that it was sometimes eaten with *limu manauea*. The skin is described as having a rank odor which necessitated its removal prior to eating. Traditionally, the *humuhumu* was broiled in *ti* leaves, but it is now more typically fried (ibid.). In conveying sentiments about the tastiness of this fish, Titcomb (ibid.:81) states, "Kepelino (52) says the flesh is good, better than *manini*; another says it is too bony to be considered a good food fish. Japanese in Hawaii are fond of it, and it therefore brings a good price in the market." Additionally, if the *humuhumu* were caught in large numbers, then the remains, particularly the head, would be tossed into the fire to help keep the fire burning because of its oils.

Titcomb (1972) documents a gathering method for these fish that involved lowering a basket with cooked pumpkins or sweet potatoes as bait onto a school of fish. While the fish attacked the bait in a frenzy the basket would be hoisted up and the fish caught.

Naso lituratus (*umaumalei, kala umaumalei)* and *Acanthurus thompsoni* (*kala*)

A member of the surgeonfish family (*Acenthuridae*), the Orangespine Unicornfish (*Naso lituratus*), known in Hawaiʻi as *umaumalei*, is common in shallow waters where it feeds upon algae, sometimes in schools. In describing the most prominent features of this fish, Hoover (2007:148) writes that it has "bright orange lips, a graceful curve of yellow from eye to mouth (somewhat like a lei), and orange caudal spine identifies this attractive hornless unicorn fish." The orange markings tend to brighten in color when hunting. The colors are dull when these fish are in their juvenile stage, while large males are distinguished by thin tail streamers (ibid.). This species ranges in size from fourteen to eighteen inches long, but they have yellow tails when they are four to five inches long, and a spike near the caudal fin used as a defense mechanism (Titcomb 1972). A chant submitted by S. Z. Kalaaukumuole (1866) to the November 24, 1866 edition of *Ka Nūpepa Kūʻokoʻa* states, "*O ka Umaumalei ke lii*," which translates as "the *umaumalei* is chief." The *umaumalei* is also referenced in the Kumulipo (Beckwith 1951; Liliuokalani 1978), where it is paired with its land counterpart the *ʻūlei* (*Osteomeles anthyllidifolia*).While the *umaumalei* is a specific species within the family *Acenthuridae*, some traditional accounts classify them under the name *kala* or *kala umaumalei* (Ka Nupepa Kuokoa 1867; Titcomb 1972). *Kala,* although distinguished more by their protruding horn, also have a caudal spine. One such *ʻōlelo noʻeau* describing this unique trait states, "*mālama i ke kala ka iʻa hiʻu ʻoi*," translated as "watch out for the *kala*, the fish with a sharp tail," which is said as "a warning to beware of a person who is well equipped to defend himself" (Pukui 1983:230).

Kala in all of its forms was a popular Hawaiian delicacy, containing white meat and usually eaten broiled over coals and rarely eaten raw. The soft parts of the fish are described as good *palu* (fish bait). This fish is sometimes dried with the tough skin stripped whole, the flesh then cut off in strips and dried, or the meat cut away from the spine and dried with the skin. If the skin is left on, the flesh is cut down to the skin, after the bones are removed, so that the salt will absorb well into the flesh. According to Titcomb (1972), an informant described this fish as best when broiled or baked, after it was about three-quarters dried, and not too stiff or hard. *Kala* is very abundant and easy to catch which is why it is eaten often (ibid.).

The skin of the *kala* is tough and has no scales which made it ideal for the covering on the *pūniu*, a small drum that was lashed onto the thigh of a *hula* dancer. The skin also produces a pungent odor, but its strong smell varied depending on the region it was from, which is a result of their diet. A traditional custom to rid the pungent smell, was done in the same manner as for the *palani*, which was to lay the fish across both hands with the head on the left palm and the tail on the right palm, then breathe in over the fish, while turning the head from left to right, and then breathe out violently. This process was repeated on the other side of the fish (Titcomb 1972).

During the spawning seasons, certain fish were prohibited from being caught and consumed, which included *kala* (ibid.). In the March 8, 1923 issue of *Ka Nūpepa Kuʻokoʻa*, an article titled "*Ka Hoʻopakele Ana I Nā Iʻa*," offered

insight into the traditional beliefs and sustainable practices of *kala* and other similar fish. Presented is a portion of this article concerning *kala*, translated by Titcomb:

> Fish such as the Manini, the kole, the uhu, the kumu and the palani and the **kala** and many others went into sea pools to live until the tiny fish were grown. No kapus were imposed on them at the spawning season. The mullet, squid, aku, opelu and other fish bore their young in a place that was not sheltered…They were made kapu when the spawning season was near until the months for this duty were over. (Titcomb 1972:14).

Manu et al. (2006) described the *'ie kala* (lit. *kala* basket) as the largest type of *hīna'i* (basket fish trap). These baskets were round and flat, and about four to five feet long and two and a half to three feet deep with a one and a half foot opening. Near the large end of the opening, a small wicker cylinder or cone is attached and turned inwards towards the bottom of the basket with the free end of the cone small enough for the *kala* to fit through. Use of the *'ie kala* is described as follows:

> Immediately below the end of this cone, on the bottom of this basket, is placed the bait, properly secured, which in the case of the **kala** is limu kala (a course brownish-yellow algae on which this fish feeds and from which it takes its name), ripe breadfruit, cooked pumpkins, half-roasted sweet potatoes, and papayas. This basket is called 'ie lawe (taking basket). The fishermen generally feed the fish at a given place for a week or more before taking any, using large feeding baskets, similar to the 'ie lawe, but without the inverted cylinder and wider at the mouth to allow the fish free entry and exit. After a week or two of feeding, the fish become very fat and fine-flavored, and also very tame, so that baskets full of fish can be drawn up in the 'ie lawe without in the least disturbing the fish which are still greedily feeding in the feeding baskets. The 'ie kala are occasionally used to catch other kinds of fish, substituting bait known to attract particular kinds, but the technique is never as successful as with **kala**. (Manu el al. 2006:96)

Additional methods for catching *kala* included the use of a *holoholo*, a net tied to a twelve-foot-long piece of *alahe'e* (*Canthium odoratum*) wood. The net was lowered down in an area with swift-ebbing tides with one person holding the net and the other corralling fish into it (Manu et al. 2006). *Hina'i pai kala*, was a method of using a plaited basket as a net. The basket was filled with *limu kala* (seaweed), *kalo* (taro) and pumpkin and then let down for the fish to feed. This process was continued until the fish became plump and accustomed to feeding in the basket, then a "catching net" was lowered down to collect *kala*.

Ostracion meleagris (*pahu*, *moa*)

The Spotted Boxfish (*Ostracion Meleagris*) or trunkfish, is a commonly known as *pahu*, meaning "box," a name likely applied because of puffy triangular shaped body (Pukui and Elbert 1986:300). This fish is also known as *moa*, which is noted as a Proto Polynesian word (ibid.). The *pahu*, identifiable by its brownish colored body with white spots, can grow up to nine inches long and prefers living in quiet waters along the shoreline (Hoover 2007). If it is disturbed it emits a poison from the skin. Traditionally, these fish were *kapu* (forbidden) to women. (Kent 1986). Titcomb (1972) adds that there was little flesh on this fish and that they were not eaten.

Paracirrhites forsetri (*hilu*, *hilu piliko 'a*)

The blackside hawkfish (*Paracirrhites forsetri)* is known by many names, including *hilu, 'ele'ele, lauwili, melemele, moelola, pano, pāni'o, piliko'a, 'ula* and *uli,* but is most commonly referred to as *hilu* (Pukui and Elbert 1986). The *hilu* is a brightly colored fish with prominent white and black stripes running horizontally across its body and a speckled face (Hoover 2007). It ranges in size from twelve to eighteen inches long (Titcomb 1972). Juvenile *hilu* are often tricolored, with bands of yellow, black, and white (Hoover 2007). Malo (1951) describes *hilu* as having eminences, or *kino 'oe'oe* (sharp protuberances). Titcomb (1972:75) relates that "they are found in crevices of the reef, under large projecting *limu*-covered rocks, or asleep in the sandy bottom, completely hidden." This species prefers to keep out of sight but they are sometimes seen associating with other species of the wrasse family such as the *'a'awa* (ibid.). Considered an "excellent eating" fish, *hilu* was traditionally either eaten raw, dried or salted and baked or broiled (Malo 1951:46). It is said that an expectant mother that craved *hilu*, "a small bright fish that feeds busily about coral heads, foretold a quiet, industrious child" (Handy and Pukui 1998:77). Titcomb (1972:75) adds that, "all Hawaiian informants remark upon the "quiet, ladylike" demeanour of the *hilu*. A child that is quiet from childhood, is called a *hilu*, a pregnant woman who eats *hilu* will have a quiet, dignified child." Likewise, Pukui related several *'ōlelo no'eau* that liken the demeanor of the *hilu* to that of a quiet child:

> *He hilu na ke aliʻi.*
>
> A *hilu* belonging to a chief
>
> When a pregnant woman longed for a *hilu* fsh, the child born to her would be a very quiet, well-behaved person. Because chiefs liked reserved, well-mannered people, such persons were often found in the royal courts and were referred to as the chief's *hilu* fish. (Pukui 1983:67)
>
> *Hilu ka iʻa, he iʻa noʻenoʻe.*
>
> The fish is the *hilu*, an attractive one.
>
> A quiet, well-behaved person. When a pregnant woman longed for *hilu* fish, the child born to her would be well-mannered, quiet, and unobtrusive. (ibid.:108)

Another *ʻōlelo noʻeau* that mentions *hilu* is given in references to a story known as "*Ka hilu pani wai o Hauʻula*," literally translated as "The water-damming *hilu* fish of Hauʻula." (Pukui 1983:143). The version of the story related by Titcomb (1972) is taken from an article titled, "*Ka Huakaʻi Pokole i Koʻolauloa*" (The short trip to Koʻolauloa), which appeared in the September 25, 1896 issue of the Hawaiian language newspaper, *Ka Nūpepa Kūʻokoʻa*. The story relates that the *hilu* was a *kinolau* (physical embodiment) of two supernatural brothers, Kaululena and Maʻiʻo, and an event that resulted in fish acquiring its distinct stripes. Kaululena and Maʻiʻo were able to assume various forms but they traveled frequently in their *hilu* form. Kaululena had the ability to become either a *hilu*, *manō* (shark) or *kanaka* (human) while Maʻiʻo could transform into a *hilu* or *kanaka*. The two brothers traveled to Oʻahu as *hilu* and as they neared Kawaihoa, Oʻahu they separated. Maʻiʻo headed towards the Koʻolau (windward) region and Kaululena, towards the Kona (leeward) region. While traveling through the Koʻolau region, Maʻiʻo came upon an area named Hauʻula where a fisherman and the chief of Hauʻula, Makaliʻi, caught a glimpse of Maʻiʻo swimming along the shore. Enthralled by his size, the men quickly cast their nets and ensnared him. As they pulled Maʻiʻo on shore the people of the village watched in amazement, excited to reap their share of the days catch. The fisherman and the Hauʻula chief quickly collected their catch and cut Maʻiʻo into pieces to divide him amongst the people. While they relentlessly worked to divvy the cut pieces, the blood of Maʻiʻo spilled slowly into the ocean. It spread so far that the sky reflected its redness.

Meanwhile, Kaululena reached Kaʻena when he saw the red sky. He immediately knew his brother had been killed. Woeful for his brother's unfortunate fate, Kaululena took his human form and walked to Hauʻula to confirm his brother's death. As Kaululena arrived at Hauʻula, he came upon a house that was broiling a piece of *hilu* and very discreetly, picked it up and threw it back into the sea. He continued to do this at every home that he encountered until he came upon the house of an elderly man. There Kaululena witnessed the elder performing a ceremony for him and his brother before drinking his *ʻawa*. When the elderly man finished his prayer, Kaululena was certain this man was their *kahu,* or mortal guardian. Kaululena then approached the man and asked him if he knew of Kaululena and Maʻiʻo to whom he prayed, to which the man replied that he had never seen Kaululena and Maʻiʻo, but that he was raised by his parents and grandparents to place a *kapu* (sacred oath) on himself pertaining to the matter of eating *hilu*. He continued to explain that he performed the ceremony because when the chief, Makaliʻi and his fishermen caught a large fish he did not accept the bounties of the catch, for *hilu* was sacred and forbidden to him. After explaining his customs, Kaululena revealed himself to the man and provided him with strict orders. He advised him to place *lepa* (sacred flags) around his home and when he was done he was to gather his family and keep them safe within those boundaries. Kaululena counseled the man to ensure his survival, for the land and its people who ate the flesh of the *hilu* would be severely punished by a great flood. Kaululena left these instructions with the man and continued on his quest to find the remaining pieces of his brother's body.

After locating all the remains of Maʻiʻo, Kaululena then traveled upland to Kipapaʻu stream, where he prayed for the rains to pour down onto the homes of those who had his brother's remains. The heavens responded to Kaululena's prayer and the water continued to rise in a hollow area surrounded by the hills. He then transformed into his *hilu* form and as the rain and water hit his body, he grew bigger and bigger until he created a barrier that prevented the water from flowing out. When the water finally filled up to the top of the basin, Kaululena quickly leaped out of the way of the gushing water and sought shelter in a cave within one of the surrounding hills. The waters raged down the stream bed and destroyed everyone and everything in its path except where the *lepa* were placed. Following the advice of Kaululena, the elderly man and his family were spared. It is said that Maʻiʻo regained his life and did so in the form of a striped *hilu* fish. The stripes, a dominant trait seen on the majority of *hilu* today, symbolize the parts of Maʻiʻo's body that were seared by fire or sliced for salting (Titcomb 1972).

Pseudanthias hawaiiensis

The brightly colored Hawaiian longfin Anthias is distinguished by its hues of pink, yellow, and orange. Males are characterized by their yellow heads and reddish-orange bodies, lavender-hued tails, and long wispy pectoral fins. Females are mostly yellow on the head and back with a pinkish body (Hoover 2007). Although endemic to the islands, the review of culture-historical literature conducted for this study did not identify any Hawaiian name or traditional cultural uses.

Zebrasoma flavescens (*lā ʻī pala*, *lauʻīpala*)

The fish commonly known as yellow tang (*Zebrasoma flavescens*) is known in Hawaiian as *lauʻīpala* or *lāʻī pala*. It is an inshore fish that grows up to approximately seven inches. A bright-colored yellow, the *lāʻī pala* has no scales with a combination of rough and soft skin. This fish although small was a delicacy and was preferred to be broiled. The skin was edible when cooked but was removed if eaten raw. This reef fish is known to school and are be beautiful in numbers (Titcomb 1972). They are common in most coastal regions, particularly in Kealakekua Bay (ibid.). In *The Epic Tale of Hiʻiakaikapoliopele*, Hiʻiaka spoke of a healing ritual that includes the consumption of the *lauʻīpala* (bolded for emphasis):

> Listen to me, this grandchild of ours will be troubled no more. When we depart, you fetch the blossoms of the maʻo in abundance, then mash them soft, make a ball of it, and affix it to the soft spot on the head of our grandchild. Before high noon, he will awaken, and will be healed. And if he hungers for food, then feed him warm potato, along with ***lauʻipala***, the fish called the yellow tang. That fish will make for abundance of food, like the bounty of Makaʻukiu. This grandchild of ours is no longer ill. (Hoʻoulumāhiehie 2006b:131–132)

It is evident from the information presented above that a large majority of these species were utilized throughout the Precontact and Historic era as they are mentioned in traditional legendary narratives and a variety of historical accounts. Collectively, these narratives provide at the very least, a baseline understanding of the ways in which these fish have been utilized in Hawaiian culture.

THE ARRIVAL OF WESTERNERS AND THE TRANSFORMATION OF MARINE RESOURCE MANAGEMENT PRACTICES IN HAWAIʻI

By the mid-18th century, the young and determined Kamehameha had directed his efforts towards consolidating Hawaiʻi Island under his rule. To accomplish this feat, Kamehameha continued to train under his more experienced kin, namely Kalaniʻōpuʻu, who held the title of *aliʻi nui* of Hawaiʻi Island (ʻĪʻī 1959). During Kalaniʻōpuʻu's reign, the first foreign vessels captained by the British explorer, James Cook arrived in Hawaiian waters. Cook first landed at Waimea, Kauaʻi in 1778 and on January 17, 1779, he anchored in Kaʻawaloa Bay, Kona within the study area (Kamakau 1992). Aboard these foreign ships were innovative technologies and diseases unknown to the original inhabitants of the Hawaiian Islands. Items such as metal, nails, guns, canons, and the large foreign vessels themselves, stirred the interest of the Kānaka Maoli. Acquisition of these technological advancements came through barter. This ultimately resulted in the *aliʻi* gaining possession of foreign items that ultimately set traditional Hawaiian warfare in new trajectory, one forged by Kamehameha himself. By the late 18th century, wars were occurring regularly between intra-island and inter-island polities, and by 1810, Kamehameha had unified all of the Hawaiian Islands under his rule. Following this unification, Kamakahonu in Kailua, Kona became his seat of government until his death in 1819 (Kamakau 1992).

The year 1778 marks the end of what is often referred to as Hawaiʻi's Precontact Period and the beginning of the Historic Period. While 1778 signifies an important date in Hawaiian history, it is vital to note that throughout the Early Historic Period, even with Western influences, the Hawaiian chiefs still held outright rule over the land and its resources, and that they maintained strict adherence to the *kapu* system—the very system from which their power was derived. At the outset of the Historic Period, there was a continued trend toward craft and status specialization, intensification of agriculture, *aliʻi* controlled aquaculture, the establishment of upland residential sites, and the enhancement of traditional oral history. The veneration of traditional gods and the strict observation of the *kapu* system were also at their peaks (Kent 1983; Kirch 1985).

The abrogation of the *kapu* system in 1819, under the rule of Kamehameha's son, ʻIolani Liholiho (Kamehameha II) also marks significant date of socio-religious change in the Hawaiian Islands. Some researchers have argued that the abolishment of the *kapu* system undermined the very foundation upon which traditional Hawaiian society was built, thereby altering the relationship between the chiefs and the people, as well as their relationship to the land (Else

2004; Kameʻeleihiwa 1992). Such cultural changes were further endorsed by early Missionaries who arrived in March of 1820 off the coast of Kawaihae, and anchored in Kailua Bay a month later. These early missionaries introduced monotheistic Christian beliefs, established Hawaiian orthography, and generally promoted a Euro-American lifestyle and political system of governance. During this same time period, the first commercial fishing ventures were underway in the islands as British and American whaling fleets began to arrive in Hawaiian waters. These early whalers established Hawaiʻi as the provisioning and trading headquarters (Schug 2001). The whaling industry lasted for several decades, and by the 1850s had reached its peak, with some five hundred whaling vessels operating out of the various island ports. Many Kānaka Maoli men, who were skillful on the ocean, had become employed in this industry.

With the influx of foreigners, many of whom were quick to introduce the idea of trade for profit and later fee simple ownership of land, Hawaiʻi's traditional culture, and the sociopolitical economy began to shift to meet the growing demands of the foreign populations. As early as 1832, fish markets had become formally established, which were supplied with various marine products caught by Kānaka Maoli (Schug 2001). As Schug (ibid.:17) explains, "commercial fishing provided Hawaiians an early opportunity to participate in the new island economy with a relatively small capital outlay and without abandoning their own customs and skills." In describing their adaption to newly introduced Western materials, Schug (2001:17) writes:

> As new goods and materials became available, Hawaiian fishermen modified their fishing accoutrements. Steel hooks, for example, replaced those carved from pearl-shell, and wooden spears were tipped with iron. But the Hawaiian retained many of the long-established fishing techniques that were so well adapted to Hawaiʻi's marine environment. Also retained were various ancient rituals to ensure safety at sea and a bountiful catch. Fishermen continued to pray to the traditional deities for success and appease them with offerings of fish.

In 1839, under the administration of Kamehameha III (Kauikeaouli) a set of laws were drafted that were known as *Ke Kumukānāwai, a me Nā Kānāwai O Ko Hawaiʻi Pae ʻĀina* (The Constitution and Laws of the Hawaiian Islands). These laws proclaimed the rights of the people, and ensured equitable protection for the people and chiefs (Achiu 2002). By October 8th, 1840, Kamehameha III and Kekāuluohi, the *Kuhina Nui* (Premier), had enacted the 1840 constitution that "…organized the parts and the functions of government at that time," and included the creation of the *ʻAhaʻōlelo* (House of Representatives) as part of the legislative body, thereby allowing the voice of the people to be heard in governmental matters (ibid.:35).

Fishing Rights Codified in the Hawaiian Kingdom Government Constitutional Laws of 1839 and 1840

Traditionally, Hawaiian land stewardship practices and philosophies were centered around the natural resources that extended from the mountain tops to the deep ocean, which were held in "trust" by the *mōʻī* (King) and his *aliʻi* (Maly and Maly 2003). Under the ancient system, land use rights included access to fisheries and natural resources that were within the lands, which were then given to the *hoaʻāina* (native tenants). Kamehameha III officially defined the ancient fishing rights and practices of the people in the Constitution and Laws of 1839 and reconfirmed them in 1840 (ibid:26). With respect to the fisheries, these laws permitted Kamehameha III to distribute the fishing grounds and resources between the *aliʻi* and the people of the land. Maly and Maly (2003:243), further emphasizes that "fisheries on coral reefs fronting various lands were for the landlords (*konohiki*) and the people who lived on their given lands (*ahupuaʻa*) under the *konohiki*." The laws were established to identify traditional fishing values and practices, while acknowledging the influences of western property rights. Maly and Maly (ibid.) have compiled the Hawaiian laws enacted between the years of 1833-1842 from archival records located at the Hawaiʻi State Archives. Extracted from Maly and Maly (ibid.:244-246), those laws pertaining to fishing rights are detailed below:

> **No na Kai noa, a me na Kai kapu.**
>
> **(Of free and prohibited fishing grounds) (1839-1841)**
> **I. —Of free fishing grounds. (No ka noa ana o ke kai)**
> His majesty the King hereby takes the fishing grounds from those who now possess them, from Hawaii to Kauai, and gives one portion of them to the common people, another portion to the landlords, and a portion he reserves to himself. These are the fishing grounds which his Majesty the King takes and gives to the people; the fishing grounds without the coral reef. viz. the Kilohee grounds, the Luhee ground, the Malolo ground, together with the ocean beyond.
>
> But the fishing grounds from the coral reefs to the sea beach are for the landlords, and for the tenants of their several lands, but not for others. But if that species of fish which the landlord selects as his own personal portion, should go onto the grounds which are given to the common people, then that

species of fish and that only is taboo. If the squid, then the squid only; or if some other species of fish, that only and [1842:36] not the squid. And thus it shall be in all places all over the islands; if the squid, that only; and if in some other place it be another fish, then that only and not the squid.

If any of the people take the fish which the landlord taboos for himself, this is the penalty, for two years he shall not fish at all on any fishing ground. And the several landlords shall give immediate notice respecting said fisherman, that the landlords may protect their fishing grounds, lest he go and take fish on other grounds.

If there be a variety of fish on the ground where the landlord taboos his particular fish, then the tenants of his own land may take them, but not the tenants of other lands, lest they take also the fish tabooed by the landlord. The people shall give to the landlord one third of the fish thus taken. Furthermore, there shall no duty whatever be laid on the fish taken by the people on grounds given to them, nor shall any canoe be taxed or taboo'd.

If a landlord having fishing grounds lay any duty on the fish taken by the people on their own fishing grounds, the penalty shall be as follows: for one full year his own fish shall be taboo'd for the tenants of his own particular land, and notice shall be given of the same, so that a landlord who lays a duty on the fish of the people may be known.

If any of the landlords lay a protective taboo on their fish, when the proper fishing season arrives all the people may take fish, and when the fish are collected, they shall be divided—one third to the fishermen, and two thirds to the landlord. If there is a canoe full, one third part shall belong to the fishermen, and two [1842:37] thirds to the landlord. If the landlord seize all the fish and leave none for the fishermen, the punishment is the same as that of the landlords who lay a duty on the fish of the people.

If, however, there is any plantation having fishing grounds belonging to it, but no reef, the sea being deep, it shall be proper for the landlord to lay a taboo on one species of fish for himself, but one species only. If the parrot fish, then the parrot fish only; but if some other fish, then that only and not the parrot fish. These are the enactments respecting the free fishing grounds, and respecting the taking of fish.

2.—Respecting the taboo'd fishing grounds. (No na kai kapu)

Those fishing grounds which are known by the people to have shoals of fish remaining upon them, shall at the proper season for fishing be placed under the protective taboo of *the tax officers, for the King*. The fishing grounds on Oahu thus protected, are 1, Kalia; 2, Keehi; 3, Kapapa; 4, Malaeakuli; 5, Pahihi. On Molokai, as follows: I, Punalau; 2, Ooia; 3, Kawai; 4, Koholanui; 5, Kaonini; 6, Aikoolua; 7, Waiokama; 8, Heleiki. On Lanai the Bonito and the Parrot fish. On Maui, the Kuleku of Honuaula and other places.

On Hawaii, the Albicore.

On Kauai, the Mullet of Huleia, Anehola [Anahola], Kahili and Hanalei, and the squid and fresh water fish of Mana, the permanent shoal fish of Niihau, and all the transient shoal fish from Hawaii to Niihau, if in sufficient quantity to fill two or more canoes, but not so small a quantity as to fill one canoe only. But if the fishermen go and borrow a large canoe, that all the fish may be put into one, then there shall be a duty upon them. [1842:38]

On the above conditions there shall be a government duty on all the transient shoal fish of the islands. The tax officer shall lay a protective taboo on these fish for his Majesty the King, and when the proper time for taking the fish arrives, then the fish shall be divided in the same manner as those which are under the protective taboo of the landlords.

If the tax officer seize all the fish of the fisherman, and leave none for those who take them, then he shall pay a fine of ten dollars, and shall have nothing more to say respecting the royal taxes. But if the order for seizing all the fish of the fishermen was from the Governor, then he shall no longer be Governor, though he may hold his own lands, and the tax officer shall not be turned out of office. At the proper time the tax officer may lay a protective taboo on all the King's fish, and the landlords' all around the island. But it is not proper that the officer should lay the taboo for a long time. The

> best course is for the officer to give previous notice to the fishermen, and then the common people and the landlords to fish on the same day. Thus the rights of all will be protected.
>
> But no restrictions whatever shall by any means be laid on the sea without the reef even to the deepest ocean. Though the particular fish which the general tax officer prohibits, and those of the landlords which swim into those seas, are taboo. The fine of those who take prohibited fish is specified above. [1842:39]

Maly and Maly (2003) also report that on May 31st, 1841, several changes were made and signed into the law on fisheries by the King and *ali'i*. One such section revised the punishment of a fisherman to state, "for two years he shall not fish at all on any fishing ground" and "if he take one fish criminally he shall pay five, and always at that rate. And if a canoe full be taken then five canoes full shall [1842:85] be paid, according to the amount taken, even to the farthest extent [1842:86]" (ibid.:245-246). In 1846, Article V of the "Statute Laws of His Majesty Kamehameha III" was published. These laws identified the responsibilities and rights of the *konohiki* and the people pertaining to various types of fishing grounds and resources. As can be seen below, the laws also acknowledged the practice of *kapu,* or restrictions, with respect to fishing customs and specific fisheries:

> **ARTICLE V.—OF THE PUBLIC AND PRIVATE RIGHTS OF PISCARY (1846)**
>
> SECTION I. The entire marine space, without and seaward of the reefs, upon the coasts of the several islands, comprising the several fishing grounds commonly known as the *Kilohee grounds*—the *Luhee grounds*—the *Malolo ground*, and the fishery of the ocean, from said reefs to the limit of the marine jurisdiction in the first article of this chapter defined, shall be free to the people of these islands. The people shall not be molested in the enjoyment thereof except as hereinafter provided.
>
> SECTION II. The fishing grounds from the reefs, and where there happen to be no reefs from the distance of one geographical mile seaward to the beach at low water mark, shall in law be considered the private property of the landlords whose lands, by ancient regulation, belong to the same; in the possession of which private fisheries, the said landholders shall not be molested except to the extent of the reservations and prohibitions hereinafter set forth.
>
> SECTION III. The landholders shall be considered in law to hold said private fisheries for the equal use of themselves and the [1846:90] tenants on their respective lands; and the tenants shall be at liberty to use the fisheries of their landlords, subject to the restrictions in this article imposed.
>
> SECTION IV. The landlords shall have power, each year, to set apart for themselves one given species or variety of fish natural to their respective fisheries, giving public notice by *viva voce* proclamation to their tenants and others residing on their lands, and signifying to the minister of the interior, in writing, through his agents in their districts, the kind and description of fish which they have chosen to set apart for themselves. The landlords shall respectively pay for such notification, the fees prescribed by the third part of this act; and it shall be the duty of the minister of the interior yearly to furnish the director of the government press with a list of said landlords, the districts and island of their residence, and the kind of fish specially set apart by each, in the form of a catalogue; which catalogue the said director shall cause to be once inserted in Hawaiian and English languages, in the Polynesian newspaper, for public information, at the expense of said minister to be included by him, according to a fixed rate, in the fees to be received at his department from the respective landlords.
>
> SECTION V. The specific fish so set apart shall be exclusively for use of the landlords, if caught within the bounds of his fishery, and neither his tenants nor others shall be at liberty to appropriate such reserved fish to their private use; but when caught, such reserved fish shall be the property of the landlord, for which he shall be at liberty to sue and recover the value from any fisherman appropriating the same; and more over, if he take one fish criminally he shall pay five, and in the proportion shall he pay to the full amount of what he may have taken wrongfully. Whoever may have taken fish in violation of this law, without paying as about, shall be fined fifty dollars for each offence.
>
> SECTION VI. The landlords shall not have power to lay any tax or impose any other restriction upon their tenants regarding the private fisheries that is in the preceding section prescribed, neither shall such further restrictions be valid. [1846:91]

SECTION VII. It shall be competent to the landlords, on consultation with the tenants of their lands, in lieu of setting apart some peculiar fish to their exclusive use, as hereinbefore allowed, to prohibit during certain indicated months of the year, all fishing of every description upon their fisheries; and, during the fishing season to exact of each fisherman among their tenants, one thirds part of all the fish taken upon their private fishing grounds. In every such case it shall be incumbent on the landlords to comply in like manner with the requirements of the fourth section of this article.

SECTION VIII. The royal fish shall appertain to the Hawaiian government, and shall be the following, viz:

1st. The bonito when off any part of the coast of Lanai.

2nd. The albicore of Hawaii.

3rd. The mullet of Huleia, Anehola [Anahola], and Hanalei; the squid and freshwater fish of Mana on Kauai.

4th. The shoal fish taken at the following places, noted for the abundance of fish frequenting them; off Oahu: 1, Kalia; 2, Keehi; 3, Kapapa; 4, Malaeakuli, and 5, Pahihi.

5th. Off Molokai: 1, Punalau; 2, Ooia; 3, Kawai; 4, Koholanui; 5, Kaonini; 6, Aikoolua; 7, Waiokama, and 8, Heleiki.

6th. And off Maui; the *kuleku* of Honuaula; and the same whenever found off said island.

7th. All the following transient fish, viz:—1, the *kule*; 2, the *anaeholo*; 3, the *alalauwa*; 4, the *uhukai*; 5, the *kawelea*; 6, the *kawakawa*; 7, the *kalaku*.

These shall be divided equally between the king and fishermen. But on all the prohibited fishing grounds the landlords shall be entitled to one species of fish, and those who have walled fish ponds shall be allowed to scoop up small fish to replenish their ponds. If the prohibited fish of the landlord be mingled with the royal fish, then the landlord shall be entitled to one third of the whole of the fish taken, though this applies only to Molokai, Oahu and the rivers of Kauai.

All which shall be yearly protected by the king's taboo, to be imposed by the minister of the interior, by means of circular from his department, as prescribed in the act to organize the executive ministry; and during the specified season of taboo they shall not be subject to be taken by the people. [1846:92]

SECTION IX. At the expiration of the taboo seasons, all persons inhabiting these islands shall be at liberty to take the protected fish, accounting to the fishery agents of the respective districts off which the same shall have been caught, for the half or portion, so taken; and the minister of the interior shall make known through his agents by *viva voce* proclamation, the respective months or seasons of the year during which the said royal fisheries may be used and the said protected fish taken.

SECTION X. The minister of the interior shall appoint suitable and proper fishing agents in the several coast districts of the respective islands, to superintend the fisheries aforesaid, to whom he shall from time to time give directions through the respective governors, in regard to the sale or other disposition of the share of fish accruing to the government.

SECTION XI. It shall be the duty of the agents appointed, to exact and receive of all fishermen, for the use of the royal exchequer, during the legalized fishing seasons the one half part, or portion of all protected fish taken without the reefs, whether at the respective places in the eighth section of this article indicated, or in the channels and enclosed seas dividing these islands, or upon the high seas within the marine jurisdiction of this country. And if any officer or agent of this government shall exact more fish of the people than is in and by this section expressly allowed, he shall on conviction, forfeit his office, and be liable to pecuniary fine, in the discretion of the court, before which he shall have been convicted.

SECTION XII. It shall be competent for His Majesty, by an order in council, from time to time, to set apart any given portion, or any definite kind of the said protected fish, or any proportional part of the avails therefrom arising, for the use of the royal palace, to be delivered or paid over to the chamberlain of his household, created by the third part of this act.

> SECTION XIII. It shall be incumbent on the minister of the interior to provide, by instructions to the respective governors, for the sale and disposal of all fish received by the said fishing agents, and to pay the avails thereof to the minister of finance. [1846:93]
>
> SECTION XIV. If any person shall, in violation of this article, take out of season the fish protected by the king's taboo, or if any person shall, within the free fishing seasons, take any of the protected fish, without delivering to the agent appointed for that purpose the proportion accruing to the royal exchequer, he shall, on conviction, forfeit all fish found in his possession, and shall, in addition, pay fivefold for all fish thus taken, or he may be put in confinement, at the discretion of the court condemning him. [1846:94; HSA collection KFH 25 .A24 1825/46] (Maly and Maly 2003:246-248)

THE LEGACY OF THE *MĀHELE ʻĀINA* OF 1848

By the mid-19th century, the ever-growing population of Westerners in the Hawaiian Islands forced socioeconomic and demographic changes that promoted the establishment of a Euro-American style of land ownership. By 1840 the first Hawaiian constitution had been drafted and the Hawaiian Kingdom shifted from an absolute monarchy into a constitutional government. Convinced that the feudal system of land tenure previously practiced was not compatible with a constitutional government, the King (Kamehameha III/Kauikeaouli) and his high-ranking chiefs decided to separate and define the ownership of all lands in the Kingdom (King n.d.). This period of land tenure transformation is known as the *Māhele ʻĀina*. The change in land tenure was further promoted by missionaries and Western businessmen in the islands who were generally hesitant to enter business deals on leasehold lands that could be taken from them at any time. After much consideration, it was decided that three classes of people each had one-third vested rights to the lands of Hawaiʻi: the King, the chiefs and *konohiki*, and their tenants (the *makaʻāinana* or common people) (Chinen 1958). Prior to the 1848 *Māhele ʻĀina*, in 1845 the legislature created the Board of Commissioners to Quiet Land Titles (more commonly known as the Land Commission), first to adopt guiding principles and procedures for dividing the lands and granting land titles, and then to act as a court of record to investigate and ultimately award or reject all claims of private individuals brought before them (Cannelora 1974). All land claims, whether by chiefs for entire *ahupuaʻa* or by tenants for their house lots and gardens, had to be filed with the Land Commission within two years of the effective date of the Act (February 14, 1846) to be considered. All of the land claimants were required to provide proof of land use and occupation, which took the form of volumes of native registry and testimony. The work of hearing, adjudicating, and surveying the claims required more time than was prescribed by the two-year term, and the deadline was extended several times, not for new claims, but for the Land Commission to finish its work (Alexander 1920). This deadline was also extended several times for chiefs and *konohiki*, but not for commoners (Soehren 2004)

The *Mōʻī* (King) and some 245 *aliʻi* (Kuykendall 1938) spent nearly two years trying unsuccessfully to divide all the lands of Hawaiʻi amongst themselves before the whole matter was referred to the Privy Council on December 18, 1847 (King n.d.). Once the *Mōʻī* and his *aliʻi* accepted the principles of the Privy Council, the *Māhele ʻĀina* was completed in just forty days (on March 7, 1848), and the names of all of the *ahupuaʻa* and *ʻili kūpono* (nearly independent *ʻili* land division within an *ahupuaʻa*) of the Hawaiian Islands and the *aliʻi* who claimed them, were recorded in the *Buke Māhele* (1848) (also known as the *Māhele* Book) (Soehren 2005b). As this process unfolded the *Mōʻī*, Kamehameha III, who received roughly one-third of the lands of Hawaiʻi, realized the importance of setting aside public lands that could be sold to raise money for the government and also purchased by his subjects to live on. Accordingly, the day after the division when the name the last chief was recorded in the *Buke Māhele*, the *Mōʻī,* Kamehameha III commuted about two-thirds of the lands awarded to him to the Hawaiian Kingdom Government (King n.d.). Unlike the *Mōʻī*, the *aliʻi* and *konohiki* were required to present their claims to the Land Commission to receive their land awards (known as Land Commission Awards or LCAw). The chiefs who participated in the *Māhele* were also required to provide to the government commutations of a portion of their lands in order to receive a Royal Patent giving them title to their remaining lands. The lands surrendered to the government by the *Mōʻī* and *aliʻi* became known as "Government Land," while the lands retained by Kamehameha III became known as "Crown Land," and the lands received by the chiefs became known as "Konohiki Land" (Chinen 1958:vii, 1961:13). To expedite the work of the Land Commission, all lands awarded during the *Māhele* were identified by name only, with the understanding that the ancient boundaries would prevail until the land could be formally surveyed.

During the *Māhele*, native tenants residing on the lands that were divided up among the Crown, *Konohiki*, and Government could claim, and acquire title to, *kuleana* parcels that they actively lived on or farmed. The Board of Commissioners oversaw the program and administered the *kuleana* as Land Commission Awards (LCAw.). Claims for *kuleana* had to be submitted during a two-year period that expired on February 14, 1848 to be considered. All of the land claimants were required to provide proof of land use and occupation, which took the form of volumes of native registry and testimony. The claims and awards were numbered, and the LCAw. numbers, in conjunction with

the volumes of documentation, remain in use today to identify the original owners and their use of the *kuleana* lands. The work of hearing, adjudicating, and surveying the claims required more than the two-year term, and the deadline was extended several times for the Land Commission to finish its work. In the meantime, as the new owners of the lands on which the *kuleana* were located began selling parcels to foreigners, questions arose concerning the rights of the native tenants and their ability to access and collect the resources necessary for sustaining life. The "Enabling" or "*Kuleana* Act," passed by the King and Privy Council on December 21, 1849, clarified the native tenants' rights to the land and resources, and the process by which they could apply for fee-simple interest in their *kuleana*.

Early in this process, questions concerning the rights of the *konohiki* and their imposing of restrictions upon the *hoaʻāina* in the matters of fisheries arose. Maly and Maly (2003:250) relate that "a number of communications clarifying the Laws cited above, were published." Among the communications was an Interior Department document (detailed below), which sought to resolve the issue:

> FISHING RIGHTS, RESTRICTIONS AND LIBERATION
> Interior Department Document Number 148
>
> That, to whomsoever it may concern, the catching with hands of fishes and shrimps, etc., from the specified seas call, "Fishing grounds", for human consumption only are hereby liberated.
>
> That, is the King or the *Konohiki* are lack in having the catch of a certain fish and wish to prohibit some of these fishes (unspecified fish: but freely given to citizens), it is well in doing so.
>
> That, the *Konohiki* is hereby ordered to take only one fish; and that the main coral fishing grounds, or other coral fishing grounds are under the jurisdiction of the government. That, the *Konohiki* is hereby allowed to take only one fish from these coral fishing grounds; and that he is not to take two or three; not that much.
>
> If the overseer or the *Konohiki* who is in charge of a fishing right knows that he is out of fish, and wishes to have some by sending his brother out to fish, it is at his discretion in doing so; but, not to accuse him after the fish is caught. (Maly and Maly 2003:250–251)

As a result of the *Māhele ʻĀina,* all lands (specifically *ahupuaʻa* and *ʻili kūpono*) within Hawaiʻi were placed into one of three categories: Crown lands, Government lands, and *Aliʻi-Konohiki* lands. With respect to those lands within the current study area, Kamehameha III retained for himself (Crown lands) eight lands, three of which are within Kohala District (Kawaihae Komohana, Puʻukapu, and Waimea), and the remaining five are within the Kona District (Haleʻōhiu, Honomalino, Onouli 2, Puaʻa 2, and Puʻu Waʻawaʻa). A total of 185 lands eventually became a part of the Government land holdings with 105 of those located in the Kona District, 69 lands in the Kohala District, and the remaining 11 situated in the Kaʻū District. A total of 111 lands were claimed by the *aliʻi-konohiki*, with 71 located in the Kona District, 37 in the Kohala District, and the remaining 3 in the Kaʻū District. In all, some 302 lands located within the study area were claimed during the *Māhele ʻĀina* of 1848 (Soehren 2004, 2005b, 2005a).

Fisheries and Fishing Rights Recorded During the *Māhele ʻĀina*

The plethora of documents that were generated as a result of the *Māhele ʻĀina* contain vital information pertaining not only to land use and practices, but fisheries and fishing rights that extended out to sea as well. In gathering information on fishery rights, Maly and Maly (2003) summarized the claims made by the *aliʻi-konohiki*, and *hoaʻāina*. While they compiled the fishery rights information for all of the major Hawaiian Islands, only those specific to the current study area are presented below. Given that many of the *aliʻi-konohiki* land claims encompassed lands on multiple islands, it is difficult to ascertain those claims specific to the current study area. Many of these claims make broad references to fisheries and do not give specific details regarding fishery types. Nonetheless, the information presented below provides an overview of claims made by the *aliʻi-konohiki*, and demonstrates the abundance and importance applied by Kānaka Maoli to maintaining traditional fishing rights following the *Māhele ʻĀina* of 1848. With respect to the *aliʻi-konohiki* claims, Maly and Maly (2003:253-254) write:

Helu [LCAw.]	**Claimant; Location; and Resource Claimed**
4452	H. Kalama (wife of Kamehameha III). Fourteen lands and fisheries on Hawaii, Maui, and Oahu.
5368	Akahi (w.) Land and fisheries of: Kealia, Makalawena and Keei iki, Kona, Hawaii; and Puuepa and Ulupaalua, Kohala, Hawaii; and Kaaipu, Waikiki, Oahu.

5525	L. Konia (w). Ten lands and fisheries at: Keei, Kona, Hawaii; Lumahai, Kauai; Napili, Honokeana, Alaeloa, and Mailepai, Kaanapali, Maui; and Kalauao, Oahu.
7712	M. Kekuanaoa. Six lands and fisheries on Hawaii, Kauai, and Oahu.
7713	Victoria Kamamalu. Fifty-three lands and fisheries on Hawaii, Kauai, Lanai, Maui, Molokai, and Oahu.
7714 B	Moses Kekuaiwa. Twelve lands and fisheries on Hawaii, Kauai, Lanai, Maui, and Oahu.
7715	Lot Kapuaiwa Kamehameha. Sixteen lands and fisheries on Hawaii, Maui, and Oahu.
7716	R. Keelikolani (w.). Twelve lands and fisheries on Hawaii, Kauai, Maui and Oahu.
8452	A. Keohokalole (w.). Thirty-seven lands and fisheries on Hawaii, Maui, and Oahu.
8515	Keoni Ana. Lands and fisheries of: Kawaihae, Kohala, Hawaii; Kukuau, Hilo, Hawaii; and Halehaku, Maui.
8516 B	Kamaikui (w.). Lands and fisheries at: Waiaka 1st, Kohala Hawaii; Kalama, Kona, Hawaii; Kahului, Kona, Hawaii; Halawa, Ewa, Oahu.
8518 B	James Young Kanehoa. Lands and fisheries at: Ouli, Kohala, Hawaii; Ulaino, Maui; and Lawai, Kauai.
8519 B	Fanny Young (w.) Kiiokalani, Kohala; and Pahoehoe, Kona, Hawaii; Maunalei, Lanai; and Haleu, Lahaina, Maui.
8520	Iosua Kaeo. Five lands and fisheries on Hawai‘i; Kealia, Lanai; Maui, and Oahu.
8520 B	Gini Lahilahi (w.) Lands and fisheries at: Waiaka 2nd and Waika, Kohala, Hawaii; Pahoehoe, Hawai‘i; Waikahekahe, Hawaii; and Puunoa, Lahaina, Maui.
8521 B	G. Davis Hueu. Lands and fisheries of: Kukuau 2, Hilo, Hawaii; and Kiilae, Kona, Hawaii.
8522 B	Kale Davis (w.). Lands and fisheries at: Honokahua, Maui; Kapaa, Kohala, Hawaii; and Waikahekahe, Puna, Hawaii.
8559	C. Kanaina. Thirteen lands and fisheries on Hawaii, Maui and Oahu.
8559 B	Wm. Lunalilo. Sixty-three lands and fisheries on Hawaii, Kauai, Maui, Molokai, and Oahu.
9971	Wm. P. Leleiohoku. Thirty-five lands and fisheries on Hawaii, Lanai, Maui, Molokai and Oahu.
10474	N. Namauu for M. Kekuanaoa. Twelve lands and fisheries on Hawaii, Maui, and Oahu.
10613	A. Paki. Six lands and fisheries on Hawaii, Kauai, Maui, and Oahu.
10806	Iona Piikoi for Kauikeaouli, Kamehameha III; and unnumbered lands described in Buke Mahele (1848). At least 159 Crown Lands covering Hawaii, Maui, Molokai, Oahu, and Kauai, with fisheries rights on all island.
11215	Kealiiahonui. Three lands and fisheries on Hawaii, Kauai, and Oahu.
11216	M. Kekauonohi (w). Fifty-seven lands and fisheries on Hawaii, Kauai, Lanai, Maui, Molokai, and Oahu

In summarizing the land claims made by the *hoa'āina* (native tenants), Maly and Maly (2003) clarify that there were some seventy-six claims that made explicit reference to fishery-related activities for the entirety of Hawai'i Island, of which twenty-three are specific to the current study area. Unlike the claims made by the *ali'i-konohiki*, which are far more vague (described in the previous section), the claims made by the *hoa'āina* provide a little more detail on the the fisheries within the current study area during the mid-19th century. These claims include references to fishponds, anchialine ponds, salt production areas, *umu 'ōhua* (stone mound fry fisheries), anchialine shrimp ponds, as well as general references to coastal fisheries. Several land claims make explicit reference to the fish that were reserved for the *konohiki* of specific lands. While the claims presented below do not reflect all possible fishery-related activities that were occurring during the mid-19th century, they do provide a glimpse into nature and location in which such activities occurred. Those fishing rights claimed by the native tenants along the coast of Hawaii Island during the *Māhele 'Āina* of 1848 have been extracted from Maly and Maly (2003:254-256) and are presented below:

Helu [LCAw.]	**Claimant; Location; and Resource Claimed**
817	Heirs of George Beckley at Kealahewa, Kohala, Hawaii. A farm and fishing grounds, given by Kamehameha I about 1811.
3480	Kauwe at Kauhako, Kapalilua, Kona, Hawaii. A *kupono* ocean fishery, like a pond.
4012	Thomas Hopu (Hooper) at Kailua, Kona, Hawaii. "Seashore *kihapai*, it is a salt pond, 17 fathoms by 27 fathoms."
4099	Keawekuloa at Puako, Waimea, Hawaii. Five *kaheka loko* (anchialine fishponds).
4140	Kamanawa at Kaloko, Kona, Hawaii. A lot bounded on side by Kaloko pond.
4452	Hazaleleponi Kalama at Kalahuipuaa and Anaehoomalu, *ili* of Waimea, Kohala, Hawaii. Lands including approximately twelve fish ponds.
5317	Kaawa at Lanihau, Hawaii. A lot in the *ili* of Kaluaolike, bounded on Kau side by pond of Alanaio.
5759	Kapule at Pahoehoe, North Kona. *Kala* is the fish to be taken by *konohiki.*
5759	Kapule at Pahoehoe, North Kona, Hawaii. "…Here is a second thought, about the fish of the *konohiki*, it is the *kala* in the fishery; and the *ulu* is the tree on the land..."
5778	Kaai at Pakini, Kau. A protected fish.
5874	Keohokalole at Kaawaloa, Kona, Hawaii. Fisheries and ponds at Hanapahoehoe, Awili, Kalaemamo, and Haliilua.
5874	Keohokalole at Kealakekua, Kona, Hawaii. Fish pond of Wailokoalii.
6230	J. A. Kuakini at Puuanahulu, Hawaii. Fifteen salt ponds and three fish ponds.
6235	Kapaakea at Kaapuna, Kona, Hawaii. Some protected fish.
7277	Kaieie at Keei, Hawaii. One pond at Kalaeohia.
7702	Kooka at Kealia, Kona, Hawaii. An *umu ohua* (stone mound fry fishery).
8773 B	Haumea at Kahuku, Kau, Hawaii. The protected fish of the Konohiki is the *opelu*, the tree is the *mamaki*.
9251	Kaea at Lanihau, Kona, Hawaii. Seven *wai opae* (anchialine shrimp ponds) at shore.

10000	Lukehiwa at Honomalino, Hawaii. "…An *ahupuaa*, received from Unualoha, from the sea to the upland *koa* forest. The *opelu* is its fish which is taken, and the *koko* is its wood which is taken…"
10264	Mahi at Hoopuloa, Hawaii. The ocean fishery of Kipehu.
10340	Namalo at Kamaoa, Kau, Hawaii. "…A fishing right is at the sea in Kawela, Puueo and Waiopua…"
10527	Namaielua at Kapua, Hawaii. A fish pond in the *ili* of Kailiohia.
10913	Uahine at Kamaoa, Kau, Hawaii. A salt land; and fishing rights in Kawela, Waiopua and Mohoae.

PROCEEDINGS OF THE BOUNDARY COMMISSION: *AHUPUA'A* BOUNDARIES AND FISHING RIGHTS ALONG THE WESTERN COAST OF HAWAI'I ISLAND

Although the entwined relationship of terrestrial and oceanic resources within the *ahupua'a* system were traditionally recognized by Kānaka Maoli, who considered the sea an extension of land, differing perceptions and realities of the ocean as it pertained to the *ahupua'a* unit began to arise during the mid-nineteenth century. With the establishment of the Commission of Boundaries (Boundary Commission) in the Kingdom of Hawai'i in 1862, boundaries of all *ahupua'a* that were awarded as part of the *Māhele 'Āina* were legally set. The boundaries of the lands were subsequently certified by the Commissioners of Boundaries in 1874. The primary informants for the boundary descriptions were old native residents of the lands, many of whom had also been claimants for *kuleana* during the *Māhele*. This information was collected primarily between 1873 and 1885 and was usually given in Hawaiian and transcribed into English as it occurred. Hearings for most *ahupua'a* boundaries were brought before the Boundary Commission and later surveyed by Government employed surveyors, many of whom were accompanied and guided by *Kānaka* who related the boundaries as passed down to them through their *kupuna*. Conversely, in some instances, *ahupua'a* boundaries were established through a combination of other methods such as conducting surveys on adjacent *ahupua'a*. Or in cases where the entire *ahupua'a* was divided and awarded as Land Claim Awards (LCAw.), and or Government issued Land Grants (both which required formal surveys), the Boundary Commission relied on those surveys to establish the boundaries for that *ahupua'a*.

Surveying land boundaries was a tough and methodical task, centered primarily around the accurate location, recordation, and triangulation of prominent geographic and cultural features, however it "was not merely a matter of measuring angles and lines, it involved listening to people about their use of land and making judgements that would affect the quality of their lives" (Moffat and Fitzpatrick 1995:60). Therefore, in order to accurately ascertain the boundaries of the *ahupua'a*, it was crucial to combine scientific concepts and procedures with generational knowledge held by the Kānaka Maoli. Some of the Kānaka Maoli who accompanied foreign surveyors even took up the practice of surveying themselves. Although these surveys aided in establishing the *ahupua'a* boundaries, the maps produced present only a basic outline of the land divisions, and they lack the cultural knowledge of the landscape presented during the Boundary Commission hearings. Generally, there was great emphasis placed on the identification of terrestrial features along, and adjacent to, *ahupua'a* boundaries that demarcated them from the next. However, many *ahupua'a* boundaries traditionally extended offshore into the *kai*. The tightly woven interconnection between *mauka* and *makai* resources, spanning from the uplands to the sea, was largely overlooked by the surveyors who sought primarily to record the boundaries of *ahupua'a* based upon physical features of the land. These differing perceptions of *ahupua'a* boundaries and resource procurement areas, whether marine or terrestrial-based, are evident in the Boundary Commission testimonies, most notably in those provided by land surveyors, rather than *kama'āina* informants, where intangible oceanic boundaries are disregarded.

While rare, testimonies presented by surveyors in lieu of *kama'āina* informants (e.g. 'Upolu Ahupua'a in North Kohala) were markedly fixated on discerning boundaries based on earthly attributes, and were non-inclusive of information pertaining to intangible *ahupua'a* boundaries that extended past the shoreline and into the sea. Alternatively, Boundary Commission testimonies provided by natives were infused with meticulous recollections of not only tangible earthly features, but also those which were imperceptible except to those who had intimate knowledge of the land, sea, and customary practices that occurred in these places. Native testimonies often preserve crucial culture-historical information related whether or not *ahupua'a* boundaries extended out to the sea, the distance to which they extended, and the fishing rights of the people therein.

The analysis of 107 *ahupuaʻa*—extending from Kahei in North Kohala to Kamāʻoa in Kaʻū—that were surveyed and testified about as part of the Boundary Commission process, reveals that seventy-four of these land divisions had boundaries extending out into sea, sixty-seven of which claimed fishing rights to those waters. The disparity between the amount of surveyed *ahupuaʻa* and those that claimed fishing rights (roughly 63%) is not necessarily an accurate representation of the general scope of traditional *ahupuaʻa* boundaries or access to fishing rights along the western coast of Hawaiʻi Island, nor is it indicative of patterns island-wide. In some cases (thirty-one total *ahupuaʻa*, roughly 29%), the extent of an *ahupuaʻa* boundary into the sea was simply not specified or discussed. It is also imperative to note that Boundary Commission testimony was not presented for every *ahupuaʻa* that claimed traditional fishing rights, and that ambiguity regarding the details of the rights of an *ahupuaʻa* often arose from the fact that the boundaries could not be clarified, either because of a total lack of testimony or because of the omission of crucial detail within existing testimonies. The Boundary Commission information for the study area *ahupuaʻa* within North Kohala, South Kohala, North Kona, South Kona, and Kaʻū presented below provides a glimpse into how the traditional *ahupuaʻa* system operated with respect to intangible seaward boundaries and access to the fishing access rights therein.

North Kohala District

Twenty *ahupuaʻa* in North Kohala stretching southward from Kahei to Waikā, the southernmost limit of the district, were surveyed for their boundaries (Table 4 and Figure 25). Of these, fourteen had boundaries that extended out to sea, and eleven were identified as having ancient fishing rights. The particulars of the extent of the fishing grounds of five of the *ahupuaʻa* (Kaiholena 1st and 2nd, Kamano, Puaʻa 1st, and Puʻuepa 1st) were elaborated upon by those who provided Boundary Commission testimony, and testimony provided for two additional *ahupuaʻa* (Kiʻiokalani and Kehena 2nd) related that fishing rights and resources were reserved for the *konohiki* or that the *konohiki* had right to collect monetary taxes for the aquatic resources obtained.

The testimonies given for *ahupuaʻa* in North Kohala with more detailed explanations of fishing rights varied in extent. In one case, fishing privileges were only permitted to as far as the bottom of the ocean that could be seen, or to indeterminable depths that were not elaborated upon, while other *ahupuaʻa* retained a broader expanse from which to gather resources, extending from near shore out into deep water. For some *ahupuaʻa* the boundaries were delineated by traditional fishing grounds, like in the case of Puaʻa 1st whose fishing rights terminated at the place where squid could be caught. In another case, the fishing rights were limited to roughly 5/8 of a mile offshore in the deep sea. Excerpts of Boundary Commission testimonies for the *ahupuaʻa* of North Kohala that discuss ancient fishing rights and boundaries are presented below (underlining and italicization added for emphasis and clarity).

Kaiholena 1st and 2nd

Kama, sworn: . . . My parents now dead, were *kamaaina* of Kohala, and pointed out the boundaries of the lands to me. The sea bounds these two lands on the *makai* side. <u>These lands had ancient fishing rights extending out to the deep sea</u>. The land Makeanehu 1st bounds Kaiholena 2nd on the south side. The lands Kaiholena 1st and 2nd lay side and side from the shore to the end of both lands. The boundary between Kaiholena 2nd and Makeanehu 1st at the sea shore is a long rocky point, narrow near the main land and growing wider a little way from the shore called Honoaumi. . . (Volume A No. 1:80)

Hauli, sworn: . . . The sea bounds Kaiholena 1st and 2nd on the *makai* side. <u>The fisheries belonging to these lands used to extend out to sea as far as from here to Kama's house (about 5/8 of a mile).</u> A point at the sea shore on south side of land is the boundary between Kaiholena 2d and Makeanehu 1. There is a *pali* called Nohonaumi just *mauka* of this point. . . (Volume A No. 1:81)

Kamano

Palua, sworn: . . . Thence *makai* to Puopahoaakahi, a resting place. From thence to Kaaka, a place where the natives tied their ropes when they were fishing. <u>Bounded *makai* by the sea. Ancient fishing rights extending out as far as you can see bottom.</u> (Volume B:143)

Kehena 2nd

Kikalaeka, sworn: . . . Hauli, now present in Court, showed me the *makai* boundaries of Kehena 2nd. I went with Wiltse several years ago when he was surveying on the sea shore. I do not know the boundaries. Do not know whether Kehena 2nd had any fishing rights or not. . . [Volume A No. 1:75]

Hauli, sworn: . . .A water spring named Maue on the north side of Keawanui is the boundary at the shore between Kehena 1st and Kehena 2d. The sea bounds Kehena 2d on the *makai* side. <u>I have</u>

always heard that Kehena 2d had ancient fishing rights extending out a good way into the sea. Nakapauluhua, father of Pohakuuli, was *Konohiki* of Kehena, and always charged people for fishing on the sea belonging to Kehena and collected the pay. . . (Volume A No. 1:75)

Ki'iokalani

Kekuaaea, sworn. . . thence to Ahuliilii, a resting place. The compass was put here to sight to Puulepo; thence *makai* to Pukoae, a resting place; thence to Malae, a point at the shore; Bounded *makai* by the sea. Ancient fishing rights extending out to sea. . . (Volume B:276)

Pohakuauli, sworn. . . Bounded *makai* by the sea, where we went fishing; we had to give fish to the Konohiki. . . (Volume B:277)

Kukuipahu

Ku, sworn. . . From the shore to Kepioholowai is as far as I know the boundaries. Ancient fishing rights extending out to sea. . . (Volume B:135)

Kaneihalau, sworn. . . I have heard that Kaauhuhu and Kukuipahu join. Bounded on the *makai* side by the sea. Ancient fishing rights extending out to sea. This is all I know of the boundaries of Kukuipahu. . . (Volume B:137)

Māhukona 2nd

Palua, sworn: . . Poupou is the point at shore between Mahukona 1st and Mahukona 2nd. Bounded *makai* by the sea. Ancient fishing rights extending out to sea. Kaheana's *kuleana* joins Mahukona 1st at the sea shore. (Volume B:141)

Pua'a 1st

Kauua, sworn. . . I was born at Puaa, North Kona Hawaii, at the time of Keoua, and have always lived there, and am acquainted with the boundaries of the land. . . Puaa is bounded *makai* by the sea and the land has ancient fishing rights near the shore but not extending out to sea. . . Puaa has ancient fishing rights extending to the squid grounds. (Volume A No 1:376)

Puanui

Kanaha, sworn: . . . Bounded *makai* by the sea. Ancient fishing rights extending out to sea. . . (Volume B:130)

Paahao, sworn: . . . Bounded *makai* by the sea. Ancient fishing rights extending out to sea. . . (Volume B:130)

Pu'uepa 1st

Pahiha, sworn: . . . Hukiaa 3d bounds Puuepa 1st on the east side; Kukuipahu *mauka* and Puuepa 2d on the north side and *makai* by the sea. Puuepa 1st always had a fishing right, extending out into deep water. A long rock in the sea called Pohakuloa is the boundary at shore between Puuepa 1st, Hukiaa 3d there is a large rock on shore marked P & H; thence the boundary runs up *iwi aina* (a ridge of small stones which the natives formed in clearing their potato and *kalo* patches) to stones set in the ground and marked P. . . (Volume A No. 1:163-164)

Waikā

Puhi, sworn: . . . A rocky point, named Oneloa, is the boundary of Waika where Kawaihae joins it. I do not know about fishing rights. . . (Volume A No. 1:171)

Kaohia, sworn: . . . The sea is the *makai* boundary, and the land had an ancient fishing right extending out to sea. Oneloa is the boundary between Kawaihae and Waika; thence up a small *awaawa* to a point *makai* of Maaukaa. . . (Volume A No. 1:172)

Table 4. Oceanic boundaries and fishing rights in the North Kohala District.

Ahupuaʻa	*Boundary Testimony*	*Boundary Extends to Sea*	*Fishing Rights*	*Notes*
Awalua	No	-	-	-
Hāʻena	No	-	-	-
Honoipu	No	-	-	-
Kāhei, Hualua	No	-	-	-
Kahuā Liʻiliʻi (1st)	Yes	Not specified	Not specified	-
Kahuā Nui (2nd)	Yes	Not specified	Not specified	-
Kaiholena 1st and 2nd	Yes	Yes	Yes	Roughly 5/8 of a mile into the deep sea
Kaihoʻonā	No	-	-	-
Kaipuhaʻa, Lamaloloa	No	-	-	-
Kalala 1st and 2nd, Kokiʻo	No	-	-	-
Kamano	Yes	Yes	Yes	As far as can see bottom
Kapaʻa	No	-	-	-
Kapaʻa Iki	No	-	-	-
Kapaʻa Nui	Yes	Yes	Not specified	No testimony given
Kapunapuna	No	-	-	-
Kaupalaoa	No	-	-	-
Kealahewa 1st	Yes	Not specified	Not specified	-
Kealahewa 3rd	Yes	Yes	Not specified	-
Kehena, Kipi	No	-	-	-
Kehena 2nd	Yes	Yes	Yes	Extended out to undetermined depth, *Konohiki* collected money from those who fished there
Kiʻiokalani	Yes	Yes	Yes	*Konohiki* fishing rights
Kokoiki	No	-	-	-
Kou	No	-	-	-
Kukuipahu	Yes	Yes	Yes	-
Māhukona 1st	Yes	Not specified	Not specified	No testimony given
Māhukona 2nd	Yes	Yes	Yes	-
Makeanehu	No	-	-	-
Makiloa, Pahinahina	No	-	-	-
Opihipau, Hukiaʻa	No	-	-	-
Pōhakulua, Ahulua	No	-	-	-
Puaʻa 1st	Yes	Yes	Yes	Near shore fishing only extending to squid grounds
Puaiki	No	-	-	-
Puakea	No	-	-	-
Puanui	Yes	Yes	Yes	-
Puʻuepa 1st	Yes	Yes	Yes	To deep water
Puʻuepa 2nd	Yes	Yes	Not specified	-
Puʻukole, Koea, Lapakahi	No	-	-	-
ʻUpolu 1st and 2nd	Yes	Not specified	Not specified	Testimony given by surveyors only
Waikā	Yes	Yes	Yes	-

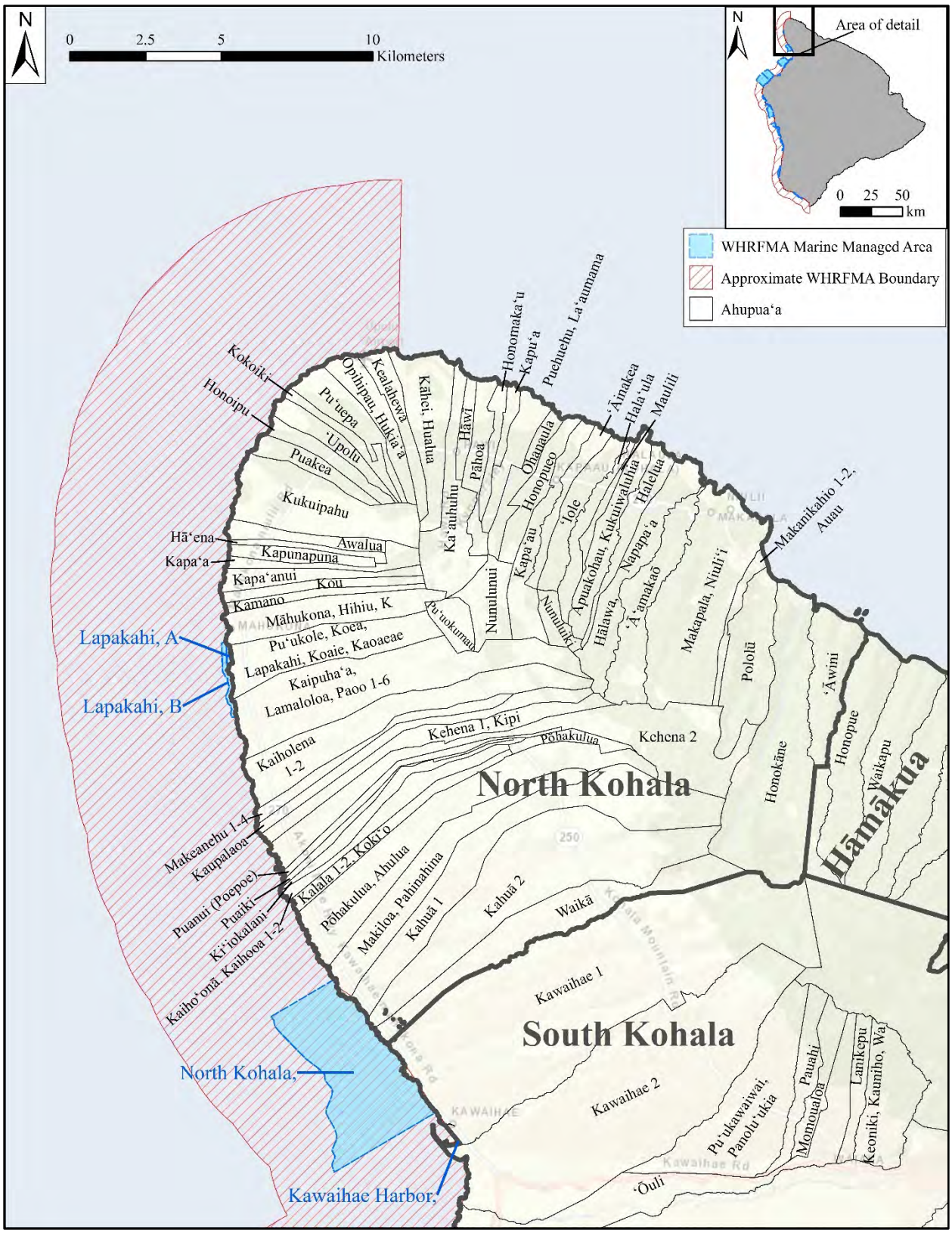

Figure 25. *Ahupua'a* of the North Kohala District.

South Kohala District

Ten *ahupua'a* of south Kohala were surveyed for their boundaries, seven of which had boundaries that extended out to sea and claimed ancient fishing rights (Table 5 and Figure 26). Of these, details are presented for only two of the *ahupua'a* (Kawaihae Akau [1st] and Hikina [2nd]). Fishing grounds for Kawaihae Akau extended from Pōki'i'āhua to Kawaihae Hikina, and the grounds for Kawaihae Hikina extended from the shore to the Kona side of Kauhuhu and Pokiiahua, although the testimony reveals that part of the catch from Kawaihae Hikina was to be given to John Young and the *konohiki* for Kawaihae Akau. Both *ahupua'a* also had rights to *poho pa'akai* (salt collection areas), particularly Kawaihae Akau, which according to the testimony had the rights to the majority of the salt. While fishing rights were also claimed by Lālāmilo, the testimony for that *ahupua'a* does not elaborate on specifics. Information presented for Puakō, however, relates that Lālāmilo had rights over Puakō's waters. The excerpts of Boundary Commission testimonies for the *ahupua'a* of South Kohala that discussed ancient fishing rights and boundaries are presented below (underlining and italicization added for emphasis and clarity).

'Anaeho'omalu

George Kaukuna, sworn: . . . Know the land of Anaehoomalu in South Kohala. Puanahulu, a land in North Kona bounds it on the Southwest side; this land used to bound it on the *mauka* side also, but I am told that Waikoloa now bounds it from the South corner, bounded on the North side by Kalahuipuaa; <u>and by the sea on the *makai* side. The land has ancient fishing rights extending out to sea.</u> . . (Volume A No. 1:386)

Naauhau, sworn: . . . Waikoloa is said to bound Anaehoomalu *mauka to* Kepani; just before you can see the trees at the shore, on Kalahuipuaa, coming towards Kawaihae. There turn *makai* along Kalahuipuaa to lliilinehe at Pohakuloa, on the sea shore. <u>Ancient fishing rights extending out to sea</u>. . . (Volume A No. 1:387)

Kalāhuipua'a

George Kaukuna, sworn: . . . a place called Milokukahi; a grove of Milo trees, where the boundary turns *makai,* along Waimea to seashore. Between the seashore and Milokukahi there is a place on the boundary called Keahaaha on *aa.* Pohakupuka, a rock in the sea, is the boundary at shore. <u>Ancient fishing rights extending out to sea</u>. . . (Volume A No. 1:384)

Naauhau, sworn: . . . thence to Pohakupuka, a large rock in the sea with holes through it. <u>Ancient fishing rights extending out to sea.</u> . . (Volume A No. 1:385)

Kawaihae Akau (1st)

Kalua, sworn: . . . The boundary runs down Keawewai gulch to Keanakawaha; thence down the gulch to Pohakuloa and thence follows the gulch to the sea. <u>Kawaihae 1st is bounded *makai* by the sea. Ancient fishing rights extending out to sea</u>. . . . (Volume B:148)

Kawaihae Hikina (2nd)

Kahiahikela, sworn: . . . <u>Kawaihae is bounded *makai* by the sea, and has ancient fishing rights extending out to sea</u>; bounded on the Kona side by the *Ahupuaa* of Waimea. In Kamehameha I time, I heard from my parents that he gave the land adjoining Kawaihae at the sea shore to Ouli; thereby making that land extend to the sea, before that time, Ouli stopped at Puuiki. Davis and John Young were great favorites of Kamehameha I and he gave them the land, thereby making Ouli (*ili* of Waimea) bound Kawaihae at the sea shore... [Volume B:74]

Kaneahiku, sworn: . . . I have been away from here 40 or 50 years, and have forgotten the boundaries. John Young was alive when I moved away. The beach and sea on the Kona side of Kauhuhu belonged to Kawaihae Hikina [Kawaihae 2]. <u>When we came from the other Kawaihae on to this place to fish, we had to give part of our fish to Olohana [John Young]</u>. . . (Volume B:390)

Kamoehau, sworn: . . . The sea from Pokiiahua to Kauhuhu belonged to Kawaihae Akau [Kawaihae 1], and the sea on the Kona side of Pokiiahua to Kawaihae Hikina. Mahi lived on the tract of land between Pokiiahua and Kauhuhu, but was *Konohiki* under Kalaimoku, and not under Olohana. He used to divide the fish and give part to Olohana. Olohana and Kalaimoku were *noho like* [lived under same privileges], so they used to give him part of the fish. . .

Part of the *poho paakai* [salt pans] belong to Kawaihae Hikina, but most of them belong to Kawaihae 1st. The boundary between the two lands is where I stated before. The folks living *mauka* on Kawaihae 2d used to go after salt at the shore to the salt works near Kauhuhu. The *poho paakai* Pohakuloa, Kaholei, Piipepii, Nupaa belong to Kawaihae Hikina, the other *poho paakai to* Kawaihae 1st. They are *lele* of Kawaihae Hikina. Kaneloa is on Kawaihae Hikina, and I know of *poho paakai* called Kaneloa. Know of place of Kawaihae Hikina called Makela, but do not know of salt piece of that name.

Malahuehue is an *ili* of Kawaihae Hikina, and I know of salt place at shore by that name, and it belongs to Kawaihae Hikina. Kukui is an *ili aina* of Kawaihae Hikina; I do not know of any salt place of that name. Kapahukapu is an *ili* of Kawaihae Hikina, I do not know of any *poho paakai* of that name. The places I have mentioned are *ili aina* of Kawaihae Hikina, and the *poho paakai* of the same names belong to it also. . . (Volume B:391-392)

J.P. Parker, Jr., sworn: . . . I know the lands of Kawaihae 1st and Kawaihae 2d, and have heard where the boundary is between them from Hueu, Kini Keoke and Kauwe. They told me that the fishing rights belong to the King's Kawaihae and that the gulch between my house at the shore and John Young's old house was the boundary. The gulch is on the Kona side of my house. . . (Volume B:392)

S.P. Wahinenui, sworn: . . . When we used to catch fish Olohana's man used to take part, and the *Konohiki* of Kawaihae 1st a part. I do not know why. I have always heard from Hueu (George Davis) that the fishing rights belonged to Kawaihae 1st. I have heard that the places for making salt belonged to both lands. The *poho paakai* have the same names as the *ili aina* to which they belong on both Kawaihae. The *makaha* of the fish pond is called Kukui and belonged to Kawaihae 2nd. I never heard any dispute about the *poho paakai,* but the dispute was about the land on the Kona side of them to Pokiahua gulch. (Volume B:393)

Lālāmilo

Kauuewahine, sworn. . . C. Kanaina only claims the beach and fishing rights. Lalamilo had ancient fishing rights, extending out to sea. . .

'Ōuli

Pupuka, sworn: . . . I was born on Ouli, and was quite large at the building of Kiholo [ca. 1812], but do not know the date of my birth. I have lived on Ouli and adjoining lands. I know all the boundaries of said land, used to *mahiai* on the *makai* portion of it. Ouli is bounded *makai* by the sea, and has ancient fishing rights; it is bounded on the Kona side by Waimea.

The boundary at seashore is at Kaihumoku, a point of stones in the sea, or the middle of the sand beach; thence direct to Ahuahaloo, the boundary following an old trail to this place. . . (Volume B:64)

Kalua, sworn. . . I was born in Waimea, South Kohala Hawaii at the time of the plague (1804), and have lived in Waimea and Kapia, a land near Ouli. I am a *kamaaina* and know the boundaries of Ouli. Kauhinek a konohiki (now dead) showed them to me. The sea bounds it *makai* and the land has ancient fishing rights. . . (Volume 1:120)

Puakō

Kauwewahine, sworn: . . . Lalamilo bounds Puako on the Kawaihae side (or North side) a wall at the dam of a fishing pond at a place called Makaha is the boundary. Thence along the stream from the pond to a place called Kaekuakapuaa, a wall at the shore; Thence along shore towards Kona to a large rock on the sand beach called Kapelekaaha. The sea belongs to Lalamilo. Thence *mauka* along Lalamilo to Puapuaa passing from the Kona side to the *mauka* side of the pond. Thence towards Kohala hills to Piikoele, an old pond now filled with sand, on the *mauka* side of the present pond; thence to the *Makaha.* These are the boundaries of Puako as told me by my parents. . . (Volume B:296)

Table 5. Oceanic boundaries and fishing rights in the South Kohala District.

Ahupuaʻa	*Boundary Testimony*	*Boundary Extends to Sea*	*Fishing Rights*	*Notes*
Alaʻōhiʻa	No	-	-	-
ʻĀnaehoʻomalu	Yes	Yes	Yes	-
Haleʻaha	No	-	-	-
Haleʻaha	No	-	-	-
Kalāhuipuaʻa	Yes	Yes	Yes	-
Kanakanaka	No	-	-	-
Kapia	No	-	-	-
Kauniho	No	-	-	-
Kaupo	No	-	-	-
Kawaihae Akau	Yes	Yes	Yes	From Pokiiahua to Kawaihae Hikina or to Kauhuhu. Had *poho paʻakai* rights
Kawaihae Hikina	Yes	Yes	Yes	Beach and Kona side of Kauhuhu/Pokiiahua. Had *poho paʻakai* rights in *ʻili* of Pohakuloa, Kaholei, Kaneloa, Malahuehue, Piʻipepiʻi, Nupaʻa. Part of fish catch went to John Young and to *konohiki* of Kawaihae Akau
Keoniki	No	-	-	-
Lālāmilo	Yes	Yes	Yes	-
Lanikepu	No	-	-	-
Momoualoa	No	-	-	-
ʻŌuli	Yes	Yes	Yes	-
Pahipa	No	-	-	-
Panoluukia	No	-	-	-
Pauahi	No	-	-	-
Paulama	No	-	-	-
Puakō	Yes	No	No	Sea belonged to Lālāmilo
Puʻukalani (Pukalani)	No	-	-	-
Puʻukapu	No	-	-	-
Puu Kawaiwai	No	-	-	-
Puʻu Ki	No	-	-	-
Waawaa	No	-	-	-
Waiʻaka	Yes	Not specified	Not specified	-
Waikōloa	Yes	No	No	-
Waimaʻa	Yes	Yes	Yes	-
Waiauia	No	-	-	-
Waiauia	No	-	-	-

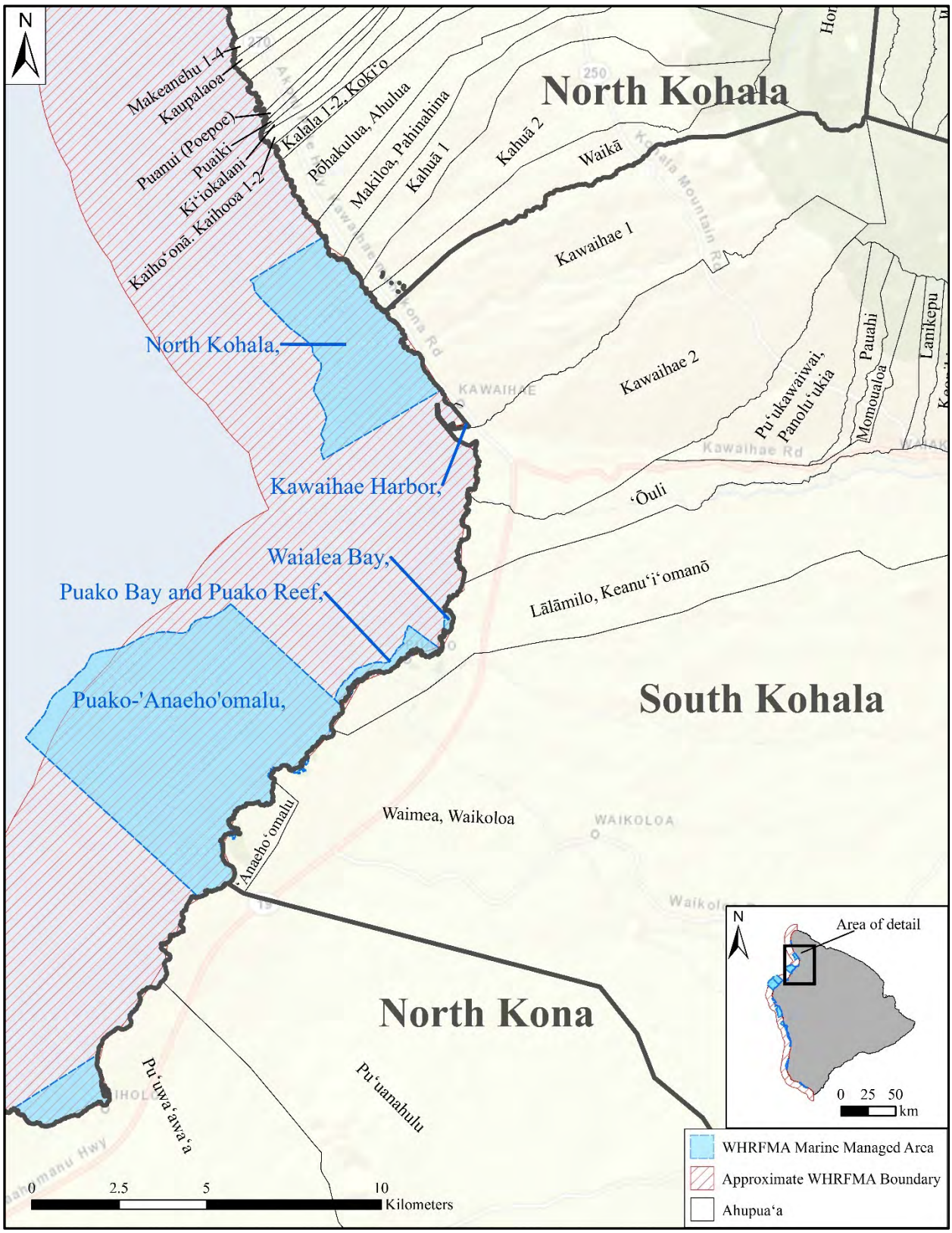

Figure 26. *Ahupua'a* of the South Kohala District.

Waikōloa

Mi, sworn: . . . Waimea is a Kalana. – which is the same as an island divided in to districts. – there are eight Okana in Waimea. In those Okana are those lands said to extend out *(hele mawaho).* These lands came in to the possession of Kamehameha I who said to Kupapaulu, go and look out to of the large lands running to the sea, for John Young and Isaac Davis. Kupapaulu went to Keawekuloa, the *haku aina,* who said if we give Waikoloa to the foreigners they will get Kalahuipua [Kalāhuipuaʻa] and Anaiomalu [Anaehoomalu] (two lands at the beach) then your master will have no fish. So they kept the sea lands and gave Waikoloa to Isaac Davis. John Young asked my parents if it was a large land they said, the black *aa* was Napuu, and the good land Waimea. . . (Volume A No. 1:7)

Moolau, sworn: . . . all the plain was given to Waikoloa, and Keanakaloa secured the fish lands at the shore. All the *pili* from Ouli to the *aa* of Kona belonged to Waikoloa. . . (Volume A No. 1:8)

Waimaʻa

Kaahumoku, sworn. . . Bounded *makai* by the sea. Ancient fishing rights extending out to sea. (Volume B:298)

North Kona District

In North Kona, forth-five *ahupuaʻa* were surveyed for their boundaries as a result of the Boundary Commission proceedings (Table 6 and Figure 27). Of these, twenty-seven had boundaries that extended out to sea, and all of those were identified in the testimony as retaining ancient fishing rights. There were twelve total *ahupuaʻa* whose specific fishing rights were described in detail as part of the testimony including Haleʻōhiʻu, Hāmanamana, Hōlualoa 4th, Honokōhau Iki (1st), Honokōhau Nui (2nd), Kaloko, Kaʻūpūlehu, Keahuolū, Keauhou 1st, Keauhou 2nd, Keōpū 3rd, and Puaʻa 1st. Within North Kona there were several *ahupuaʻa* that either had fishing rights to waters in a neighboring *ahupuaʻa*, or shared fishing rights with another *ahupuaʻa*.

With respect to the fishing rights of Honokōhau Nui and Keauhou 2nd, testimonies did not specify whether the boundaries of the former extended out to sea nor whether there were any ancient fishing rights belonging to its inhabitants. However, testimony relates that residents of Honokōhau Nui did have permission to fish within the waters of Honokōhau Iki, and that the fishing rights within Honokōhau Iki were small, extending only from Maliu to Kananaka, where they were truncated by the seas belonging to Kealakehe and Honokōhau. While Honokōhau Iki held these shared fishing rights with Honokōhau Nui, there was some controversy over a *koʻa ʻōpelu* which was claimed and fished by the people belonging to Kaloko Ahupuaʻa. Also of note in the testimony are the chronological limitations of *akule* fishing rights as they pertain to Keauhou 1st and 2nd, as the latter possessed fishing rights to *akule* during the reign of Keʻeaumoku, but following the end of his reign (and the marital union of chiefs belonging to both Keauhou *ahupuaʻa*), rights to the *akule* (and *ʻahi*) transferred to Keauhou 1st, and Keauhou 2nd only retained rights to bird hunting in the *mauka* lands. In the case of Haleʻōhiʻu Ahupuaʻa, fishing encompassed the waters of neighboring Hāmanamana Ahupuaʻa, where residents were restricted to shoreline fishing only.

Table 6. Oceanic boundaries and fishing rights in the North Kona District.

Ahupuaʻa	*Boundary Testimony*	*Boundary Extends to Sea*	*Fishing Rights*	*Notes*
ʻAuhaukeaʻē 1st	Yes	Yes	Yes	-
Awakeʻe	No	-	-	-
Awalua	No	-	-	-
Elepaio	No	-	-	-
Halekiʻi	Yes	Not specified	Not specified	No testimony given
Haleʻōhiʻu	Yes	Yes	Yes	Also held fishing rights to Hāmanamana

Table 6 continued on next page.

Table 6.continued.

Ahupuaʻa	*Boundary Testimony*	*Boundary Extends to Sea*	*Fishing Rights*	*Notes*
Hāmanamana	Yes	Yes	Yes	Rights belonged to Haleʻōhiʻu, fishing confined to rocks on shore
Haukalua 2nd	Yes	Yes	Yes	-
Hienaloli 1st	Yes	Not specified	Not specified	No testimony given
Hienaloli 2nd	Yes	Not specified	Not specified	-
Hienaloli 3rd	No	-	-	-
Hienaloli 4th	Yes	Yes	Yes	-
Hōlualoa 1st	Yes	Yes	Yes	-
Hōlualoa 2nd	Yes	Not specified	Not specified	-
Hōlualoa 3rd	Yes	Not located	-	-
Hōlualoa 4th	Yes	Yes	Yes	Only out until one couldn't see the sea floor
Honalo	No	-	-	-
Hōnauau	Yes	Yes	Yes	-
Honokōhau Iki	Yes	Yes	Yes	Small fishing rights extending from Maliu to Kananaka limited by the sea belonging to Kealakehe and Honokohau. May have jurisdiction over a *koʻa ʻōpelu* which was also fished and claimed by natives of Kaloko. Fishing also allowed here by natives of Honokōhau Nui.
Honokōhau Nui	Yes	Not specified	Not specified	Testimony for Honokōhau Iki relates Honokōhau Nui had fishing rights there
Honuaʻino 1st	Yes	Not specified	Not specified	-
Honuaʻula	No	-	-	-
Hokukano, Kalukalu	Yes	Not specified	Not specified	No testimony given
Kahaluʻu	Yes	Yes	Yes	-
Kahului 1st	Yes	Not specified	Not specified	No testimony given
Kahului 2nd	Yes	Yes	Yes	-
Kalaoa 1st - 5th	No	-	-	-
Kaloko	Yes	Yes	Yes	Claimed fishing rights to the *koʻa ʻōpelu* in Honokōhau Iki
Kanaueue	No	-	-	-
Kapalaaea 1st	Yes	Not specified	Not specified	No testimony given
Kau	No	-	-	-

Table 6 continued on next page.

Table 6. continued.

Ahupuaʻa	*Boundary Testimony*	*Boundary Extends to Sea*	*Fishing Rights*	*Notes*
Kaulana, Awalua, ʻŌhiki	No	-	-	-
Kaulehua	No	-	-	-
Kawanui Iki	Yes	Not specified	Not specified	No testimony given
Keahuolū	Yes	Yes	Yes	Keahuolū claimed the *ʻōpelu*
Kealakehe	No	-	-	-
Keauhou 1st	Yes	Yes	Yes	*Akule* and *ʻahi* belonged to Keauhou 1st after Keʻeaumoku's reign
Keauhou 2nd	Yes	Not specified	Yes	*Akule* belonged to Keauhou 2nd during Keʻeaumoku's reign. No fishing rights after his reign following the marriage of two chiefs of Keauhou 1st and 2nd
Keōpū 1st	Yes	Not specified	Not specified	No testimony given
Keōpū 2nd	No	-	-	-
Keōpū 3rd	Yes	Yes	Yes	Small fishing rights cut off by Honuaʻula, limited to Okolepohopohu
Kohanaiki	No	-	-	-
Kuamoʻo	No	-	-	-
Kūkiʻo, Maniniʻōwali	No	-	-	-
Laʻaloa 1st	Yes	Yes	Yes	-
Lanihau Iki (1st)	No	-	-	-
Lanihau Nui (2nd)	Yes	Yes	Yes	-
Laula	No	-	-	-
Lehuula Iki	Yes	Not specified	Not specified	No testimony given
Lehuula Nui	Yes	Yes	Yes	-
Mahaiʻula	No	-	-	-
Māʻihi 1st	Yes	Yes	Yes	-
Makalawena	Yes	Yes	Yes	-
Makaʻula	No	-	-	-
Maniniowali	No	-	-	-
Moeauoa 2nd	Yes	Not specified	Not specified	-
Ohiki	No	-	-	-
ʻOʻoma 1st and 2nd	No	-	-	-
Onouli Iki (1st)	Yes	Not specified	Not specified	No testimony given

Table 6 continued on next page.

Table 6. continued.

Ahupuaʻa	*Boundary Testimony*	*Boundary Extends to Sea*	*Fishing Rights*	*Notes*
Onouli Nui (2nd)	Yes	Not specified	Not specified	-
Pāhoehoe 2nd	Yes	Not specified	Not specified	No testimony given
Puaʻa 1st	Yes	Yes	Yes	Near shore and possibly to squid grounds
Puaʻa 2nd and 3rd	No	-	-	-
Puapuaʻa 2nd	No	-	-	-
Puapuaʻa Nui	Yes	Yes	Yes	-
Puʻu Anahulu	No	-	-	-
Puʻu Kala	No	-	-	-
Puʻu Waʻawaʻa	Yes	Yes	Yes	-
Waiʻaha 1st	No	-	-	-
Waiʻaha 2nd	Yes	Yes	Yes	-

End of Table 6.

Collectively, the testimonies provided for the remaining *ahupuaʻa* of North Kona relay little detail, particularly with regard to distance offshore. The fishing rights of Kaʻūpūlehu were spatially restricted between Keawaiki and Popoʻomino. Similarly, the fishing rights of Keōpū 3rd were cut off by the waters of Honuaʻula, seemingly limited to the a stone on the shoreline called Okolepohopohu. The fishing grounds for Puaʻa 1st expanded out a bit further to encompass the near shore fisheryand the squid fishing grounds, while the rights of Hōlualoa 4th extended out as far as the ocean floor was visible from land. Excerpts of Boundary Commission testimonies for the *ahupuaʻa* of North Kona that discussed ancient fishing rights and boundaries are presented below (underlining and italicization added for emphasis and clarity).

ʻAuhaukeaʻē 1st

Kekoanui, sworn: . . . Kailianu w. was the *kamaaina* at the shore; she lived near the land; she pointed out the boundaries on both sides of the land at the shore; I marked the corner of the land on the South side, cut into a large rock X; on the North side is a ridge of rock in the sea by a sand beach; did not mark that. <u>That land always had undisputed fishing right in the sea.</u> . . (Volume B:450)

Haleʻōhiʻu

Kanehailua, sworn: [near the southern boundary, *makai*] . . . thence to Kuula [a near shore hill], a *puu pohaku,* where we used to worship. <u>Bounded *makai* by the sea. Ancient fishing rights extending out to sea.</u> . . (Volume B:266)

Hāmanamana

Kaukaliinea, sworn: . . . thence to Kahua, a *lae* at the seashore. <u>Bounded *makai* by the sea. I have heard that the Ancient fishing rights belonged to Haleohiu. The people from Hamanamana had their fishing confined to the rocks.</u> . . (Volume B:264)

Kanehailua, sworn: thence *makai* to Kahua at the seashore. Bounded *makai* by the sea. The ancient fishing rights was limited to the rocks at shore. The sea belonging to Haleohiu. . . (Volume B:264)

Haukalua 2nd

Hoolau, sworn: . . . <u>Bounded on the *makai* side by the sea. Ancient fishing rights extending out to sea.</u> . . (Volume B:214)

Hienaloli 4th

Haleokane, sworn: I was born at Hianaloli, North Kona, Hawaii and have lived here ever since. I was quite large when Mr. Thurston arrived [1820], know the boundaries of the land, my *makua* (now dead) pointed them out to me. <u>The sea is the *makai* boundary and the land has ancient fishing rights extending out to sea.</u> . . (Volume A No. 1:346)

Figure 27. *Ahupua'a* of the North Kona District.

Hōlualoa 1st

Keliikanakaole, sworn: . . . thence *makai* following an *iwi aina* to a place at shore called Kuapae, a rocky point in the sea, with sand each side of it. The boundary at shore between Puapuaa and Holualoa 1st. Ancient fishing rights extending out to sea. . . (Volume A No. 1:337)

lhihi, sworn: . . . thence *makai* to Puuopelu, an *oioina kukui* [trail side resting place, shade by *kukui* trees]; thence *makai* along the *iwi aina* to Kuapae, a *puu pahoehoe* with sand on Kailua side and sea on the *makai* side. Ancient fishing rights extending out to sea. . . (Volume A No. 1:338)

Hōlualoa 4th

Kea, sworn: ...My parents (now dead) who were also *kamaainas*, pointed out the boundaries to me. At that time all lands had different *Konohiki.* Kaumalumalu bounds Holualoa 4th on the South side; the sea on the *makai* side. Ancient fishing rights extending out to where it is hard to see bottom. . . (Volume A No. 1: 343)

Haleokane, sworn: . . . The sea is the *makai* boundary and the land has ancient fishing rights extending out to sea. Hienaloli 5th is on the South side, the boundary at shore between Hianaloli 4th and Hianaloli 5th is Okikau, a water hole and bathing place. . . (Volume A No. 1: 346)

Hōnaunau

Kila, sworn: . . . Ancient fishing rights extending out to sea. . . (Volume A No. 1:282)

Kuiline, sworn: . . . Know a place called Anapuka; it is way on Honaunau. The boundary as it was told to me runs from Anapukalua to Puulehu, and then to Mahana. Bounded *makai* by the sea. Ancient fishing rights extending out to sea. . . (Volume B:223)

Honokōhau Iki (1st)

Hoohio, sworn: . . . Thence *makai* to Maliu a lae, the sea bounds the land *makai*; and there is a very small fishing right cut off by the sea of Kealakehe and Honokohaunui. . . (Volume A No. 1:364)

Kamohai, sworn: . . . Thence to a *heiau* named Halekuo thence to Maliu a *lae* in the sea; on the North side of the point. Ancient fishing rights extend from Maliu to Kananaka; a ledge of rocks in the sea, which looks red from the water is next to Honokohaunui. . . (Volume A No. 1:365)

Kekoanui, sworn: I am a *kamaaina* of Honokohau, and live there. I went with Mr. Hitchcock to survey the land. We commenced at the corner marked by Brown, at the seashore. Kaloko, said to be Keelikolani's land, is on the North side of the land. Kaohi w. and Kailioha kane were our *kamaainas* in the surveying; they pointed out the boundaries, a large rock in the sea, over which the waves break; it is quite a little distance off from the shore. There is a "*Koa Opelu*" in the sea, the *kamaainas* say it belongs to this land. Kaohi is a very old woman and is feeble, as is the man; they said that the people of Kaloko fish in the *Koa Opelu*, as formerly the *Konohiki* of Honokohau was a woman, who married a man who was the Konohiki of Kaloko, and allowed him to fish on her grounds. . . Honokohau nui has fishing right in the sea. . . (Volume B:452-453)

D.H. Hitchcock, sworn: I marked the North *mauka* corner by the aa, as near as I could tell from what the natives told me of the boundary. . . According to the boundaries of Honokohau the "*Koa Opelu*" is entirely within the land, as the old woman said it belonged. . . From the beach up the North side of the land, the boundary line strikes up onto the *aa* to an *Ahu*, and on to a stone wall, said to be the boundary. The South side was surveyed by J.F. Brown, as far up as Honokohau iki extends, and we found his corner… The only disputed point was about the "Koa Opelu," which the Kaloko people claim. . . (Volume B:453)

Kahalu'u

Papa, sworn: . . . The sea bounds it *makai,* and it has ancient fishing rights extending out to sea. Keauhou bounds Kahaluu on the Southern side; at the sea shore the boundary between these two places is at Ohiki, a point on the South side of Paaniau, and near to it. . . (Volume A No. 1:321)

Kaahuna, sworn: . . . Keauhou bounds Kahaluu on the South side; sea *makai;* and the land has fishing rights. The boundary at shore is Ohiki, a pile of stones on the South side of Paaniau. . . (Volume A No. 1:322)

Kahului 2nd

Niniha, sworn: . . . I pointed out the boundaries of Kahului 1st when it was surveyed; thence along the land sold, to Kalalii, a *pulu lepo* at seashore. Ancient fishing rights extending out to sea. . . (Volume A No. 1:328)

Makuakane, sworn: . . . Thence the boundary runs along land sold, to the sea, and the land has ancient fishing rights extending out to sea. . . (Volume A No. 1:329)

Kaloko

Nahuina, sworn: . . . thence *makai* to Keawewai, an *awaawa,* with water near the shore road thence to Okuhi, an *awaawa* in the sea with a point on each side of it. On the *makai* side Kaloko is bounded by the sea; and the land had ancient fishing rights extending out to sea. The *koa* is on Kaloko and the *olona* on Honokohaunui. . . (Volume A No. 1:371)

Kaumalumalu, Pāhoehoe

Kamakahoohia, sworn: . . . Kaleiahana (now dead) pointed out the boundaries to me; they used to go into the mountain after *uwau.* I went with them after sandalwood. The sea bounds this land *makai* and it has ancient fishing rights extending out to sea. Pahoehoe 1st is on the South side; the boundary at shore between these two lands is Manawai, a water hole on the North side of the landing. . . thence to Kui, a *pali* in the woods where canoe makers used to worship; here the boundary strikes the Judd road. . . (Volume A No. 1:324-325)

Palauolelo, sworn: . . . (The boundary at seashore between Holualoa and Kaumalumalu is at Kuula opelu, a *heiau* [an *ʻōpelu* fisherman's temple] The *Kaheka* [near shore pond—anchialine pond] is on Kaumalumalu . . . (Volume A No. 1:325)

Kaʻūpūlehu

Keliihanapule, sworn: . . . Bounded on the South side by Kukio owned by Pupule, the boundary at shore is in the middle of a place called Keawaiki. The land had ancient fishing rights extending out to sea from Keawaiki to Popoomino, a pile of stones at the corner of Pupule's land. . . The place where they make salt at the seashore is on the Puna side of the lava flow. . . (Volume B:247-248)

Kahueai, sworn: . . . The boundary on Kohala side at shore is a spot of sand called Kolomuo on the south side of Kalaemano. . . Bounded *makai* by the sea. Ancient fishing rights extending out to sea. . . (Volume B:249-250)

Keahuolū

J.Z. Waiau, sworn: . . . thence to Puunahaha, a large red hill on the *mauka* side of the *makai* Government road, thence to Puuokaloa, an *oioina* or small hill; thence to Kaiwi, a *lae pohaku* on the middle of point. Ancient fishing rights extending out to sea. . . (Volume A No. 1:354-355)

Kealakai, sworn: . . . thence to Puunahaha; the boundary passing on the North side; from thence to Puuokaloa; thence *makai* to Kaiwi, the *kula* in middle of point and *lae pohaku* on the point at sea shore. Ancient fishing rights extending out to sea and claiming the *opelu*. . . (Volume A No. 1:356)

Keauhou 1st

Lono, sworn: . . . The boundary at the shore between Keauhou1st and Keauhou 2nd is at Kamauae, a heiau for fishermen situated above the beach, on the hill where the houses stand; thence *mauka* to a breadfruit tree; thence to the head of Holua. . . Keauhou is bounded by the sea and the land has ancient fishing rights extending out to sea. . . (Volume A No. 1:319)

Keauhou 2nd

Kakio, sworn: . . . The boundary at shore between the two Keauhous is at a place called Kamauae at the beach; Thence it runs *mauka* to the head of *Holua* (an old sliding place). . . They say in the days of Keeaumoku the *Akule* used to belong to Keauhou 2d and the birds to Keauhou 1st, but the Chief of Keauhou 2 married a chief of Keauhou 1st and after that all the fish were given to Keauhou 1st and the birds and land *mauka* to Keauhou 2nd. . . (Volume A No. 1:267)

Keōpū 3rd

Kaleiheana, sworn: . . . John Ii (now dead) pointed out the *makai* boundaries to me. The land has very small fishing rights, which are cut off by Honuaula. The sand in the sea is on Honuaula, and the *aa* is on Keopu. The boundary at shore between these two lands is at Puukoa, a noted place for surf riding. There is a wall here called Papaula, and the boundary comes to the middle of said wall. . . Bounded *makai* by the sea. . . Commencing on the other side at seashore at a large stone called Okolepohupohu *makai* of the Governor's stone house Hulihee. . . (Volume A No. 1: 302)

Kauakahi, sworn: . . . Papaula is the boundary at the shore between Keopu and Honuaula; The land had ancient fishing rights at Okolepohopohu, and from there the boundary runs *mauka to* Makakauahi, an *oioina*. . . (Volume A No. 1: 303)

La'aloa 1st

Nahina, sworn: . . . Ancient fishing rights extending out to sea. . . (Volume A No. 1: 331)

Lanihau Nui (2nd)

J.Z. Waiau, sworn: . . . It is bounded on the North side by Keahuolu and on the South side by Lanihauiki, the land has ancient fishing rights extending out to sea. The boundary at shore between Lanihaunui and Lanihauiki is Kukanapaio, an *awaawa kai* in the rocks; thence *mauka* to Kuaaona between the fish ponds, outside of the fort [at Ahuena]. I think one good sized fish pond is on Lanihauiki, called Waikauila; Waihonu is on Lanihaunui ; thence to a cocoanut tree on the inside of the old fort; thence to a long stone above the fort, buried in sand, some of the *kamaaina* say it used to reach wet sand. . . (Volume A No. 1:305-306)

Lehuula Nui

Hapuku, sworn: . . . I only know the boundaries of Lehuulanui below the great walled lot. Sea bounds this land on the *makai* and it has ancient fishing rights extending out to sea. . . Paaaoao is the boundary at sea shore between Kawanui and Lehuulanui; there is a wall and landing there. . . (Volume A No. 1:315)

Mā'ihi 1st

Ehu, sworn: . . . Honalo bounds it on the north side. Maihi 2nd on the south side. Leinakaloa is the boundary at shore between Maihi I and Maihi 2nd. Ancient fishing rights extending out to sea. The *Opelu* belonged to Maihi and the *Ahi to* Keauhou; bounded *makai* by the sea. . . (Volume A No. 1:311)

Kailikini, sworn: . . . Leinakaloa, a canoe landing is the boundary between Maihi 1st and Maihi 2nd. A *pali* between Koa Opelu [a *heiau]* belongs to Maihi 1st. The sea bounds it *makai.* The boundary at shore between Maihi 1st and Honalo is at Keawakui running along the south side of it. . . (Volume A No. 1:312)

Makalawena

Kahailii, sworn: . . . Commencing at the seashore, the boundary between the land of Makalawena and Mahaiula is a *kaheka* [tidal pool], called Kaelemiha. . . thence to Mokupohaku, or Kaiwikohola, a large rock in the surf. Makalawena is bounded *makai* by the sea, and the land has ancient fishing rights, extending out to sea. . . (Volume A No. 1:373-374)

Mamae, sworn: . . . The boundary at shore between Makalawena and Mahaiula is Nahaleoahumakaike, a *kaheka;* thence to an *ahu* called Kaelemiiha. . . Thence to Pohakuanaeapoapu, a large rock at the seashore, and from thence to a large rock in the surf called Kaiwi Kohola. . . (Volume A No. 1:374-375)

Pua'a 1st

Kauwa w., sworn: . . . Puaa is bounded *makai* by the sea and the land has ancient fishing rights near the shore, but not extending out to sea. Thence commencing at a *punawai* by the seashore called Holoke, between the lands of Puaa and Auhaukeae and running *mauka* to Poholua, a *huli pali* near the shore and just above a house. . . *makai* to Hiilia, a punawai; thence to Kekawa, at the seashore.

Hiilia is *mauka* of Governor Adam's wall, and Kekawa is the *awaawa kai* [an ocean inlet], with points each side. The boundary is between the two. Puaa has ancient fishing rights extending to the squid grounds. . . (Volume A No. 1:376-378)

Kahueai, sworn: . . . The boundary at shore on the Kau side is Nakakai, owned by Pupule, the *mauka* corner of Pupule's land on Puaa 2nd is at Kaopapa. . . thence *makai* along Hauanio's land and thence along Ukumea's land and then along Kole to the sea shore. Bounded *makai* by the sea. Ancient fishing rights extending out to sea. . . (Volume B:244-245)

Puapua'a Nui

Ukumea, sworn: . . . Bounded on the North side by Piki, the boundary at shore between these two lands is Keawapuapua on the south side of the *awa* [landing]. . . thence to Huloa, a resting place above Governor Adams wall; thence to seashore. I do not know the name of this *makai* point. Bounded *makai* by the sea. Ancient fishing rights extending out to sea. . . (Volume B:260-261)

Mahalo, sworn: . . . Commencing at the seashore on the Kau side of the Awaawa Puhiuhiu, the *awaawa* being on the Kau side of the canoe landing; thence to Pakuhano, *aa mauka* of the wall. . . thence *makai* to Ahuloa; thence to Puuopelu; thence to Kuapae at the seashore. Bounded *makai* by the sea. Ancient fishing rights extending out to sea. . . (Volume B:261)

Pu'u Wa'awa'a

Aea, sworn: . . . Ono, an older cousin of mine, now dead, pointed out the boundaries to me; as the different lands had different *Konohiki* and different *koele* [planting areas worked for the chiefs] &c. The land of Puawaa is bounded on the South side by Kaupulehu and *mauka* by the same. On the North by the land of Puanahulu, and *makai* by the sea. The ancient fishing rights of the land extend out to sea.

The boundary at sea shore between this land and Kaupulehu, is at Pohakuokahai, a rocky point in the *aa* on the lava flow of 1801, the flow from Hualalai to sea. I think it is the third point from Kiholo, in the flow, as you go toward Kona; thence the boundary between these lands runs *mauka* on *aa* to Keahupuaa. . . (Volume A No. 1:253)

Wai'aha 2nd

Peahi, sworn: . . . A water hole called Waialipi is on the boundary between the two Waiahas. Waiaha 2d is bounded by Waiaha 1st to a banana grove at the edge of the woods. . . Waiaha 2d is bounded *makai* by the sea. Ancient fishing rights extending out to sea. . . (Volume B:269)

South Kona District

There were twenty-nine *ahupua'a* in South Kona whose boundaries were surveyed (Table 7 and Figure 28). Of these, twenty had boundaries that extended out into the sea, and nineteen of those were identified as having ancient fishing rights. Boundary Commission testimony that included detailed accounts regarding these fishing rights were provided only for seven of these *ahupua'a* (Ka'apuna, Kahauloa 2nd, Kalamakowali, Kalamakumu, Ke'ei 1st, Ki'ilae, and Pāpā 2nd),while the testimony for 'Ōlelomoana Nui related that fishing rights and resources belonged to the *konohiki*. With respect to Ki'ilae and Pāpā 2nd, fishing rights only extended out to where the bottom of the sea was no longer visible. Several other *ahupua'a*, including Kahauloa 2nd, Kalamakumu, and Ke'ei 1st, likely held rights only in shallow water, with Kalamakumu being cut off by the fishing grounds of Kealakekua. Similarly, the fishing grounds of Ka'apuna, although they extended out further out into the deep sea, were truncated by Honomalino. The rights of Kalamakowali were geographically restricted to a fishing place known as Mokunui. Excerpts of Boundary Commission testimonies for the *ahupua'a* of South Kona that discussed ancient fishing rights and boundaries are presented below (underlining and italicization added for emphasis and clarity).

'Alikā

Kahinalua, sworn: . . . Bounded *makai* by the sea. *Pali* called Kahoolewlewa is the boundary at shore between Alika and Kipahoehoe. There is a rock marked K. I think by land surveyed by Wiltse. (Volume B:322)

Makia, sworn: . . . Bounded *makai* by sea. Kipahoehoe bounds it on Kona side from shore to *mauka* end. Boundary at shore is at Kahoolewalea a *pali* at shore. The rock is marked. (Volume B:322)

Table 7. Oceanic boundaries and fishing rights in the South Kona District.

Ahupuaʻa	*Boundary Testimony*	*Boundary Extends to Sea*	*Fishing Rights*	*Notes*
Alaʻē 1st	Yes	Not specified	Not specified	-
Alaʻē 2nd	Yes	Not specified	Not specified	-
ʻAlikā	Yes	Yes	Not specified	-
Anapuka, Hoʻopūloa	No	-	-	-
Haleili	No	-	-	-
Haukālua 1st	No	-	-	-
Haukālua 2nd	Yes	Yes	Yes	-
Hōnaunau	Yes	Yes	Yes	-
Honokua	Yes	Yes	Yes	-
Honomalino	Yes	Yes	Yes	-
Hoʻokena	Yes	Yes	Yes	-
Hoʻopūloa	No	-	-	-
Ilikahi	No	-	-	-
Kaʻapuna	Yes	Yes	Yes	Extending into deep sea until it became jurisdiction of Honomalino
Kahauloa 2nd	Yes	Yes	Yes	Only shallow water
Kalāhiki	Yes	Yes	Yes	-
Kalamakowali	Yes	Yes	Yes	Only at Mokunui
Kalamaililoa	Yes	Not specified	Not specified	-
Kalamakāpala	No	-	-	-
Kalamakumu	Yes	Yes	Yes	Only to short distance out, truncated by Kealakekua's fishing rights
Kalamaumi	No	-	-	-
Kalamawaiawaawa	No	-	-	-
Kalihi	No	-	-	-
Kalukalu, Hokukano	Yes	Not specified	Not specified	No testimony given
Kamakaolohe	No	-	-	-
Kanakau	No	-	-	-
Kaʻohe 1-3	No	-	-	-
Kaʻohe 4th	Yes	Yes	Yes	-
Kaʻohe 5th	No	-	-	-
Kapuʻa	Yes	Yes	Yes	-
Kapuai	No	-	-	-
Kauahia	No	-	-	-
Kauhakō	No	-	-	-
Kaulanamauna	No	-	-	-
Kauleolī 1st and 2nd	No	-	-	-
Kealakekua, Kaʻawaloa	Yes	Not specified	Not specified	No testimony given
Keālia 1st	Yes	Yes	Yes	-
Keālia 2nd	Yes	Not specified	Not specified	No testimony given
Keʻei 1st	Yes	Yes	Yes	Possibly only in shallow water

Table 7 continued on next page.

Table 7. continued.

Ahupuaʻa	*Boundary Testimony*	*Boundary Extends to Sea*	*Fishing Rights*	*Notes*
Keʻei 2nd	Yes	Not specified	Not specified	-
Keʻekeʻe 1st2nd, Kanakau	No	-	-	-
Keōkea	Yes	Not specified	Not specified	-
Keopuka	No	-	-	-
Kiʻilae	Yes	Yes	Yes	Only as far as can see bottom of sea
Kiloa	No	-	-	-
Kīpāhoehoe	No	-	-	-
Kipu	No	-	-	-
Kolo	No	-	-	-
Kukuiopaʻe 1-2	No	-	-	-
Makuʻu	No	-	-	-
Maunaoni 1-6	No	-	-	-
Miloliʻi	No	-	-	-
Okoe 1-2	No	-	-	-
ʻŌlelomoana Iki	Yes	Yes	Yes	-
ʻŌlelomoana Nui	Yes	Yes	Yes	Fishing rights belonged to *konohiki*
Omokaʻa	No	-	-	-
ʻŌpihihale	No	-	-	-
Pāhoehoe 1st	No	-	-	-
Pāhoehoe 2nd	Yes	Yes	Yes	-
Pāpā 1st	No	-	-	-
Pāpā 2nd	Yes	Yes	Yes	Fishing rights extend out to where bottom is no longer visible
Waiea	No	-	-	-
Waipunaula	No	-	-	-
Waikākuʻu	No	-	-	-

End of Table 7.

Haukalua 2nd

Hoolau, sworn: . . .Bounded on the *makai* side by the sea. Ancient fishing rights extending out to sea. . . (Volume B:214)

Hōnaunau

Kila, sworn: . . . Ancient fishing rights extending out to sea. . . (Volume A No. 1:282)

Kuiline, sworn: . . . Know a place called Anapuka; it is way on Honaunau. The boundary as it was told to me runs from Anapukalua to Puulehu, and then to Mahana. Bounded makai by the sea. Ancient fishing rights extending out to sea. . . (Volume B:223)

Honokua

Kaleikoa, sworn: . . . The sea bounds it *makai.* Ancient fishing rights extending out to sea. . . (Volume B:211)

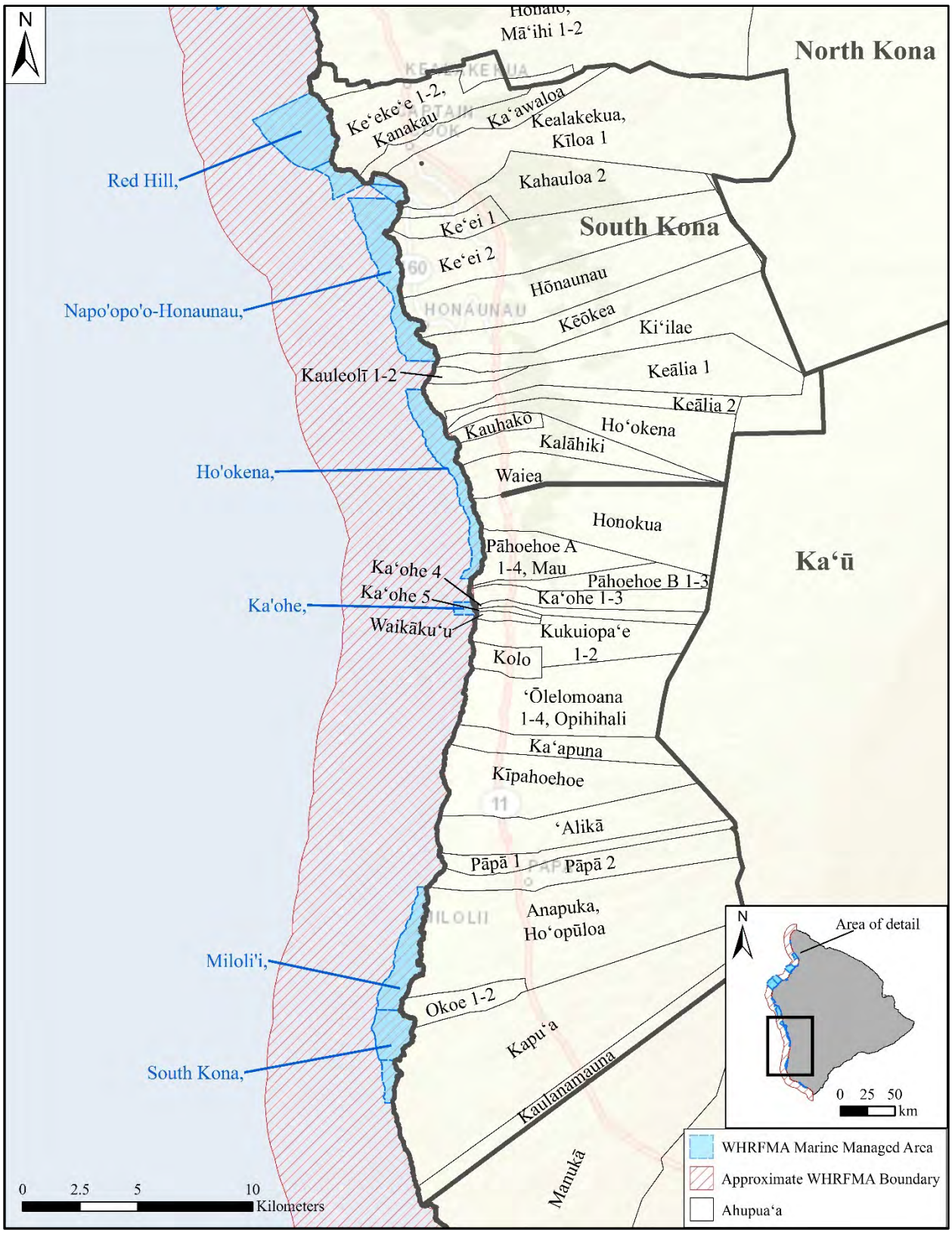

Figure 28. *Ahupua‘a* of the South Kona District.

Honomalino

Kuakahela, sworn: . . . Bounded *makai* by the sea, ancient fishing rights extending out to sea. Kalipo is the boundary at shore between this land and Kalihi. Kalihi has been sold by Government from shore to the Government road. . . (Volume B:190)

Ho'okena

Kekuhaulua, sworn: . . . Hookena had ancient fishing rights extending out to sea. . . (Volume A No. 1:275)

Kamaka, sworn: . . . Hookena had ancient fishing rights extending out to sea. . . (Volume A No. 1:277)

Ka'apuna

Kama, sworn: …Commencing at *ahupuaa* on the South side of Kipahoehoe bounded at the shore by Kaleokane, a point extending into the sea, boundary in the middle of the point… running *mauka*, then returning on southern boundary to *makai*. . . Thence along land sold to Kapunanaka, a *puu pahoehoe* all cracked up, at the shore, bounded *makai* by the sea. Ancient fishing rights extending out to the sea. . . (Volume B: 198-200)

Kahauloa 2nd

Kahula, sworn: . . . From Kaneaa the boundary runs *makai* along an *iwi aina* to Kahuamoa, a pile of stones; thence *makai* to Mahana, a pile of stones; thence to Kaneahuea, the *pahoehoe* at the foot of the *pali* being on Keei and the *pali* on Kahauloa. Fishing rights in shallow water only. . . (Volume A No. 1:297)

Kalāhiki

Palea, sworn: . . . Pohokinikini is the name of two water holes on Waiea, where Cummings' land ends and my lands bound Kalahiki from there to the seashore. The sea bounds it on the *makai* side and the land has Ancient fishing rights extending out to sea. . . (Volume A No. 1:291)

Kalamakowali

Naili, sworn: . . . Kaaemoku's land on Kalama 4th bounds Kalama 3rd at seashore on the South side; and the place called Mokunui is said to be the only fishing place belonging to Kalama 3rd [Kalamakowali] From the seashore the boundary runs *mauka,* along *kuleanas*, and lands sold, and along remnants, belonging to Government. . . (Volume A No. 1:310)

Kalamakumu

Kamauoha, sworn: . . . Kalamakumu is bounded *makai* by the sea and it has ancient fishing rights extending out a short distance; the outside sea belonging to Kealakekua. My father-in-law, who was *Konohiki*, pointed out the boundaries to me. I am *Konohiki* now. The boundary at sea shore between this land and Kalama Ililoa is at a landing on Kalama Ililoa, at the south side of Kaiwikahua; Kapahukula's *kuleana*; thence the boundary runs *mauka* along a stone wall. . . (Volume A No. 1:300)

Ka'ohe 4th

Palea, sworn: . . . Pohokinikini is the name of two water holes on Waiea, where Cummings' land ends and my lands bound Kalahiki from there to the seashore. The sea bounds it on the *makai* side and the land has Ancient fishing rights extending out to the sea. . . (Volume B:219)

Huakano, sworn: . . . Bounded *makai* by the sea. Ancient fishing rights extending out to the sea. . . (Volume B: 219)

Kapu'a

Nakai w., sworn: . . . In old times they were very particular about the boundaries of lands. Kaulanamauna bounds it on the Kau side, Okoe on the Kona side, I do not know the *mauka* boundary. The boundary at the sea shore on the Kau side is at a fishing place called Ahuloa, there is a large rock there called by that name; thence *mauka* to Kaanamalu, a cave. . . (Volume B:185)

Makea, sworn: . . . I lived at Manuka for a while. The last witness is my wife and she was the cause of my going there. I know the boundary of Kapua at the shore. Keau, my father (now dead) told me that Ahuloa was the boundary between Kapua and Kaulanamauna . . . From the shore to the Government road I do not know the boundaries, the boundary there is the *pa heiau* [temple wall] *makai* of the road. . . (Volume B:186)

Kuakahela, sworn: . . . Ahuloa is at the sea shore, the sand is on Kaulanamauna ; thence along the *aa* to Kahepapa where the boundary leaves the *aa* and runs up a short distance...across the *aa* to *koa* woods, to a place called Kawiliwahine where they make canoes for both lands, thence to Koolau where Kapua ends, it is here cut off by Kaulanamauna and Honomalino, this is where *Kokoolau* grows, in the *koa*. . . thence along Okoe along the *awaawa* to Makalei, at the sea shore. I can go and point out all the places I have been to and I can tell the marks the *kamaaina* showed me. Bounded *makai* by the sea, ancient fishing rights extending out to sea. . . (Volume B:189)

Keālia 1st

Kekuhaulua, sworn: . . . the boundary turns toward Kona, to Keawe o Kini the *makai* boundary at seashore. Ancient fishing rights extending out to sea . . . (Volume A No. 1:274)

Ke'ei 1st

Kaluna, sworn: . . . Mokuape, a rock in the sea, is the boundary at shore between Keei 1st iki and Kahauloa it is on the North side of a place called Kaneahuea. . . Bounded *makai* by the sea. Ancient fishing rights extending out to sea . . . (Volume B:225)

Kahula, sworn: . . . Fishing rights in shallow water only. . . (Volume B:226)

Ki'ilae

Kila, sworn: . . . Kuwaia, a water spring, under the *pali,* at the seashore, is the boundary between Kiilae and Keokea; the land has ancient fishing rights extending out, as far as you can see bottom; Commencing at the spring at the sea shore, the boundary runs *mauka* along Keokea to a *kahawai* (gulch) called Keokea. . . (Volume A No. 1:292)

'Ōlelomoana-Iki (1st)

Kimo, sworn: . . . Commencing at a large rock in the sea called Kaluahee; thence *mauka* to Kapulehu. . . Bounded *makai* by the sea. Ancient fishing rights extending out to sea. The boundary at shore between Kolo and Olelomoana 1st iki is a large hill, as large as this house, called Kaluaolapauila… (Volume B:206-207)

Kapule w., sworn: . . . Commencing at the seashore, the boundary between Olelomaoana 2d nui and Olelomoana 1st iki is at Kaluahee; the boundary line running in an *awaawa* to the right of it… The boundary I have testified to is the boundary of Olelomoana 1st iki from the shore to Papai. . . Bounded on the North by Kolo Kapuaau, or Kaleiulala is the boundary at shore. . . Puaau is a *moku* in the sea. Bounded on the *makai* side by the sea. Ancient fishing rights extending out to sea. . . (Volume B:208)

'Ōlelomoana Nui (2nd)

Kamaka, sworn: . . . The boundary at the shore is in an *awaawa* on the North side of Kaluahee; thence *mauka* up the *pali* to the North side Kauhiuli, a *kauhale*. . . Bounded *makai* by the sea. Fishing rights belonging to Konohiki; bounded on the South side by Opihale… (Volume B:204)

Kapule w., sworn: …Opihale 1st bounds it on the South side. The boundary at shore between Olelomoana 2d nui and Olelomana 1st iki is Kaluahee; there is an *awaawa* at the right side of it; thence up the *awaawa* to Kauhiuhi. . . The boundary at shore between Opihale and Olelomoana 2d nui is at Kukulu; thence *mauka* to Kapakoholua. . . I can point out the boundaries from woods to shore. Bounded *makai* by the sea. Ancient fishing rights extending out to sea. (Volume B:205)

Pāhoehoe 2nd

Kuaimoku, sworn: …Bounded *makai* by the sea and I have always been told that the land has ancient fishing rights extending out to sea. I was born here. . . (Volume B:196)

Papa 2nd

Kuakahela, sworn: The boundary at shore between the two Papas is at Keawemoku. . . There is *koa* on this land fit to make canoes, but the most of the *koa* is on Honomalino. Anapuka bounds it on the South side of a point called Namakahiki. . . Bounded *makai* by the sea. Ancient fishing rights extending out to sea. . . (Volume B:193-194)

Makia, sworn: . . . Anapuka bounds it on the South side at a large *puka* on the South side of Namakahiki; thence *mauka* along a line of craters or holes, to the woods. . . Sea bounds it on the *makai* side. Ancient fishing rights as far out as you can see bottom. . . [Volume B:194]

Ka‘ū District

Of the six *ahupua‘a* in Ka‘ū that extend southward from Kaulanamauna in South Kona to Ka Lae, Pu‘u‘eo within the study area (Table 8 and Figure 29), one (Kī‘ao) is landlocked, and five extended from *mauka* to *makai*. The significance of landlocked *ahupua‘a* such as Kī‘ao, represented "a very significant anomaly, since this means inhabitants of these ahupua‘a were either not using any marine resources, which seems unlikely, or they needed to trade them from outside communities" (Gonschor and Beamer 2014:69). The boundaries of three of the five remaining *ahupua‘a* (Kahuku, Pākini-iki, and Pākini-nui/Pu‘u Lena) were brought before the Boundary Commission in 1873. With respect to these *ahupua‘a*, the testimonies collectively relate that all three extended out to sea and retained fishing rights. However, in the case of Kahuku, it appears that although the *ahupua‘a* indeed had ancient fishing rights, it was said in the testimony the inhabitants preferred hunting birds to fishing. Excerpts of Boundary Commission testimonies for the *ahupua‘a* of Ka‘ū that discussed ancient fishing rights and boundaries, are presented below (underlining and italicization added for emphasis and clarity).

Table 8. Oceanic boundaries and fishing rights in the Ka‘ū District.

Ahupua‘a	*BoundaryTestimony*	*Boundary Extends to Sea*	*Fishing Rights*	*Notes*
Kahuku	Yes	Yes	Yes	Natives did not fish, they hunted birds
Kamā‘oa, Pu‘u‘eo, Ke	No	-	-	-
Kī‘ao	No	-	-	Landlocked
Manukā	No	-	-	-
Pākini-iki	Yes	Yes	Yes	-
Pākini-nui, Pu‘u Lena	Yes	Yes	Yes	-

Kahuku, Kau District

Kumauna, sworn: The sea bounds Kahuku on the *makai* side and the land had ancient fishing rights. The cave Kanupa is between Puulonolono, Puukeokeo and Pohaha on the *aa*; a hill called Hapaimamo is on Kahuku and the boundary between kapuhonu and Puuohia runs *makai* of this hill. I am an old canoe maker. . . In ancient days the people of Kahuku did not go fishing, but were after birds of all kinds to eat and this is the reason all the land on the mountain belonged to Kahuku. My *makuahonowai* and others always took their weapons with them as they used to have fights when they found people from other lands catching birds. . . (Volume A No. 1:141-142)

Pākini-iki

Puhi, sworn: . . . I was born at Kawela, Kau three months before the Okuu and have always lived at same place near there. I am a *kamaaina* and know the boundaries of Pakiniiki. I used to go with my parents, cultivating and fishing and they showed me boundaries of the lands. . . (Volume A No. 1:391)

Kuehu, sworn: . . . thence to Pohakukulua, two rocks in the sea on the boundary between Pakini iki and Kamaoa; thence along shore to Pakini nui. Ancient fishing rights extending out to sea. . . (Volume A No. 1:392)

Pākini-nui, Pu'u Lena

Puhi, sworn: . . . thence to Kanikaula a *heiau*; thence to Pouli, a kauhale and canoe landing; thence to Mokuhonu, a rock in the sea. The sea bounds it on the *makai* side, and the land has ancient fishing rights extending out to sea. . . (Volume A No. 1:395)

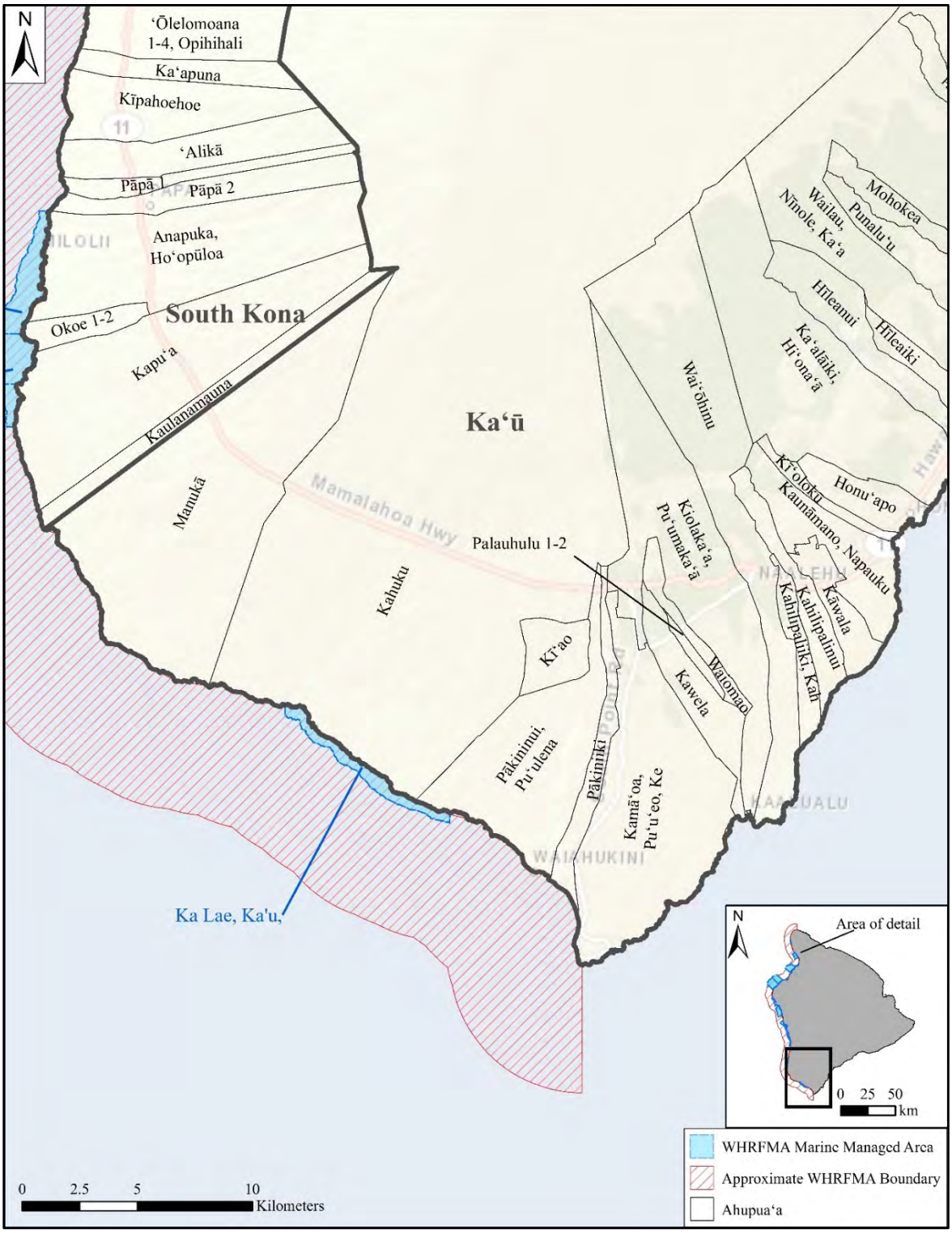

Figure 29. *Ahupua'a* of the Ka'ū District.

POST-*MĀHELE* TO EARLY TWENTIETH CENTURY COMMERCIAL FISHING

In the decades following the *Māhele ʻĀina*, Kānaka Maoli sought to navigate their way through a major land and political transitions, moving from a time when fisheries were strictly managed by appointed *aliʻi* and *konohiki*, to one where fee-simple interest and broader public rights existed (Maly and Maly 2003). While the *Māhele ʻĀina* enabled foreigners to own property in fee-simple, it simultaneously resulted in the displacement of many Kānaka Maoli from their ancestral lands, which severely disrupted the ancient system of land management (Kameʻeleihiwa 1992). Galzier (2007:66) suggests that during these challenging times, subsistence fishing remained an important part of the Kānaka Maoli lifestyle. He points out that during this time "certain beliefs and ways of living were not abandoned in full, but rather subverted" (ibid.). The years following the *Māhele* of 1848 were filled with difficulties for Kānaka Maoli fishers, as fishing laws continued to be redefined as a means to address a wide range of fishery-related issues including access rights, *konohiki* rights, and taxation. Maly and Maly (2003:312) report that by 1850, the traditional method of using plant-based poisons, specifically *ʻauhuhu* "or other substance deleterious to fish" was made illegal. Regardless of these changes, for close to 100 years— through the whaling era (1820-1865) and well into the 20th century—Kānaka Maoli continued to play the leading role in Hawaiʻi's commercial fishing industry (Cobb 1905; Glazier 2007; Schug 2001). Despite the vast socio-political and economic changes that occurred in the islands during this time period, Kānaka Maoli managed to adapt their subsistence lifestyle and culture to meet the demands brought about by a market economy.

The shift to fee-simple ownership of land ultimately paved the way for large scale commercial agriculture, which led to successive waves of migrant contract laborers, including those of American, Chinese, Portuguese, Filipino, and Japanese descent. Schug (2001:17), who conducted historical research on Hawaiʻi's commercial fishing industry, reports that in 1872 "Hawaiʻi's non-indigenous population" numbered around 5,366, but that by the turn of the 20th century, that number had increased to some 114,345 individuals of foreign descent. Of all of the ethnic groups to arrive in Hawaiʻi to support the burgeoning sugar industry, the Japanese had become the most heavily involved in Hawaiʻi's commercial fishing industry. Schug explains:

> When their plantation contracts expired many Japanese who had previously been skilled commercial fishermen in the coastal areas of Wakayama, Shizuoka, and Yamaguchi Perfectures remained in Hawaiʻi and turned to the sea for a living. The earnings of these fishermen were on average higher than those of plantation workers. (ibid.:17)

Many of the *issei* (first generation Japanese migrant laborers) become deeply invested in Hawaiʻi's commercial fishing sector. Gradually, these Japanese fishers introduced fishing gear and methods that were well suited for deep-sea and some nearshore fishing. Some of the more popular technological introductions included long line fishing and the sampan fishing vessel, originally propelled by oar or sail (Glazier 2007; Schug 2001). Sampan fishing vessels were later outfitted with an engine which gave access to previously unexploited deep-sea fisheries (ibid.). Additionally, the introduction of the Japanese cast net sometime around 1890, which was well-suited for near-shore fishing, was quickly adopted by Kānaka Maoli fishers, who then later dubbed it the *ʻupena hoʻolei*, or throw net (Figure 30) (Mitchell 2001; Pukui and Elbert 1986). During the late 19th century, Hawaiʻi's political system underwent a series of monumental changes as the Island Kingdom shifted to an American Territory. In summarizing the political climate of the islands during this time, and its impact on local fisheries, Maly and Maly (2003:viii) write:

> This system was radically altered in 1893, when the Hawaiian Monarchy was overthrown by foreign residents and American forces. Subsequently, the leaders of the parties responsible for the overthrow, made a steady move towards annexation of the Hawaiian Islands by the United States, which occurred in 1898. Then in 1900, the Hawaiian Islands became a "Territory" of the United States, and the resulting "Organic Act" set in place the legal parameters for freeing up the fisheries of Hawaiʻi.

In 1901, John N. Cobb, Agent of the United State Fish Commission visited the islands to investigate the condition of the islands' commercial fisheries. Cobb (1905) compiled his findings in his 1903 report titled, *The Commercial Fisheries of the Hawaiian Islands*, which provided details about fishing practices of this time, as well as the changing cultural tapestry of the islands. In relating what he observed during his visit, Cobb (ibid.:718) wrote:

> In numbers the native Hawaiian fishermen surpass all others combined, but this is partly because so many women and children engage in the hand fishery for octopus, algae, etc., and these have been counted in total. Some of the natives are at the head of quite important fisheries, and for many years held a monopoly of the industry, but more recently the Japanese have been engaging in it in large numbers and now occupy second place. The native fish spasmodically, as a rule, while the Japanese give to it their whole time and attention, and as a result are profiting much more. They are especially

> numerous on Oahu and Hawaii, most of them being engaged in deep-sea line fishing, which they virtually monopolize. They have several companies at Honolulu, Lahaina, and Hilo, and in this way control certain features of the fishing industry, thus enhancing the cost of the products to the general public.

Furthermore, Cobb (ibid.) reported that much of the same fishing methods and apparatuses used in early times were still being employed by Kānaka Maoli fishers. These technologies included fishing from canoes and from the shore using nets of various types, spears, basket traps, lures, hand lines, snares, and poles, all of which have been previously described in this study (see Traditional Hawaiian Nearshore Fishing Techniques section). While Cobb provides a variety of statistical information on Hawaiian fisheries during the turn of the 20th century, most interesting is perhaps his detailed list of catch yields sorted by island. His detailed list indicates that near-shore reef species, particularly on Hawai‘i Island, constituted a significant portion of the catch yields during 1900. Throughout the early part of the 20th century, the participation of Japanese in Hawai‘i’s commercial fishing continued to increase, while Kānaka Maoli participation gradually waned (Glazier 2007). As the commercial fishing industry continually expanded to meet the demands of the growing consumer population in the islands, the fish and other marine resources became more scarce. With the shift to a market economy and a commercial fishery these marine resources were valued mostly for their economic potential, and little to no regard was paid to the myriad of traditional values and more that emphasized the spiritual, cultural, familial, and ecological importance of the fish and other marine species. Maly and Maly (2003:ix) contend that “this trend has continued through the present-day and fostered the decline in health and well-being of the broad range and diversity of Hawaiian fisheries.”

Figure 30. Fisherman using the *‘upena ho‘olei* (throw net) ca. 19th century (Hawai‘i State Archives Call No. PP-22-8-003).

Commercial Aquarium Fishing in Hawai‘i

After the turn of the 20th century, on March 19, 1904, the Honolulu Rapid Transit and Land Company established the first public aquarium in Waikīkī, O‘ahu. Known then as the Honolulu Aquarium, Frederick A. Potter (for whom the Potter’s Angelfish; *Centropyge potteri* is named after), who worked as a clerk for the Honolulu Rapid Transit Company became the aquarium’s first Director. During its early years, the Honolulu Aquarium showcased various marine animals that were collected by local fishermen (University of Hawai‘i n.d.; Wiegel 2008). By the 1940s the collection of reef fish and other marine species to be used in aquariums had developed into a commercial industry. Throughout the mid-20th century, the aquarium fish industry went through a period of expansion, moving from O‘ahu to the outer islands. In 1953, the territorial government of Hawai‘i enacted Act 154, which authorized the Board of Agriculture and Forestry to establish a permit system for the use of fine-mesh nets and traps for the taking of aquarium fish (Walsh 2000).

The history of the aquarium fishery in West Hawai‘i has been detailed by Dr. William J. Walsh, of the Division of Aquatic Resources. The following section presents a brief history of aquarium fishing leading up to the creation of the WHRFMA, as described in Walsh’s (2000) report, *Aquarium Collecting in West Hawaii: A Historical Overview.* By the early 1970s, growing public concern over the take of fish in West Hawai‘i prompted the Division of Fish and Game to temporarily suspend the issuance of additional aquarium fish permits. A week later, the Division of Fish and Game resumed issuing aquarium fish permits, but stipulated that permittees submit monthly catch reports—a process that by 1983, was called into question by Fish and Game biologist. Throughout the latter half of the 20th century, as the number of permits continued to increase so did the conflict between different marine user groups, but most notably, dive tour operators. In July of 1987, as a means to deescalate the mounting conflict, DAR (formerly the Division of Fish and Game) in conjunction with Sea Grant helped to establish a “Gentleperson’s Agreement” between the two groups “whereby aquarium collectors agreed to refrain from collecting in certain areas,” and in return, dive tour operators “agreed to not initiate legislative-opposition collecting and to cease harassment” (ibid.:1). This agreement had only short-lived success, however, as conflict continued to mount following the expiration of the agreement a year later, when it was reported that aquarium collectors had resumed operations is the previously closed areas.

Over the next decade, a series of legislative actions were undertaken to establish areas that would prohibit the removal of fish for aquarium purposes. In 1991, the areas previously defined under the “Gentleperson’s Agreement,” were incorporated into the Kona Coast Fisheries Management Areas (FMA), and a year later the Old Kona Airport Marine Life Conservation District was established. In May of 1996, House Resolution (HCR 184) established rules that required DLNR to work in conjunction with a task force in order to develop a comprehensive management plan that would regulate the collection of aquarium fish. In May of 1993, the task force was formed and duly named the West Hawai‘i Reef Fish Working Group (WHRFWG). The roughly seventy member working group met over a period of fifteen months to gather the information that would assist in the management efforts. The working group helped to identify areas where user conflict was most intense, and proposed various management recommendations, which were later included in DAR’s 1997, legislative package.

During this time, DAR staff worked with groups from Ho‘okena and Miloli‘i, Kūki‘o, and Ka‘ūpūlehu—where there was a native Hawaiian presence and participation in fisheries management, and also strong opposition to the take of reef fish for the aquarium industry (Brandt personal communication 2019)—to develop FMA rules for these communities. To improve understanding of the biological impact of aquarium collecting, DAR also established a joint research project with the University of Hawaii at Hilo. These efforts, however, did not come to fruition during the following legislative session. In response to this outcome, several members from the WHRFWG branched out and created the Lost Fish Coalition, who pushed for a complete ban on aquarium collecting in West Hawai‘i. House Bill 3349 was introduced in January 1997 by Republican Paul Whalen, a Representative for the Kona and Ka‘ū Districts. This bill sought to ban aquarium collecting between Kawaihae and Miloli‘i. House Bill 3349 was killed in the following legislative session. House Bill 3457, which eventually established the WHRFMA, and included a provision to set aside 50% of the FMA as FRAs where aquarium collecting would be prohibited, was also introduced in 1997 by Democratic Representative, David Tarnas (North Kona and South Kohala). Following the committee hearings on House Bill 3457, the 50% provision was reduced to 30%, but the bill was ultimately approved by the Hawai‘i State Legislature, where it became Act 306, and thereby established the WHRFMA extending from ‘Upolu Point in Kohala to Ka Lae in Ka‘ū.

4. CONSULTATION

Gathering input from community members with genealogical ties and long-standing residency or relationships to the study area is vital to the process of assessing potential cultural impacts to resources, practices, and beliefs. It is precisely these individuals that ascribe meaning and value to traditional resources and practices. Community members often possess traditional knowledge and in-depth understandings that are unavailable elsewhere in the culture-historical record of a place. As stated in the OEQC Guidelines for Assessing Cultural Impacts, the goal of the oral interview process is to identify information "relating to the practices and beliefs of a particular cultural or ethnic group or groups" (State of Hawai'i, Office of Environmental Quality Control 2012:11). It is our contention that, in addition to assessing the significance of any identified traditional cultural properties, oral interviews should also be used to augment the process of identifying traditional cultural properties. Thus, it is the researcher's responsibility to utilize the gathered cultural-historical background information, as well as the information collected through the consultation process, to identify and describe potential cultural impacts to resources, practices, and beliefs, and to propose appropriate mitigative measures for those impacts as necessary.

In an effort to identify individuals knowledgeable about traditional cultural properties, practices, beliefs, and/or uses associated with the entire WHRFMA, a public notice was submitted to the Office of Hawaiian Affairs (OHA) for publication in their monthly newspaper, *Ka Wai Ola*. The notice was submitted via email on February 14, 2019, and was subsequently published in the March 2019 issue. A copy of the public notice is included as Appendix A of this report. As of the date of this publication, one individual, Diane Makaʻala Kanealiʻi responded to the public notice. Mrs. Kanealiʻi invited ASM staff to the Kailapa Hawaiian Homestead Community located in Kawaihae 1st Ahupuaʻa, as well as to the April 2019 Kai Kuleana Network quarterly meeting held at Manini Beach in Nāpoʻopoʻo. The summaries from these consultation efforts are detailed below. Sixteen individuals participated in the Kailapa Hawaiian Homestead Community interview all of whom reviewed and approved their interview summaries; another thirteen individuals participated in the Kai Kuleana Network interview, of which ten individuals responded with approval to include their thoughts in this study.

In addition to the responses received from the March *Ka Wai Ola* publication, ASM staff contacted an additional thirty-eight individuals (via email and/or telephone) with requests for consultation. Table 9 (presented below) lists all the individuals and/or organizations contacted for consultation and presents brief comments concerning the outcome of the consultation effort. In addition to the thirty-eight individuals contacted by ASM directly, another twenty-five individuals also participated in the consultation process (either through recommendation or invitation of those contacted). In all, a total of fifty-five individuals, representing various communities within the WHRFMA and various user groups (including cultural practitioners, aquarium collectors, subsistence and commercial fishers, dive tour operators, and researchers), participated in the consultation process. The consultation process commenced in March of 2019, and the interviews were conducted between April and September of 2019.

Table 9. Persons/organization contacted for consultation.

Name	*Initial Contact Date*	*Date of Interview*	*Comments*
Bimo Akiona	3/13/2019	4/2/2019	Summary below
Henry Cho III	3/13/2019	n/a	No response
Makani Christensen	6/6/2019	n/a	Makani called on 6/6, spoke with Aoloa. Lokelani called on 6/7, left message with request for interview. Aoloa called 6/10 with request for interview. Did not receive a call back.
Kevin Awa	5/21/2019	9/7/2019	Summary below
Chelsea Faavesi	5/21/2019	9/23/2019	Summary below
Elena Waiwaiole	5/20/2019	n/a	No response.
Kela Pule	5/20/2019	n/a	No response.
Adrian Kuauhia	5/20/2019	n/a	Number was disconnected.

Table 9 continued on next page.

Table 9. continued.

Name	*Initial Contact Date*	*Date of Interview*	*Comments*
Nicki Kohia	5/20/2019	n/a	Aoloa spoke with Nicki. Nicki stated she would call back to set up a time to meet. Aoloa followed up but no response was received.
Henani Enos	3/28/2019	5/5/2019	Interview not approved as of 9/26/2019
Kamehameha Schools, Jason Jeremiah	3/28/2019	n/a	No response
Kehau Springer	3/28/2019	4/29/2019	See summary below. Recommended we speak to the *‘ohana* at Miloli‘i
U‘ilani Macabio	3/28/2019	n/a	No response
Pelika Andrade	3/28/2019	4/12/2019	Summary below
Milton “Shorty” Bertlemann	3/28/2019	n/a	No response
Randy Vitousek	3/28/2019	4/2/2019	Summary below
Mele McPherson	3/28/2019	n/a	Responded via email. Declined to comment and recommended ASM staff speak to Pelika Andrade.
Leina‘ala Lightner	3/28/2019	n/a	No response
Leivallyn Ka‘upu	5/15/2019	n/a	Contacted 5/15 by Kehau Springer. ASM staff followed up on 5/16 to schedule interview. Was interested in participating but was not able to secure a date. Followed up again 6/14. No response
Ka‘imi Kaupiko	5/15/2019	6/28/2019	Contacted 5/15 by Kehau Springer. ASM staff followed up with Ka‘imi. Summary below.
Laila Ka‘upu	5/15/2019	n/a	Contacted 5/15 by Kehau Springer. ASM staff followed up with Laila. No response
Wilfred Kaupiko	5/15/2019	6/28/2019	Contacted 5/15 by Kehau Springer. ASM staff followed up. Summary below.
Bobo Lopez	5/15/2019	n/a	Contacted 5/15 by Kehau Springer. ASM staff followed up. No response.
Limah Lopez	5/15/2019	n/a	Contact 5/15 by Kehau Springer. ASM staff followed up. No response.
Greg Asner	n/a	6/28/2019	Was invited by Ka‘imi Kaupiko to the interview. Summary below.
Gail Garoutte	n/a	6/28/2019	Was invited by Ka‘imi Kaupiko to the interview. Participated in the interview but did not approve her portion of the summary.
Alan Holokai Brown	3/28/2019	n/a	No response.
Akoni Palacat-Nelson	6/21/2019	6/28/2019	Summary below.
Charles Young	3/28/2019	n/a	No response.
Damien Kenison	6/25/2019	8/1/2019	Summary below.
Joe Balsimo	n/a	8/1/2019	Invited by Damien Kenison to the interview. Summary below
Stanford Cho	n/a	8/1/2019	Invited by Damien Kenison to the interview. Summary below.
Hawila Alani	n/a	8/1/2019	Invited by Damien Kenison to the interview. Interview not approved as of 9/29/2019
Nohea Ka‘awa	3/28/2019	6/12/2019	Summary below.
Mel Johansen	n/a	6/12/2019	Invited by Nohea Ka‘awa to the interview. Summary below.

Table 9 continued on next page.

Table 9. continued.

Name	*Initial Contact Date*	*Date of Interview*	*Comments*
John Replogle	n/a	6/12/2019	Invited by Nohea Ka‘awa to the interview. Summary below.
Meghan Lamson	n/a	6/12/2019	Invited by Nohea Ka‘awa to the interview. Summary below.
Shaylan Crysdale	n/a	6/12/2019	Invited by Nohea Ka‘awa to the interview. Summary below.
Lester Gebin	n/a	6/12/2019	Invited by Nohea Ka‘awa to the interview. Summary below.
Kala Mossman	3/28/2019	n/a	Recommended ASM staff speak with James Mahona and Luka Mossman.
James Manoha	5/20/2019	5/23/2019	Summary below.
Luka Mossman	3/28/2019	n/a	No response.
Diane Maka‘aka Kaneali‘i	3/14/2019	4/16/2019	Responded to OHA public notice. Requested that ASM staff meet with members of the Hawaiian Homestead community at Kailapa, Kawaihae as well as the Kai Kuleana Network. Summary below.
Cindy Sharp	n/a	4/16/2019	Invited by Diane Maka‘ala Kaneali‘i to Kaipala Hawaiian Homestead Community interview. Summary below.
Jordan Hollister	n/a	4/16/2019	Invited by Diane Maka‘ala Kaneali‘i to Kaipala Hawaiian Homestead Community interview. Summary below.
Kaena Peterson	n/a	4/16/2019	Invited by Diane Maka‘ala Kaneali‘i to Kaipala Hawaiian Homestead Community interview. Summary below.
Justin P. Asing	n/a	4/16/2019	Invited by Diane Maka‘ala Kaneali‘i to Kaipala Hawaiian Homestead Community interview. Summary below.
Jonah Yardley	n/a	4/16/2019	Invited by Diane Maka‘ala Kaneali‘i to Kaipala Hawaiian Homestead Community interview. Summary below.
Robin Yardley	n/a	4/16/2019	Invited by Diane Maka‘ala Kaneali‘i to Kaipala Hawaiian Homestead Community interview. Summary below.
Ted Angelo	n/a	4/16/2019	Invited by Diane Maka‘ala Kaneali‘i to Kaipala Hawaiian Homestead Community interview. Summary below.
Jimmy Bouncs	n/a	4/16/2019	Invited by Diane Maka‘ala Kaneali‘i to Kaipala Hawaiian Homestead Community interview. Summary below.
Pualani Lincoln Maielua	n/a	4/16/2019	Invited by Diane Maka‘ala Kaneali‘i to Kaipala Hawaiian Homestead Community interview. Summary below.
Tani Waipa	n/a	4/16/2019	Invited by Diane Maka‘ala Kaneali‘i to Kaipala Hawaiian Homestead Community interview. Summary below.
Keali‘i Maielua	n/a	4/16/2019	Invited by Diane Maka‘ala Kaneali‘i to Kaipala Hawaiian Homestead Community interview. Summary below.

Table 9 continued on next page.

Table 9. continued.

Name	*Initial Contact Date*	*Date of Interview*	*Comments*
Mark Keali‘i Freitas	n/a	4/16/2019	Invited by Diane Maka‘ala Kaneali‘i to Kaipala Hawaiian Homestead Community interview. Summary below.
Roger Kaneali‘i	n/a	4/16/2019	Invited by Diane Maka‘ala Kaneali‘i to Kaipala Hawaiian Homestead Community interview. Summary below.
Susan Fischer	n/a	4/16/2019	Invited by Diane Maka‘ala Kaneali‘i to Kaipala Hawaiian Homestead Community interview. Summary below.
Paul Fischer	n/a	4/16/2019	Invited by Diane Maka‘ala Kaneali‘i to Kaipala Hawaiian Homestead Community interview. Summary below.
Chad Wiggins	4/2/2019	4/16/2019	Arranged for ASM staff to meet with the Kai Kuleana Network.
Cecile Walsh	4/12/2019	4/16/2019	Arranged for ASM staff to meet with the Kai Kuleana Network.
Hannah Kihalani Springer	n/a	4/16/2019	Member of the Kai Kuleana Network. Summary below.
Kalani Hamm	n/a	4/16/2019	Member of the Kai Kuleana Network. Summary below.
Reggie Lee	n/a	4/16/2019	Member of the Kai Kuleana Network. Summary below.
George Fry III	n/a	4/16/2019	Member of the Kai Kuleana Network. Summary below.
Pi‘i Laeha	n/a	4/16/2019	Member of the Kai Kuleana Network. See summary below.
Aric Arakaki	n/a	4/16/2019	Member of the Kai Kuleana Network. Summary below.
Ku‘ulei Keakealani	n/a	4/16/2019	Member of the Kai Kuleana Network. Summary below.
Krista Johnson	n/a	4/16/2019	Member of the Kai Kuleana Network. Summary below.
Chuck Leslie	n/a	4/16/2019	Member of the Kai Kuleana Network. Summary below.
Francis Ruddle	n/a	4/16/2019	Member of the Kai Kuleana Network. Did not approve summary.
George Roberson	n/a	4/16/2019	Member of the Kai Kuleana Network. Did not approve summary.
Mike Nakachi	6/21/2019	6/26/2019	Summary below.
Ling Nakachi	n/a	6/26/2019	Invited by Mike Nakachi to interview. Summary below.
Kaiakea Nakachi	n/a	6/26/2019	Invited by Mike Nakachi to interview. Summary below.
KAHEA Hawaiian Environmental Alliance	6/21/2019	n/a	Called on 6/21, left message. Sent interview request to Jon Osorio on 6/25 and to Bianca Isaki on 7/2. Corresponded with Bianca but was not able to secure a date for an interview.
Kealoha Pisciotta	6/25/2019	7/5/2019	Summary below.

Table 9 continued on next page.

Table 9. continued.

Name	*Initial Contact Date*	*Date of Interview*	*Comments*
Department of Hawaiian Homelands (DHHL), William Aila	6/25/2019	n/a	No response.
Office of Hawaiian Affairs (OHA)	n/a	6/29/2019	Request for consultation forwarded from Shane Palacat Nelson, OHA Outreach Coordinator for West Hawai‘i to Kamakana Ferreira, OHA’s Lead Compliance officer.
Joseph “McGee” Akiu, Jr.	9/10/2019	9/10/2019	Summary below

End of Table 9

INTERVIEW METHODOLOGY

ASM staff utilized a combination of informal one-on-one interviews as well as informal group interviews. The locations at which the interviews took place were determined by the individual, or the point of contact for the group interviews. While one-on-one interviews afford the researcher the opportunity to gather more detailed personal history, the group interviews (which ranged from five or six to more than sixteen participants) allowed for more nuanced discussions about the topic, but limited the researcher’s ability to gather detailed personal history. As a result, most of the group interviews focused more on knowledge of past, and/or ongoing cultural practices, general thoughts on the proposed action, and recommendations, rather than personal recollections. All of the interviews were conducted in person with the exception of the interviews conducted with Pelika Andrade, Kevin Awa, Joseph Akiu, Jr., and Chelsey Faavesi, which were conducted by phone.

Prior to the interview, ASM staff provided a written description of the proposed action, its location—which included maps showing all current marine managed areas in the WHRFMA (see Figure 1)—and the “white-list” species that included any known Hawaiian names, scientific name, and common names (see Table 3). The interviewees were asked five primary questions about:

1) their personal background and connection to the study area;
2) their knowledge of any past and or ongoing customary cultural uses, beliefs, traditions, and practices within the proposed project area;
3) any traditional cultural knowledge, beliefs, and uses of the forty “white-list” species;
4) their thoughts on whether the proposed action would result in any impact on traditional cultural practices, beliefs, and uses associated with the study area or the “white-list” species; and
5) their recommendations to mitigate any identified cultural impacts as well as share any additional through about the proposed action.

Some of the interviews, with the consent of the interviewees, were audio recorded for note taking purposes only (audio files are not available). Where audio recordings were not permitted, ASM staff recorded hand-written notes throughout the interview process. Upon completion of the interview, ASM staff prepared an interview summary, which was later emailed to the interviewees for review. To ensure that the summaries prepared by ASM staff accurately reflected the thoughts, feelings, and information shared by the interviewees themselves, ASM staff afforded the interviewees the opportunity to review the summary and revise, edit, or delete any information as they saw fit. Where revisions were requested, ASM staff continued to work with the interviewees, making all requested changes. The approval to publish the summaries was obtained by ASM staff via email or phone. The final interview summaries are presented below, these summaries were all reviewed and approved by the interviewees prior to the publication of this CIA.

BIMO AKIONA

On April 2, 2019, Lokelani Brandt interviewed Mr. Edward “Bimo” Akiona, a retired firefighter for the County of Hawai‘i and a former aquarium fish collector. Born in Hilo, Hawai‘i in 1954, Bimo shared fond memories of spending the entire summer at his uncle’s home in Kahalu‘u, Kona, where he gained his love and respect for the ocean. At the age of eight, Bimo recalled being given a pair of bamboo goggles by his uncle Jimmy, with instruction to peer under the water. Bimo remembered peering under the water and was amazed by the active reef and ocean life below. It was this childhood experience that established his deep connection to the ocean, leading him to become an expert diver

and fisherman. Bimo shared that one of the most important traits of being a diver or fisherman is their observation skills, which includes understanding changes in the tide, the moon cycle, the time of day that was most ideal for fishing, fish habits, and conservation practices. From a very young age, fishing and diving was simply a way of life for Bimo.

Bimo's involvement with aquarium collecting began when he returned to Hawai'i Island and later joined the Hawai'i Police Department. Bimo shared that his very first case as a police officer involved a dive shop, which eventually led to his involvement in the aquarium collection industry. In 1985, Bimo started his own aquarium fish collection company, which he operated for eight years. He shared that growing up and learning about the ocean from his family helped to guide much of his business practices. Bimo recalled his primary collection areas extending from Kulaimano to Hōnaunau as well as from Kawaihae Harbor to 'Anaeho'omalu as well as Ka Lae. His experience in diving and fishing in these areas and observing fish behavior and cycles had led him to believe that certain areas should be restricted from all forms of commercial activities, namely Puakō, Kaiwi Point (from Honokōhau to Kailua Bay) as well as Ka Lae. Bimo stated that the aforementioned areas are where breeding groups congregate and for this reason, should be protected. He also stated that at Ka Lae in the district of Ka'ū, the ocean conditions in this area can be treacherous to novice fishers and divers.

When asked if he knew of any traditional practices within the region, he shared that he would see people gathering *'ōpihi* or laying net but believes the lack and difficulty in coastal access have limited the number of practitioners. Bimo believes that over time these families that no longer have access to these areas have lost their connection and as a result no longer possess the traditional knowledge and practice of these places. He believes it is important for families and people with ties to the area to be given access. However, although Bimo is in favor of giving access to families and communities he recommends that certain areas should be restricted from commercial use in order to improve and restore the ocean resources.

When asked if the proposed project could result in any potential cultural impacts, Bimo did mention that aquarium collecting methods can have a damaging effect on the reef, which in itself, is considered a valued cultural resource. He spoke specifically about the method used to capture and remove Potter's Angelfish (*Centropyge potteri*), Hawaiian Flame Angel (*Cirrhilabrus jordani*), Hawaiian Saddleback Butterfly (*Chaetodon ephippium*), and Angler fish (*Antennarius sp*.) and all eels. Bimo explained that these species often conceal themselves deep within the coral reefs and that removing them requires significant damage to the reefs. He believes that the economic value of these fish does not justify the environmental damaged required to catch them. Because of the damaging effects, he strongly recommends that these fish not be caught and removed from Hawai'i. However, Bimo shared that the collection and removal of invasive species would yield long-term benefits to Hawai'i's reef systems. He has witnessed firsthand the dramatic impacts of introduced species such as the Bluestripe Snapper (*Lutjanus kasmira*), also known as Ta'ape, that has contributed to a decline in reef fish population. Bimo noted additional impacts to Hawai'i's reef system which includes runoff and pollution. Following major storms, he has witnessed drastic changes that have completely devastated ocean wildlife and reef systems, which has adversely impacted many subsistence fishers.

Mr. Akiona shared that the business of fish collection requires a great deal of "self-management" and should always include conservation practices. He further explained that policies and restrictions did not exist when he was involved in the industry, but managed to heed the teachings of his elders to "*mālama* your resources." He strongly feels that these businesses should have a "connection to place" and be respectful of the resources, particularly in Hawai'i, where cultural values and traditions continue to thrive. In his experience, Bimo was involved and witnessed many disputes between "shop divers" and "dive operators." Dive operators have argued that aquarium collectors were "raping the ocean," implying that they were taking all the fish from certain areas. Disturbed by the untrue statements, Bimo began attending public meetings to stay informed and remain involved in the process when policies and restrictions were being written. Bimo also spoke about the safety issues of the business, having been put in a hyperbaric chamber several times due to having the bends, or decompression sickness. The demand of the business may affect "self-management" practices and suggests that divers take caution not just from a cultural standpoint but also for a person's health as the industry require divers to spend a substantial amount of time in the ocean.

RANDY VITOUSEK

On April 2, 2019, Lokelani Brandt interviewed Randy Vitousek, a third-generation fisherman and long-time resident of Waimea on Hawai'i Island. Randy frequents the coastal fisheries in West Hawai'i, primarily in the areas between Kīholo in North Kona and 'Upolu in Kohala. He is experienced in shoreline fishing and diving but now prefers deep-sea vessel fishing. He has held a commercial fishing license for the past twenty-five years. Randy shared that he comes from a family of fishermen and learned how to fish from his father at a very young age. His grandfather owned a boat and his grandfather and father would bring the boat from Kewalo to Kailua-Kona or Kawaihae to fish. Randy stated

that he learned about the ocean from his father and from other men and women of his father's generation, and this accumulation of knowledge is something he has passed on to his children and grandchildren.

When asked if he was aware of any ongoing traditional cultural practices along the West Hawai'i coastline, Randy stated that "modern fishing is a continuation of cultural practices, but with more durable gear." He describes that fishing practices are based upon a person's awareness of the ocean and marine life patterns, such as understanding what areas are abundant with a certain species of fish and the reasons they are so abundant in these specific areas. Randy added that these basic observations are considered traditional knowledge, the difference being that *kupuna* (ancestors) depended on this intimate knowledge much more than we do today. He noted that the advancement of fishing technology and equipment has altered our dependency on the ocean and our understanding of marine life patterns. Randy, however, emphasized that the activity is the same, more so for those fishing for subsistence purposes. He noted that subsistence fishing and even some commercial fishers help to provide food for family and friends, which continues the practice of connecting with the ocean environment.

Randy believes that living on an island is a remarkable experience as it forces people to take care of their resources and each other. Randy noted that this same kind of behavior that is seen in other island communities around the world who depend on the ocean. This involves developing common practices and beliefs based on environmental conditions and understanding the limitations of the land, which necessitates harvesting resources from the ocean. Randy opined that there is something important to be said for people who make a living on the ocean. He went on to explain that when we lose the ability to make a living on the ocean or from the ocean resources, we also lose important knowledge about the ocean. He believes that having vibrant marine employment is this is an important part of living on an island and that all people have a unique place in our communities. He emphasized that markets are ever-changing and noted some of the historical changes in Hawai'i's fishing industries. Randy pointed out that at one time there was a big market for *aku* (*Katsuwonus pelamis*) and now economically the aquarium fishing is or can be a big component of this ever-changing market.

When asked if there were any potential cultural impacts associated with the proposed action, Randy stated that he has witnessed many changes in fishing in Hawai'i, particularly along the West Hawai'i region. Although Randy is not against aquarium fishing, he stated that easily accessible areas like Puakō, NELHA, and Kawaihae Harbor should be temporarily closed, have restrictions, or have bag limits, as he has seen a major decline in reef population in these areas, which he believes is associated with "catch and kill" fishing. Although seasonal changes pose some difficulty in determining an overall trend and knowing the catch statistics, he has personally not seen any significant changes in off-shore and in deeper waters. He recommends and advocates for easily accessible areas to be a preserve as a "no-take, catch and release" or limit fishing to families and children so they can stay connected or reconnect to the ocean. Randy emphasized that these simple fishing practices teach basic skills and knowledge in fishing and the practice of observation, which are vital for our future generations. Despite this, he believes that there should be an appropriate and regulated amount collected for all fishing, commercial and non-commercial that is based on reliable scientific evidence. He explained that there should be "controls based on sustainable yields of different species" as well as having certain areas restricted and catch areas rotated. He believes aquarium fishing is a good thing for the communities because it allows for the "continuation of the tradition to harvest the sea" and further added that aquarium collection "is not culturally inappropriate as long as the practice is done with respect for the ocean and its resources."

Randy also spoke about *ko'a* (traditional fishing grounds) and when asked if the tradition of fishing at the *ko'a* in West Hawai'i would be impacted by the proposed action, Randy spoke specifically of *'ōpelu* (*Decapterus pinnulatus* and *D. maruadsi*). He has seen about four or five *'ōpelu ko'a* situated between Kawaihae and 'Upolu and added that it tends to be associated with a *hale wa'a* (canoe house) on land. These highly concentrated areas of *'ōpelu* have a thriving ecosystem that builds up around them. He mentioned that off-shore fishing *ko'a* is not fixed to a particular spot rather it shifts in a known area and its location is determined by where the fish congregate. Randy expressed that aquarium fishers will not likely affect these traditional fishing *ko'a* because aquarium fishers often fish close to the shore. Randy believes that Native Hawaiians should be allowed to continue their practice and hopes that the proposed action does not adversely affect Native Hawaiians communities who rely on the ocean.

Randy's understanding of the aquarium industry is that they try to limit the destruction to the reef and to the fish. He explained that using a finer mesh net instead of a gill net would allow for the proper handling of the fish and limit any damage to the fish. Based on his knowledge of the industry and if the proper measures based on valid science are taken to ensure sustainable harvesting of aquarium fish, Randy does not anticipate any major cultural or environmental impacts.

Randy believes that regulatory efforts should focus on enforcing existing fishing laws, developing science-based quotas, size limits and fishing areas, and improving parks, harbors and public marine and coastal facilities to encourage residents and visitors to have easy, authentic connection to the ocean around us.

PELIKA ANDRADE

Pelika Andrade, an Extension Agent for the Hawai‘i Sea Grant was interviewed via phone by Lokelani Brandt on April 12, 2019. Born on the island of Kaua‘i, to a family adept at the cultural and physical aspects of the ocean, Pelika recalled spending most of her childhood on and in the ocean. Her upbringing and later experiences led her to the field of marine resource management, where she has earned a degree in Hawaiian Studies and certificates in Marine Science and Pacific Island Studies. Currently residing in Waimea on Hawai‘i Island, Pelika continues to develop educational programs that integrate traditional knowledge and science to address issues facing marine resource management in Hawai‘i.

When asked if she knew or witnessed any traditional fishing practices occurring within the West Hawai‘i region, Pelika offered an in-depth perspective on the “traditional” practice of *lawai‘a* (fishing). She described the *kai* as inseparable from the *‘āina* (land), literally translated as “the thing that feeds (us),” and just as a farmer would tend to their fields to ensure its productivity, the *lawai‘a* (fisher) did the same. In describing how the Hawaiian fisher tended to the ocean, she explained that the people fed the ocean with food that they grew and noted the *ko‘a* as an example of this feeding practice. She highlighted that the practice of *kilo* (astute observation) played an important role for the fisher that allowed them to understand the nuances of the ocean environment as well as any seasonal correlations. *Kilo* provided the *lawai‘a* with an in-depth understanding of natural fish cycles and its relationship to its ecosystem and the greater ocean. Pelika stated that in some areas, the *lawai‘a* (fishers) role in a community was so valued that the chiefs often relied on the *po‘o lawai‘a* (head fisher) to determine what and when certain practices were to take place—a role that was often delegated to the *konohiki* or headman of an *ahupua‘a*. She explained that the *lawai‘a* (fisher) spent a large majority of their time “tending to the ocean garden,” and that the act of *lawe i‘a* (taking fish from the ocean) constituted a very small component of this tradition. She noted that when large communal fishing was performed, it was done at the order of the *po‘o lawai‘a* or the *konohiki* and the collected resources benefitted the whole community, providing both a short and long-term supply of food. Adding to this, she explained that traditionally, when decisions were made, an individual was held accountable to that community. Pelika edified that fishing is a practice that is found around the world, but in Hawai‘i the traditional practice of fishing encompassed caring for one’s equipment and gear, understanding the natural cycles, seasonality, and productivity; but most importantly, traditional *lawai‘a* in Hawai‘i is fully engaging in the practices of managing marine resources, and being an active contributor to its productivity and its ecosystems. She expressed that *lawai‘a* are acts of sustainability, which in her view is the balance of sustainable marine resources and thriving and productive communities.

When asked if the proposed project would lend to any potential cultural impacts, Pelika compared the practice of *lawai‘a* to aquarium fish collection as it is practiced in Hawai‘i today. She evaluated that *lawai‘a*—the reciprocal relationship between man and the environment—and aquarium collection, which focuses on the act of *lawe i‘a*, removing fish from the ocean does not align with the Hawaiian worldview of caring for the ocean and its resources. She stated that aquarium fishing is not about feeding those at your table, but a business that impacts that larger community. She feels that there is no accountability to the communities that are impacted by this industry, which was a fundamental aspect of traditional fishing practices. Based on this, Pelika believes that the proposed project would lend to adverse impacts to the community and is not aligned with traditional fishing practices. She went on to explain that with aquarium collection, “there’s no tending process, only *lawe i‘a.*” She argued that modern aquarium collection practices negatively impact fisheries and disrupts traditional knowledge systems, because there is no input or contribution to maintaining the very resource that the industry is dependent upon. She emphasized that the practice of *kupuna* (Hawaiian elders) was not based exclusively on *lawe i‘a* (taking fish), rather the act of *lawe i‘a* was carried out after a fisher understood all of the other components that allowed for healthy marine resources. She argued that identifying oneself to the act of *lawe i‘a* (taking fish) with no forms self-management, severely limits the individual from fully embracing the traditional practice of *lawai‘a*, which emphasized caring for the resources. Pelika opined that the act and the sense of entitlement associated with *lawe i‘a* (taking fish) can be applied to other fishing industries, from commercial to subsistence fishing. She explained that this mindset shift from caring for our resources, to entitlement to our resources, is a result of a lifestyle change. For these reasons, Pelika does not support aquarium fishing and other fishing practices or industries that make no effort towards contributing to maintaining the resources or encourages self-management.

While Pelika was not against utilizing our resources to support our families and communities, she strongly advocated for changing the current mindset and practice of *lawe i‘a* (taking fish). She argued that Hawai‘i’s current

system of marine management, which is comprised of western concepts and rules, is set up in such a manner that accepts the mindset and practices of *lawe iʻa*—a causal element that has led to the decline of our marine resources along with other important factors such as water diversions (affecting estuary and nursery habitat), development (increasing nitrification and affecting water quality), and management rules/regulations that work against productive fisheries. She opined that the contemporary practice of establishing marine preserve areas, rest zones, and conservation areas, have also impacted the traditional practice of *lawaiʻa*, because it disrupts people's ability to interact with and understand the productivity of the resource in an area. She noted that there are conservation models that are trying to counter western system of marine resource management. Despite these efforts, she explained that these models often fall short, because they do not support caring for the resources nor do they foster developing a relationship to place, both of which were crucial to sustaining traditional *lawaiʻa* practices. Pelika also questioned the industry's techniques and methods to harvest fish, noting that some methods are known to be destructive to coral heads and general productivity of targeted species. She also questioned the quantity of fish that are being harvested from Hawaiʻi's reefs for the aquarium industry.

When asked for recommendations on how we can improve the current state of aquarium fish collecting in Hawaiʻi, Pelika commented that anyone choosing to utilize our marine resources whether for subsistence or commercial use should have a more holistic understanding of the resources. She believes that these individuals and industries should sustainably interact with our marine systems and make more than financial contributions to ensuring Hawaiʻi's marine resources are thriving and productive. She noted that most people seem to be aware of the industry's failures and drawbacks rather than its benefits. She expressed that all aspects of this industry have remained shrouded in mystery resulting in a poor public perception and understanding. While Pelika felt that she did not know a significant amount about the aquarium industry or how to resolve the contentious relationships, she does know that the conservation proponents are at one end of the spectrum and noted that "rarely is the loudest voice, the one in the middle or the voice of reason." She expressed that many who are screaming "conservation" rarely are attached to the lifestyle that is dependent upon fishing. She opined that this is also true for those proponents advocating for aquarium fishing. She believes that this is not a fair representation and what has resulted is an emphasis on "bad practices" of the industry.

Pelika also explained the importance of having a proper balance of small and large fish in Hawaiʻi's reefs to ensure minimal disruption to natural fish cycles. She believes that the aquarium industry as well as others that remove fish from the ocean should have export limits that are reasonable and are based on the percentage of local fish stocks. Hypothetically, Pelika explained that if the amount allowed to be collected is based on the percentage of local fish stocks, when the number reaches below a certain percent, then the industry needs to advocate for management and better fishing practices and only then will we all benefit. She believes that as a part of their responsibilities to their industry and to Hawaiʻi's fisheries, the aquarium industry should invest in aquaculture, which would teach them how to grow and spawn their own supply and make contributions to replenishing the fish removed from our waters. Pelika believes that if the aquarium industry and fishers want to continue to reap the benefits of removing fish from the sea, it needs to be a shared initiative and there must be a shift towards a more reciprocal relationship.

KAI KULEANA NETWORK: ARIC ARAKAKI, GEORGE FRY III, KALANI HAMM, PIʻI LAEHA, REGGIE LEE, MAKAʻALA KANEALIʻI, HANNAH KIHALANI SPRINGER, KUʻULEI KEAKEALANI, KRISTA JOHNSON, AND CHUCK LESLIE.

In response to the OHA public notice published in February 2019, Lokelani Brandt was invited to the April 16, 2019, Kai Kuleana Network quarterly meeting held at Manini Beach in Nāpoʻopoʻo, Kealakekua, Hawaiʻi. Kai Kuleana Network is comprised of multiple members representing various *ahupuaʻa* communities from Kohala to South Kona on Hawaiʻi Island. A total of fifteen individuals were in attendance of which twelve participated in the talk-story, sharing their knowledge of traditional cultural practices associated with their respective areas throughout West Hawaiʻi as well as their knowledge of some of the fish species listed on the "white-list." Participants included, Aric Arakaki of Ala Kahakai National Historic Trail, George Fry III of Puakō, Kalani Ham of Keauhou-Kahaluʻu and Laʻaloa, Piʻi Laeha of Kalāhuipuaʻa, Reggie Lee of Kaloko-Kohanaiki, Makaʻala Kanealiʻi of Kawaihae, Hannah Kihalani Springer and Kuʻulei Keakealani of Kaʻūpūlehu, and Krista Johnson and Chuck Leslie of Nāpoʻopoʻo. While the individuals spoke at various points throughout the interview, for readability, their individual thoughts and insights have been compiled into paragraph form and are presented below.

Kalani Hamm: Kalani noted that her family often used the beach as part of their cleansing ceremonies. She also recalled one of the last *hukilau* taking place in Kailua-Kona in 1948. She described that in the past, these large communal fishing efforts provided food for multiple communities. Kalani recalled going to *kūʻula* to *pule* (pray). She remembered going to the ocean while the fish were sleeping to catch them and using them as offerings.

Reggie Lee: Reggie spoke about the importance of *mālama*, caring for our resources, a practice that was handed down to him by his mother tūtū Maluʻihi. He shared that knowledge of different fishing spots was handed down in families. He added that the aquarium industry should consider raising their own fish to supply its industry. And if fish are to be taken out of the ocean, the industry should assist with supplementing the fish stock by investing in hatcheries. Reggie also emphasized the importance of having adequate enforcement, noting that there are very few DOCARE officers that patrol this region. With the aquarium industry potentially adding to the workload, he recommended that the aquarium industry should help to supplement DOCARE's efforts so they can be productive in enforcing the rules and regulations.

Hannah Kihalani Springer: Hannah explained that in the past, people delighted in eating a wide variety of reef fish, but today, peoples preferences are more limited and fewer varieties of fish are eaten. She spoke of encouraging each other to develop an *ʻono* for different kinds of fish. She also emphasized the importance of restoring our food producing capability and capacity. In reviewing the "white-list" species, Hannah remarked that the wrasse, the *hīnālea* fish, is a *kinolau* or physical embodiment of the god Kanaloa. She described another wrasse, the *hilu*, as being representative of positive attributes and that in traditional times it was venerated and that its importance is recorded in several traditional accounts. Hannah stressed the ecological importance of reef fish, describing them as cleaners and rehabilitators of reef ecosystems. She questioned what the aquarium fish industry's contribution to the public trust, that includes the aquatic resources of Hawaiʻi is. She questioned the sustainable yield quotas for the aquarium fish industry and stressed the importance of them.

Makaʻaka Kanealiʻi: Makaʻala highlighted the extent of the traditional *ahupuaʻa* boundaries. In her community in Kawaihae, she explained that the traditional *ahupuaʻa* rights extended three miles out into the ocean. She explained that in her community, they are working towards restoring their traditional fishing rights and practices so that families can once again utilize the ocean for sustenance. She strongly opposed the proposed issuance of commercial aquarium collection permits because this action is not aligned with the current efforts to restore physical and cultural aspects of the fisheries in West Hawaiʻi. She commented that aquarium collection is disrespectful to the fish and that when we capture fish without having the intent to consume them, then we lose the function of the fish. Makaʻala added that what are the fines and repercussions for aquarium collectors that do not comply with the laws. She hopes that DLNR considers having more rigid fines and serious repercussions to those who violate the law.

George Fry III: George spoke of many subsistence fishermen who access the Puakō area to gather fish and *ʻopihi*. He described this area as once having an abundance of fish but noted that today the fish stock has been seriously depleted, which he attributes to overfishing, warming waters, and poor water quality.

Piʻi Laeha: Piʻi opposed the proposed action and stated that there should absolutely no collection of fish for the aquarium industry outside of Hawai'i, especially any endemic fish that is listed on the "white-list." Piʻi emphasized that having fish in the ocean is important for educational purposes but also with the education and awareness process, it should allow established institutions in Hawai'i, those that show a perpetual responsibility for fish sustainability, the opportunity to responsibly collect fish under a Special Activity Permit. Piʻi described the near-shore zones as the place where it is the safest for *keiki* (children) to learn about marine life and added that... *ʻaʻohe pau ka ʻike i ka hālau hoʻokahi* (all knowledge is not taught in a single school).

Aric Arakaki: Aric spoke about coral bleaching in West Hawaiʻi and asked if coral bleaching is being accounted for in the scientific studies that are being done for the EIS?

Kuʻulei Keakealani: Kuʻulei emphasized that culturally fish are connected to humans and that this connection is well recorded in the Hawaiian cosmogony chant, *Kumulipo*. In referencing the *Kumulipo*, Kuʻulei further explained that certain fish was paired with a land/forest counterpart. In Hawaiʻi, certain fish often shared familial bonds with particular individuals and families who cared for them. In turn, these fish aided the fisher in their endeavor. She noted that within one generation in her family, their reliance on fish and some of the associated cultural practices such as praying to *kūʻula*, a Hawaiian fishing deity, has changed significantly. Despite these changes, she stood firm in her belief that Hawaiian today must continue to maintain our traditions. She stressed that familial bonds to our oceans must be considered as an important cultural tradition. Kuʻulei also spoke of the ceremonial aspects of fish, noting that some fish were desirable for certain cultural practices. She stated that these aspects of Hawaiian culture are still being practiced. Adding to this Kuʻulei stated that "the *kai* is medicine for us, truly something or place that is sought for healing, a sense of well-being, a familiar part of the *kanaka* being. *Iʻa* (fish) therefore, is looked at as *lāʻau* as well." She expressed that she has family stories of *kupuna* (*elders*) requesting certain species of fish to treat particular

ailments. Kuʻulei explained that whether it's the fish name and or color, healing properties are held in fish species and this knowledge and practices are still in the living memory of folks and further applied in our lives. She added that the lack of fish necessary for these facets of our cultural ways has a direct impact on the health of our *kanaka*. In her closing remarks, Kuʻulei stated, "truly, healthy land and sea, healthy people!"

Krista Johnson: Krista commented that there is so much death with aquarium collection and spoke of instances when bags of dead fish were found in Kona. She questioned whether the industry is going to self-regulate? She worried that the current enforcement is not adequate and hope that more enforcement officers will be added.

Chuck Leslie: Check asked, "why should people take our fish just for pleasure?" He emphasized that we should be encouraging people to come to the ocean and view our marine life first hand. Chuck, who has fished at *koʻa* was asked specifically whether the proposed action would impact the tradition of *koʻa* fishing. He explained that *koʻa* are typically located offshore and in deeper waters and that aquarium collectors fish closer to shore and are targeting different fish species. For these reasons, he didn't anticipate the proposed action to have an impact on the traditional fishing *koʻa*. He did, however, recall the tradition of *imu*, which involved the construction of stone houses on the reefs. He explained that stones were often stacked in the water on the reefs and that these houses would attract fish. After the fish had become accustomed to living in the *imu*, people would throw their net over the house and catch the fish. Kuʻulei added that the *imu* was typically built so that *kupuna* (elders) and *wahine* (women) could fish easily and safely. Hannah noted that fish *imu* was known to exist at Kaʻawaloa and Kīholo. Chuck expressed that the *imu* fishing method is a dying art.

KAILAPA HAWAIIAN HOMESTEAD COMMUNITY: CINDY SHARP, JORDAN HOLLISTER, KAENA PETERSON, JUSTIN P. ASING, JONAH YARDLEY, ROBIN YARDLEY, TED ANGELO, JIMMY BOUNCS, PUALANI LINCOLN MAIELUA, KEALII MAIELUA, TANI WAIPA, MARK KEALII FREITAS, MAKAʻALA AND ROGER KANEALIʻI, AND SUSAN AND PAUL FISCHER

In response to the OHA public notice published in February 2019, Lokelani Brandt was invited by Makaʻaka Kanealiʻi, (the President of the Kailapa Community Association) to the Kailapa Hawaiian Homestead Community in Kawaihae Ahupuaʻa, Kohala. Makaʻala Kanealiʻi organized a community meeting, which was held at the Kailapa Community Center and a total of sixteen individual representing two distinct communities (Kailapa Hawaiian Homestead community and the nearby Kohala Estates), were in attendance all of whom participated in the talk-story. The names of the participants from Kailapa are Cindy Sharp, Jordan Hollister, Kaena Peterson, Justin P. Asing, Jonah Yardley, Robin Yardley, Ted Angelo, Jimmy Bouncs, Pualani Lincoln Maielua, Kealii Maielua, Tani Waipa, Mark Kealii Freitas, Diane Makaʻala Kanealiʻi and Roger Kanealiʻi. Representing Kohala Estates, were Susan and Paul Fischer. The community members expressed that they would like their *manaʻo* and concerns to be expressed as a unified voice instead of individually.

When asked if they were aware of any ongoing traditional cultural practices, the community expressed that fishing from the reef is an ongoing traditional cultural practice. They emphasized the traditional practice of taking only what is needed is a practice that has been taught to them and is something they are passing down to their children. They stressed that culturally, fish that was caught was for eating and that the Hawaiian saying, "*ka ʻai a me ka iʻa*" literally translated as "the vegetable and the fish" constituted a complete meal. In looking at the "white-list", some individuals added that *iʻa* (fish) was and will always be an important part of the Hawaiian diet. They noted that many of the fish on the "white-list" are still caught for subsistence purposes and stressed that fishing is part of Hawaiʻi's subsistence economy. They also spoke about the Hawaiian cosmogony chant *Kumulipo*, and urged for the need to maintain balance in our marine ecosystems. Some members shared that *pule* (prayer) was integral to maintaining balance and to traditional fishing practices.

Several community members spoke about the fishing *koʻa* in their area and noted that some fishers continue to *hānai* (feed, care for) these *koʻa*. They described that every family in an *ahupuaʻa* had and maintained a *koʻa*. They stated that everything in the ocean is a part of Hawaiian culture and that every species has a role in maintaining a healthy marine ecosystem.

One community member noted that the Kohala shoreline was once considered a spawning ground and that the historical changes that have occurred on land have severely impacted the coral reefs in some areas. One community member recalled seeking a lot of black coral in the area and that today, it is almost impossible to find any. They noted

that during episodic rain events, the runoff from land clouds the ocean for weeks at a time, leaving the coral reef severely depleted.

In their collective efforts to better steward their marine resources and the entire Kawaihae *ahupuaʻa*, the Kailapa community has been active in maintaining the traditional practice of *kilo* or astute observation. One community member emphasized that *kilo* is one way they are improving their understanding of their resources so that they can properly manage these resources. This community member also emphasized that proper stewardship is "always about management" and "never about taking." It was also stressed that Hawaiians continue to maintain and revive their traditions, practices, and beliefs. Also, highlighted was that the idea that society today requires the culture to evolve and naturally the practices, traditions, and beliefs coevolve with it.

The Kailapa Community members and those from the Kohala Estates spoke openly against the collection of reef fish to supply the aquarium industry. Many stated that the practice of catching fish without intending to consume it goes against traditional belief and that this act is not *pono* (proper, morally fitting, beneficial). They expressed that all fish are part of the public trust and that removing fish to supply a "lucrative" industry undermines traditional practices and beliefs associated with the ocean. They urged people to view fish in their natural environment where their colors are bright and brilliant. Several community members expressed concern for the high mortality rates of aquarium fish. They believe that removing any part of the ecosystem alters the natural balance and that removing small fish disrupts the natural food chain. The members from Kohala Estates believe that the aquarium industry is unsustainable.

They urged for more fish studies, and for establishing open and closed seasons that are based on fish stocks. They believe that if the permitting is approved then there should be more DOCARE officers and that the aquarium industry should help to offset the additional operating costs. The community did support the removal of those invasive species noted on the "white-list" and saw this as a benefit to restoring balance to the reef system in West Hawaiʻi.

JAMES MANOHA

On May 23, 2019, Aoloa Santos conducted an interview with James Manoha, a *kamaʻāina* of Naʻalehu and retired fireman. James is also a recreational and commercial fisherman, which he has done for over thirty years. James frequents the coastal fisheries in West Hawaiʻi, primarily in the Ka Lae or South Point region in the Kaʻū District. He is experienced in a range of fishing activities such as spearfishing, diving, pole fishing, throwing net, and boat fishing, and utilizes the ocean resources primarily for subsistence purposes.

When asked if he was aware of any ongoing traditional cultural practices along the West Hawaiʻi coastline, James stated that traditional cultural practices have definitely evolved and fishing practices have changed, though the need to survive has remained. James shared that he has witnessed many native Hawaiians fishing, using various methods, for subsistence purposes. He identified species on the white-list that were traditionally and are still utilized as an important source of food. James noted that within his *ʻohana* (family) the *pākuʻikuʻi*, *lāʻī pala*, and *kole* are amongst some of their favorite eating fish.

When asked if there were any potential cultural impacts associated with the proposed action, he stated that the fish on the white-list are numerous and therefore feels aquarium collection of these species would not negatively impact fish population and subsistence practices. However, he strongly advocated, with respect to the general harvesting of resources for subsistence or commercial purposes, that any permitting process give preference to those of "Native Hawaiian blood." James believes that the ocean is a resource that should be utilized to support families, whether for subsistence or financial and therefore, supports recreational or commercial fishing practices as long as it is done sustainably and responsibly. He further emphasized that "it is our responsibility to take care of our resources" and does not support the "abuse of resources," or overfishing practices.

James also spoke extensively about the implementation of "restricted areas" and explained that over the years, he has witnessed significant growth in fish populations which he credits to the implementation of "restricted areas." He also added that the literature and research he has reviewed supports many of his observations. Argumentatively, James added that although "restricted area" designations have produced positive results for heavily impacted coastal fisheries, he, in turn, has witnessed unnecessary designations that negatively impact subsistence fishing practices. He stated that he is concerned about a recent "restricted area" designation from Kaʻaluʻalu to Kahuku, an area that is renowned for its "bottom-fishing" grounds. He argued that this new restricted area is "self-regulated" due to rough seas and numerous predators. He added that there is no scientific basis that supports the creation of this "restricted area" which has led him to believe that it was created due to federal demands and pressures to establish conservation areas. Additionally, he stated that with a small number of fishermen that frequent this region, implementation of this restricted area would be met with less resistance in comparison to other areas. As a result, the local fishermen have reverted to unsafe and expensive practices in order to continue fishing near these fishing grounds. James recommended

that these designations should only be considered if backed by extensive scientific data. He also stated that such studies should be conducted by a neutral third-party to ensure an unbiased representation of those fisheries so that rules and regulations can be formed that would benefit all parties and establish a "common ground." James also added that areas have different resources and disapprove of the "blanket approach" for an entire region. He recommended that extensive research should be conducted to identify areas, its resources, and impacts in order to develop specific management practices.

James concluded that from his experience and observations in fishing within the WHFMA, the designation of "restricted areas" has positively impacted these areas resulting in increased fish populations. However, in order to safeguard these outcomes, he recommended that substantial scientific data must be included when identifying areas proposed regulated areas. In addition to "restricted areas," he also supports the idea of "residential only" areas, as demonstrated by the community of Kaimū, in which only the residents of the area are allowed to fish. He strongly believes this designation will encourage fishing communities to develop and implement sustainable management practices resulting in improved resources. Based on scientific data and from his personal observations, he firmly stated that he does not anticipate any major cultural impacts as a result of aquarium fish collection as long as collectors conduct sustainable and responsible practices.

KEHAU SPRINGER

On April 29, 2019, Aoloa Santos met with Kehau Springer of Volcano, Hawaiʻi. Born and raised on Oʻahu, Kehau always had a "love of the *kai*, growing up." Her deep love of the ocean coupled with her academic career inevitably led her to the field of marine resource management, where she has earned degrees in both Marine Science and Hawaiian Studies and a master's degree in Tropical Conservation Biology. As the Coastal Community Capacity Development Advisor for Conservation International Hawaiʻi, Kehau shared her knowledge and extensive experience in working within the West Hawaiʻi region but has declined to provide any recommendations.

When asked if she is aware or has witnessed any ongoing traditional cultural practices along the West Hawaiʻi coastline, Kehau provided a candid perspective on some of the traditional and customary practices. She stated that traditional fishing is contingent upon access of *kanaka* (man) to places in order to maintain sustainable and "*pono*" relationships with the resources which then ensures the perpetuation of traditional harvesting practices. She also added that traditional customary practice is not one singular or specific practice, such as "paddling a canoe or using a specific type of net to catch a specific type of fish," but in the actions of caring for and acknowledging the communities, we harvest from. Kehau provided examples of this which includes traditional practices such as offering an *oli* (chants) or *hoʻokupu* (offering) or *mālama ʻāina*, the acts of caring for the land.

Through her work, Kehau has witnessed different communities along the West Hawaiʻi region that maintain specific cultural practices. In North and South Kohala, particularly in the Kawaihae area, she observed the use of *waʻa* (canoe) which are used to access adjacent fisheries. At Puakō, she has witnessed "*lawaiʻa*" (fishermen) catching *heʻe* or using a three-pronged spear for diving. At Kīholo, a place known for its freshwater and groundwater input, the community is knowledgeable in managing *loko iʻa* (fishponds). She has also seen salt gathering, diving, "throw net" and active use of *ʻōpelu koʻa,* areas that mackerel scad (*Decapterus pinnulatus and D. maruadsi*) gather. Through her collaborations with the community, Kehau has seen the active use of the *koʻa* in various ways including education by teaching children to clean and prepare fish for consumption.

In North Kona, Kehau observed a large number of anchialine pools, that are very healthy and continue to maintain *ʻōpae ʻula* (*Halocaridina rubra*), an endemic shrimp species known to be ideal *ʻōpelu* bait. Kehau has seen people still use *ʻōpae ʻula* as bait but due to the difficulty in collecting this shrimp the practice is not as common. However, she has seen these communities take on the initiative to maintain these anchialine pools with the intent to revive the practice of using *ʻōpae ʻula*. Additional practices she has observed in this district is salt gathering, diving, and pole fishing.

In areas of South Kona, particularly at Nāpoʻopoʻo, Hōnaunau, Hoʻokena, Miloliʻi, the tradition of *hānai koʻa* continues. Kehau explained that *hānai koʻa* is the traditional practice of feeding and caring for a *koʻa*, which she described as "natural areas within the ocean where fish gather." Kehau stated that this phenomenon is influenced by the mixing of currents and natural formations underwater that attract the fish to these areas. The tradition of *hānai koʻa*, is a method to gather the fish to eat. A bag or handkerchief is filled with cooked vegetables such as pumpkin, avocado, papaya, *kalo* (taro), or *ʻuala* (sweet potato) and with an attached lead weight, the bag is lowered down onto the *koʻa*. She explained that the use of pumpkin is popular because as it disperses into the water and that the color of the pumpkin resembles that of *ʻōpae ʻula*. The practice of *hānai koʻa* ran throughout the year but *kapu* (restrictions,

prohibitions), are enacted to restrict harvesting during the months of April through August, which coincides with the *ʻōpelu* spawning period.

Through her interactions with various communities in West Hawaiʻi, and in speaking with *kamaʻāina* of the areas, certain harvesting and fishing practices have changed due to a decrease in fish population and environmental changes as exemplified by the *pākuikui* (*Achilles tang*). Kehau shared that this is a favorite delicacy in South Kona. Elders of the area shared that this fish was highly favored for parties and gatherings. However, according to oral interviews with various community members, in the last decade, there has been a major population decline. As a researcher, she confirmed that she has observed a very small population of *pākuikui* in these areas and in comparing scientific monitoring data, statistics, and literature reviews, their numbers have decreased significantly over the years. She does contend that there are other factors that may affect the population, such as their monogamous behavior, urbanization, pollution, and overharvesting.

Kehau shared from her experience and observation that the influx of ocean activities, including aquarium fishing, has caused a major disruption to fish behavior. With the increase in boat traffic and people, she has seen a change in fish aggregation patterns and thus has seen the differences in the natural patterns of ocean wildlife. These increased activities have not only affected ocean life behavior but have consequently altered human behavior and as a result, affected traditional and cultural practices.

HENANI ENOS

On May 5, 2019, Lokelani Brandt interviewed life-long fishermen and educator Henani Enos. Born in the Hawaiian Homestead community of Anahola, East Kauaʻi, Henani relocated to Hawaiʻi Island and currently lives in ʻŌlaʻa, Puna District. With his experience and upbringing in Hawaiian fishing practices and beliefs, art, and traditional navigation and wayfinding, Henani has taught ethnozoology, Hawaiian lifestyle, and Hawaiian moon phases courses at Ka Haka ʻUla O Keʻelikōlani College of Hawaiian Language at the University of Hawaiʻi at Hilo since 2001. He is also a high school math, science, and navigation teacher at Ke Kula ʻO Nāwahīokalaniʻōpuʻu, a Hawaiian immersion school. Early in the email correspondences, Henani explained that he was aware of how different Hawaiian fishes were used by *kūpuna* (ancestors) but added that he did not have much knowledge about any ongoing cultural practices in West Hawaiʻi. Henani, however, provided a wealth of knowledge concerning the traditional aspects of certain fish including those listed on the "white-list." The interview was conducted in ʻŌlelo Hawaiʻi (Hawaiian language) and what appears below is a translated summary.

Henani stated that nearly all of the fish listed on the "white-list" are considered *ʻai* (food). With the exception of butterfly fishes, puffers, and boxfishes, which were not considered safe to eat, Henani explained that traditionally any fish that could be consumed safely was eaten. He opined that today people are *pailani* (spoiled) and favor certain fish over others, which he believes is one of the reasons for the decline in the more popular fish species.

With respect to traditional fish naming practices, Henani shared that sometimes fish were named based on their characteristics, body shape, behavior, or where they live, which differs from the classical scientific taxonomy. He shared that while some of the general names have been retained, many people today do not know the specific Hawaiian names that were given to distinct fish species. He also added that certain fish names changed based on their growth stages and including such names in the cultural impact study are important to understanding the Hawaiian cultural value of those fish. He believes that the names given during each growth stage attest to the cultural value of that fish and indicates that its life cycle was carefully observed by *kūpuna*.

Henani described in detail the importance of certain fish in traditional house blessing ceremonies and described several occasions when friends have asked his help in obtaining certain fish for such ceremonies. He noted that the yellow ring around the eye of the *kole* was considered a sign of luck and that this fish was planted under the wall on the eastern side of the house where the sun rises. Henani noted that when the sun rises in the east, the belief is that it raises the luck for the occupants of the home. He expressed that there were other fish that were used in these types of ceremonies including *āholehole*, which is believed to *hole* (strip) a house of unwanted spiritual energy and therefore kept the occupants safe from harm. The *weke* was placed at the entrance of a new home when being blessed as a way to *weke* (open) the home. The *ʻamaʻama*, which is associated with enlightenment and knowledge was also placed inside of a new house during the blessing so that the house would have light and the occupants will receive constant enlightenment and knowledge. The *kūmū* fish was used during *ʻūniki* (graduation ceremonies) as its name means "master". Henani emphasized that from a *kuanaʻike* Hawaiʻi (Hawaiian perspective), fishes carry cultural connotations that are often articulated in their name and sometimes their behavior. If certain energies or beliefs were desired for a home, then the homeowner tried to obtain a fish that possessed those qualities. He added that while there were

prescribed fishes for certain ceremonies, there was flexibility and other fishes that shared similar qualities, whether behavioral, physical characteristics, or in name, could be substituted.

With respect to the *kīkākapu* (butterfly fishes), Henani explained that these fish were considered extremely *kapu* (restricted) and were not caught because they were associated with *kauwā*, a menial class of people that lived apart from the general populace and were drawn upon for human sacrifices. Henani specified that the black band of color that marks the forehead of the fish was similar to the tattooed marking of the *kauwā*. Henani added that while growing up, *kūpuna* enforced the practice of releasing this type of fish back into the ocean because of its association with *kauwā*. He explained that if this fish was accidentally caught in a net, it was immediately released and as a child, he was not allowed to take this fish home.

Henani described that traditionally each family had their respective fishing areas at the ocean and that growing up, they were not allowed to roam or fish in another family's area. He laughingly explained that there were no signs to indicate whose fishing spot it was, rather, that knowledge was held within the families and passed on to the children while they were fishing with elder relatives. Henani stated that these areas were sometimes referred to by elder relatives as a family's "icebox." He believes that this practice followed the traditions associated with the *ahupua'a* system and lamented that these traditions are no longer practiced. Henani expounded on this, noting that families tended to their fishing areas just as they did to their gardens. He added that growing up, they would prepare and cook vegetables such as *kalo* (taro) and pumpkin which they took to the ocean to feed the fish. He lightheartedly commented that it was a lot of work to prepare vegetables and to feed the fish. When asked if this practice of feeding the fish was associated with the *ko'a* fishing, Henani clarified that the concept was the same but that feeding was done near the shore where other favored fish lived.

Henani spoke at length about how this type of detailed cultural knowledge was a natural way of life. He stated that while growing up, what the *kupuna* shared was adhered to and that questions were not asked. He stated that these types of practices were "*a mea ma'amau, a hahai wale nō*" (a customary thing, to which we just followed). He explained that people today want to know why certain traditions are followed and for these reasons, Henani stated that he takes the time to learn why certain traditions were practiced and now shares that information with his children and students. He believes that if we don't take the time to understand why certain traditions were practiced, then we cannot convey its importance to the youth and to others who don't understand. He opined that knowing why our *kupuna* did certain things is critical to the perpetuation of Hawaiian cultural practices and traditions.

He emphasized that the detailed cultural knowledge associated with the seasonal changes in the ocean and its lifeforms were carefully developed by *kupuna* because of their ability to *kilo* (astutely observe) the subtle distinctions. He stressed that *kilo* is a skill that needs to be practiced all of the time and that it required a great deal of self-motivation and discipline. He expressed that *kilo* should allow one to observe and be able to convey the subtle distinctions in the natural environment. In describing how *kilo* can be practiced at the ocean, Henani explained that when you continuously observe your environment, you will be able to see things like the gradations of color and that over time, you will be able to observe and distinguish things in nature such as fish types. He emphasized that fishing and preparing and repairing equipment requires a lot of time and energy but if one is able to develop skills in *kilo* they can become more efficient at fishing.

Henani also spoke about changes to the ocean environment that he has observed throughout his lifetime and questioned whether these changes are associated with environmental change or whether it was having a sort of limited understanding of the ocean. He described changes in fish habitat and noted seeing *uhu* (parrot fishes) in rocky areas devoid of coral and has observed *'ō'io* (bonefish) in rock filled areas with no sand, which to his understanding are not their preferred habitats. He stated that these observations are unusual and is likely attributed to the changes in the environment and supposes that these are *hō'ailona maika'i 'ole* (not good signs). He stated that today, fish habitats seem to be disrupted and recalled knowing where certain fish could be found. Henani added that today, fish seem to be moving into other areas outside of their preferred habitat and noted that this is cause for concern.

When asked about his thoughts on the proposed action, Henani shared that he has always enjoyed observing fish and therefore, has an appreciation for aquariums. However, he explained that when fish are removed from their habitat, it severs the natural life cycle which is of no benefit to the overall health of the ocean. He believes that what is most important is that the proper studies be conducted, and that the aquarium industry and the public remain vigilant and watchful. Henani stated that what is most important is that aquarium collection is not "*'ae wale 'ia*" (freely allowed) and that too many fish are not taken because what we do not know now, are the long-term effects of taking too much fish from the ocean. Henani added that there is a reason these fish exist in the ocean and that these fish have been there since the beginning of time, so they are, therefore, an important component of the ecosystem. He emphasized that many people don't realize this and added that this idea is not only applicable to the aquarium industry, but to all people

that harvest marine resources. Henani spoke about a mindset that causes people to take what they can, even if they don't actually need it and the notion that if they don't take it, someone else will. He stated that this is an unfortunate mindset. In light of these thoughts, Henani believes that aquariums can serve as an important educational tool.

When asked if he had any recommendation, Henani stated that since they are extracting natural resources, the "*hana kūpono*" (proper things to do) would be to provide a give back. He added that if those within the industry have an understanding of how to properly care for a fish in a tank, he believes that some of the targeted fish species could be farm raised, which could be used to restock the ocean or to supply the industry.

NOHEA KA ʻAWA, MEL JOHANSEN, JOHN REPLOGLE, MEGHAN LAMSON, SHAYLAN CRYSDALE, AND LESTER GEBIN

On March 28, 2019, ASM staff contacted Nohea Kaʻawa, a *lawaiʻa* practitioner and educator from Waiʻōhinu, Kaʻū. Nohea invited five other community members to lend their *manaʻo* to this study and on June 12, 2019, Lokelani Brandt, Matt Clark, and Aoloa Santos conducted a group interview with six individuals representing several communities from the Kaʻū and South Kona Districts. Participants included employees of The Nature Conservancy (TNC), Nohea Kaʻawa (Hawaiʻi Island Forest Program Coordinator), Mel Johansen (Kona Hema Field Coordinator), Shalan Crysdale (Hawaiʻi Island Forest Program Coordinator) and Lester Gebin (Field Coordinator); Former TNC employee, John Replogle, and Megan Lamson, a coral reef fish biologist. While the individuals spoke at various points throughout the talk-story, for readability, their individual thoughts and insights have been compiled into paragraph form and are presented below.

Nohealani Kaʻawa: Born and raised in Waiʻohinu, Kaʻū, Nohealani "Nohea" Kaʻawa currently resides with her family in the Palauhulu Ahupuaʻa in Kaʻū. She is the Hawaiʻi Island Forest Program Coordinator for TNC and has worked for the Hawaiʻi Wildlife Fund. She serves in various capacities within her district including a volunteer and educational outreach teacher for the ʻImi Pono No Ka ʻĀina program with the State of Hawaiʻi's, Department of Forest and Wildlife in partnership with Three Mountain Alliance in addition to serving as a board member of Ka ʻOhana O Honuʻapo. She is also working with the Department of Hawaiian Homelands to develop a management plan for the South Point area. Nohea has long-standing genealogical ties to Kaʻū where she and her family continue to reside. She learned many of her cultural values and traditional practices from her *ʻohana*, particularly her grandfather, which has been passed down in their family over the generations.

When asked if she was aware of any traditional practices and beliefs within the WHRFMA and with any of the fish on the "white species" list, Nohea named the fish she was most familiar with and elaborated on some of her family's traditions, customs, and beliefs. She also described fish characteristics and behaviors which she has observed as a fisher and diver that are important for certain traditional practices and customs. Nohea explained that many of these family traditions and beliefs were learned from direct experience. She emphasized that unless you ask the why questions, the elders will not openly disclose that kinds of information. Described below are some of the cultural practices and beliefs that were shared by Nohea.

Nohea stated that the *pākuʻikuʻi*, is sometimes referred to as *pākakui* or *pākukui*. She explained that this fish is symbolically connected to the *kukui*, or the candlenut tree (*Aleurites moluccana*). Nohea described that when a family member passes away, it is customary to bring a *lei* made of *kukui* to the funeral as this plant is believed to bring enlightenment so that the *ʻuhane* (spirit) can transition into the afterlife. She shared that the beliefs and customary practices associated with the afterlife may differ between families but the practice of bringing a *lei kukui* to a funeral continues to be an important part of the funerary rituals maintained in her *ʻohana*. Nohea added that if the deceased was "an ocean person," then *pākukui* was gathered for the *ʻaha ʻaina make*, or funerary feast. She explained when this fish is cooked it produces a distinct bright yellow color, which is something that does not occur when cooking other fish. In explaining why the *pākukui* was consumed during the *ʻaha ʻaina make*, Nohea explained that to consume this fish during such an event "served as an added layer of protection." Nohea elaborated on this practice, stating that:

> …so just as the *pele*, the sulphur, the yellow is a layer of protection or when you wear your *kīhei* (traditional garb), you dye your *kīhei* yellow with *ʻōlena*, the *pākukui* kinda serves as that layer of bodily protection…your body possessed a lot of oils and so to um, consume the fish and to have that oil a part of the things running throughout the system of your body, all of the *wai*, all of that *ʻau* going on, the currents moving, the *pākukui* kind serves as that shield of protection.

Nohea then pointed out the *hilu* and explained how this fish is utilized in the rituals associated with depositing a child's *piko* (umbilical cord). Nohea explained that all fish, like humans, have personalities and the *hilu* is considered as an easy-going, "go with the flow" type of fish that is not fearful of human nor does it stick around during times of

danger. Nohea expressed that although there are different rituals that are used when depositing a child's *piko*, she described that in her family, the *piko* was deliberately placed into the mouth of a *hilu* and the fish was allowed to swim away. The belief is that as the child grows it takes on the characteristics of the *hilu*, which was much desired by certain family members because "the *piko* is an extension of the physical person."

With respect to the *hīnālea ʻakilolo*, Nohea described how this fish was used medicinally to treat brain-related trauma or illness. She described how the *hīnālea ʻakilolo* was used to treat an uncle that had suffered a stroke. Nohea explained that when the family became aware of this person's condition, some family members ordered the gathering of the *hīnālea ʻakilolo*. She explained that this fish is valued for its medicinal properties and is used specifically to treat brain-related trauma or illness. She described that there are differing opinions with the use of the *hīnālea ʻakilolo*, noting that some *ʻohana* believe that it will improve brain function because it *ʻaki* (snip) at the *lolo* (brain) thereby removing those things that have brought confusion to the brain, while others contend that consuming the fish may worsen a person's condition and make them more *lōlō* (feeble-minded).

Nohea spoke about the cultural beliefs associated with the *kīkākapu* fish, noting that this fish along with other fish species are considered a *kapu* class of *iʻa*. She explained that just as the *kauā* was set aside as a *kapu* class of people, there was also a *kapu* class of fish which included the *kīkākapu* and other fish species that have a black marking on its forehead. Nohea expressed that the distinct black colored band or marking on the forehead of the fish resembled the tattoo that was inked onto the forehead of the *kauā* class of people and for this reason, this fish was not intentionally caught.

In referencing the *kala*, Nohea shared that this fish is used in the rituals that accompany *hoʻoponopono*, a ceremonial process held to resolve disputes and restore peace between feuding family members. She emphasized that the *kala*, whose meaning translates to forgive is a part of the repertoire of rituals items that were utilized in this ceremony.

Nohea expressed that the *kūpuna* of Kaʻū fought hard to protect their area from overexploitation and development and that this sentiment and practice continues to be maintained by the people of Kaʻū. She added that today, especially during large fishing tournaments, many people flock to Kaʻū because they have fished out their areas. She described aquarium collectors as just another group that comes to Kaʻū to take its resources and lamented that "it's hard to watch." Nohea added that many people come to Kaʻū just to take its resources and that these people do nothing to give back to these resources. She expressed that seeing these kinds of extractive practices have significantly altered her family's fishing practices to the point that today, she and her family "rarely go *holoholo* at the *kai* because there's just too much taking and the balance is not in place anymore." Nohea then reflected on the efforts at Kaʻūpulehu in North Kona and noted that since the implementation of the fishing ban, they have seen a tremendous increase in the fish population. She noted that although there was protest regarding the creation and implementation of the fishing ban at Kaʻūpulehu, it has, however, allowed the fish population to flourish.

Nohea also expressed concern for the size of fish harvested by aquarium collectors and related memories from her childhood where she learned about the role of juvenile fish in the ecosystem. She described that as a child her family would cross-net at Kaʻaluʻalu Bay and that the grandchildren would help to *paipai* (the act of slapping and scooping the surface of the water to excite the fish into the net) and were responsible for sizing the fish, a method that was done using their hands. Nohea added that any fish that was smaller than the length of their hand was returned to the ocean. She stated that although her uncles would pull in a large catch, "not everything went home with us" and what was taken was just enough for the families to sustain themselves. She added that "when you start to take the *keiki* from the families, you're not going to have future *kupuna*."

Nohea then reflected on some of the potential cultural impacts that could result from the proposed action and expressed that many of the fish species listed on the "white-list" are widely used in various traditional practices and for subsistence purposes. Nohea cautioned that if these fish continue to be adversely impacted or their numbers continue to decline, it will indisputably have an adverse impact on many traditional Hawaiian cultural practices. Nohea stressed that these fish play an integral role in these customary traditions and rituals and opined that these traditions are critical to maintaining the traditional Hawaiian family system. She also stated that "by taking away the fish, you take away certain traditional practices" and *ʻike kupuna* (traditional knowledge), such as understanding the relationships between *mauka* (upland) and *makai* (ocean).

Mel Johansen: Mel Johansen was born and raised in Pāpā Ahupuaʻa and grew up in the areas of Manukā, Honomalino, Kapuʻa, and ʻĀlika—lands that are within a region known traditionally as Kapalilua in South Kona. He is an avid diver, pole and boat fisherman, and recalled spending many weekends and even weeklong expeditions where he camped and utilized the reef purely for subsistence purposes. Mel openly expressed that he is "totally against collecting fish that aren't yet ready for harvest because that seems like a totally different, opposite concept" than what he grew

up with. Mel stated that he grew up with the understanding that when you took "resources from the reef it was for home use and to sustain yourself." He added that all of the kūpuna he has ever encountered also shared in this same philosophy, which was "to take what you need and you take what's ready...you don't harvest small fish." Mel stressed that taking small fish was never traditionally practiced and is an "odd concept" that he cannot relate to.

Mel reflected on the changes to the reef that he has observed over the past sixty years. He recalled the first time he had jumped into the water with a dive mask as a child and recalled seeing the reef covered with all kinds of colors and different varieties of fish. He shared that today when he visits this same place, he no longer sees the diversity of fish he experienced as a child—a change that he believes is associated with the increase in people utilizing the reef and its resources. He believes that the overall decrease in reef species and abundance should be a motivating factor to revive the traditional beliefs and practices of taking only what is needed and what is ready for harvest. Mel stated that some of the fishing grounds he frequented as a child are now protected from aquarium collecting and since the implementation of these no-take areas, he described seeing some recovery to the reef ecosystems but added that "it is still not the same as before." Mel also stated that many of these coastal areas are historically significant and shared that Kapuʻa Bay is known to be one of the training grounds for Kekūhaupiʻo, a famed lua fighter. Mel stressed that the current aquarium collection practice of taking small fish to be sold elsewhere is "a terrible concept." He equated the current aquarium collection practice with going to the forest and pulling young native plant species and selling them to another place.

In reviewing the "white-list" fish species and providing recommendations, Mel expressed that all fish have ecological value and that we do not know the impacts of removing too much of anyone species from the reef. Mel stated that for issues as important as the proposed action, he believes that the public and culture of the affected communities should be allowed to weigh-in on the issue and discuss the appropriateness of the fundamental concept of the industry—"is it a good concept or a bad one?" He stated that "what is important is the concept, not whether you can prove it scientifically." He explained that culturally, everything he has ever learned about resource management stresses the importance of leaving juvenile fish so that they can mature, and taking only what is needed for subsistence purposes. Mel recommended that larger group interviews and public surveys should be included for issues that relate to the use of a public resource. He believes that the results from such interviews and surveys may offer a better understanding of the cultural appropriateness of the proposed action.

John Replogle: Born in Laupāhoehoe, Hilo District, John Replogle at the age of three moved to the Kaʻū District and currently resides in the Ocean View subdivision. He is retired from TNC where he served as an environmental outreach educator. During his youth he spent a lot of time fishing from the lands of Kaʻū. At age of twenty-three, around the same time John began his carrer as a cowboy, John began to notice the crisis of overfishing and made a personal decision to stop nearshore fishing. Although John no longer fishes regularly, he has, at times, accompanied his friends on subsistence focused fishing trips which has allowed him to witness the use and impacts of modern fishing equipment and technology, such as jet skis, scuba gear, and boats.

John shared that while growing up, access to the Kaʻū coast was often long and arduous and that the rough conditions severely limited human access to the coastal areas and its resources. He shared that at Waioʻahukini—a place that was frequented by his father—a private access road was built and despite this road, access was still very limited. He added that the *ulua* fishermen that wanted to get to Waioʻahukini had to hike down the *pali* (cliff) to get there. He noted that after his return from college, sometime shortly after 1974, his father informed him of a group of young fishermen that had come down to Waioʻahukini to night dive. In explaining the story shared to him by his father, John stated that this group of fishermen would spear the sleeping *ʻuhu*. John shared that "these young people saw no harm in what they did; filling coolers of *ʻuhu*. He referenced several images that he saw on the web that showed fishermen standing over a plethora of reef fish that were laid out in their garage. John opined that it's these kinds of fishing practices that "have brought us to where we are at." John sees the aquarium industry as "adding to this crisis." John explained that today, access to nearshore resources is no longer limited to roads or trails as fishers now utilize modern technologies such as boats and jet skis which makes everywhere accessible to them. He added in the past, to get to Waioʻahukini took almost two hours by vehicle, but with boats and jet skis, people can access this area from South Point within minutes. In describing the importance of Waioʻahikini, John shared that Mary Kawena Pukui described it as a very rich fishing ground. In describing what makes this area rich, John explained that the Halaʻea current that sweeps around Ka Lae is nutrient-rich and as this current moves, it deposits a great deal of nutrients into the vicinity of Waioʻahukini.

In speaking about the history of aquarium fishing in West Hawai‘i, John shared that during the late 1980s, when aquarium fishing began to expand, there were huge public rallies where people paraded through the streets of Kona to stop the taking of fish for the aquarium industry. He added that although there was tremendous public opposition, the State of Hawai‘i continued to allow aquarium collecting because of the tax revenue.

John also raised concern for the mortality rate of the fish and noted that there have been several instances when bags of dead aquarium fish were dumped and “thrown out like garbage.” He described that culturally when something of value needs to be disposed of, it is done so properly and cited the example of a *lei*, where once it is no longer needed, it is returned to the land. John contends that although only a few cases of dumped aquarium fish have made public headlines, he believes that such cases may be more common.

In describing some of his concern about the proposed action, John exclaimed that in fifty years from now, what will those people think of the culture that would allow this type of activity to happen. He stated that these marine resources are a part of a living culture and are a part of a living ecosystem that is intimately connected to the land. John stressed that currently, Hawai‘i’s reefs are under severe stress brought about by things like introduced toxins from sunscreen, overfishing, rising ocean temperatures, pollution, and unregulated fishing. He made reference to the hunting of the Pacific Sea Otter to near extinction, which led to an explosion of sea urchins that in turn created ocean floor deserts. John expressed that “man has no brakes” when it comes to the take of natural resources. He opined that we are surrounded by water and that in Hawai‘i you don’t need to have any license or education to use this resource. He exclaimed that today, all people need to do is go down to their local fishing store and “buy the stuff and catch um…catch as many as you can.” John believes that this current mindset is tied to proving one’s masculinity and dominance over Nature which he described as a “western civilization mindset.

In reflecting on the current state of land and marine resource management, John stated that “we can’t even take care of where we are, what we have, and what we have been given responsibility for, yet we want to go and take more!” John added that “these reefs existed just fine without us and now it’s a race to catch the next fish with no regard for the whole reef.” John stated that “the State of Hawai‘i is incapable of managing such an industry” as the State does not have the funding or the enforcement to regulate this industry. John stated that in Ka‘ū and because of the way the management boundaries were drawn, DOCARE officers from both east and west Hawai‘i have to patrol this district. He stated that this is problematic because depending on where the infraction occurred will determine what region will respond. He expressed that DOCARE on Hawai‘i Island is under staffed and related a saying from a former DOFAW manager who exclaimed “I would rather poke my eye with a sharp stick than work in Ka‘ū.” John shared that this statement is not just about Ka‘ū but is a reflection of the entire state and the “need to stop prostituting Hawai‘i for personal gain.”

John shared that there is a hand full of people collecting and about three million dollars in tax revenue is generated by the aquarium industry. John stated that the ecological value of Hawai‘i’s marine ecosystem to the islands and to the planet should supersede any dollar amount. He advocated, at the very least, for an ecosystems services fees and believes that we should not be freely giving away our natural resources. He argued that the state and county agencies are so “focused on visitors and pleasing the outside world” that we have overlooked proper management of our island resources. John shared that once a place is depleted of fish, fishers will just move to the next location. He expressed that this is one of the reasons why people come to Ka‘ū, because they have fished out their areas and that it will only be a matter of time before Ka‘ū is depleted of its marine resources. He also added that the rough ocean conditions in Ka‘ū have helped to protect the area’s resources because it limits accessibility. John does not support the taking of reef fish for the aquarium industry and believes that reef fish should only be collected for educational purposes within the State of Hawai‘i. While he does support the taking of fish for subsistence purposes, he believes that even recreational fishing should be regulated because most fishers don’t know the damage they are doing to the marine ecosystem. He reflected on the current hunting license fees and noted that if the fees were higher, it would generate more income that could be used to improve management of the resources and that people would be more invested in protecting their resources. He stated, “it cost money to take care of our resources.” John shared that even in Pre-contact times, people had to learn about the ocean first before they caught their first fish. He would much rather see people visit the island and view fish in their natural habitat accompanied by knowledgeable practitioners. John stated that “we cannot take care of what we have and we want to give more…enough already! It’s well past time to turn this trend around within the whole state, not just West Hawai‘i.”

Megan Lamson: Born and raised in California, Megan Lamson moved to Hawai‘i and currently resides in Honalo Ahupua‘a, South Kona. She has earned degrees in marine biology and tropical conservation biology and has a background in coral reef fish ecology and community-based resource management. She is a Board member for Ka

‘Ohana O Honu‘apo, a community organization based in Ka‘ū. She also works for Hawai‘i Wildlife Fund and the Pacific Cooperative Studies Unit for the Hawai‘i Division of Aquatic Resources in Kona.

With respect to the role of technology in altering traditional fishing practices, Megan shared that access to the coast coupled with the advancement in technology has drastically altered traditional fishing practices. Additionally, Megan pointed out that changes to Hawai‘i’s commercial jetliners have aided in the transportation of aquarium fish, the bulk of which are shipped to offshore locations. She added that improved scuba technology now makes it possible for divers to go deeper and for longer periods of time.

Megan also spoke about the invasive species that are listed on the “white-list” (*roi* and *ta‘ape*) and noted that while most people believe removing these fish are good for the reef ecosystems, she shared that more recent scientific research is dispelling the anecdotal myths that associate declining reef health with *roi* (*Cephalopholis argus*). She stated that it is really easy to point to any one aspect as the leading cause of declining reef health, but she stressed that declining reef health is a consequence of multiple stressors. Megan pointed to the 2015 coral bleaching event that resulted in the loss of close to fifty percent of live coral covers in West Hawai‘i. She added that the drastic reduction in coral has severely altered the very foundation upon which reef fish and other marine life need to survive. She emphasized that although some fish listed on the “white-list” are highly valued in Hawaiian culture, she explained that all fish have a role in maintaining the necessary balance of the ecosystem. She stressed that we don’t fully understand the ecological relationships that exist between the different species. Megan explained that the forty species listed on the “white-list” was passed in 2012 when Governor Neil Abercrombie signed and approved it along with the “rules package” and noted that prior to this, people “could essentially take whatever.” Megan clarified that it took years and the effort of many people and organization to get these rules approved. She added that these rules apply only to the WHRFMA and believes that all fisheries in the State of Hawai‘i are deserving of such stricter legislative protection. Megan also pointed to the endemic species on the “white-list” and stated that there should be no taking of any endemic species because these species are found only here in Hawai‘i and should be protected.

With respect to her personal thoughts on aquarium collecting, Megan shared that unless these fish are being used as an instructional tool to teach the current and next-generation about fish and marine ecosystem or environmental education (such as in public aquariums and schools/university classrooms), she stated that she cannot fully support the take of fish for the aquarium industry. Megan added that from a scientific perspective, she would like “to support sustainable harvest of any species as long as it is not detrimental to native wildlife.” Reflecting on the data that has been analyzed for the no-aquarium take areas in the WHRFMA that goes back to 1998, Megan stated that there has been an overall increase in fish abundance, but noted that when analyzing specific species, the population of *pākukui* has been decimated. For this reason, Megan strongly opposes the take of *pākukui*. Megan further explained that *pākukui* is one of the top three fish species that is collected within the WHRFMA.

Megan added that despite the WHRFMA being one of the best-managed fisheries in the state, the State of Hawai‘i still does not have the capacity to manage all of the aquatic resources on its own, and needs continued support from communities and other partner agencies. She added that historically for West Hawai‘i, the State of Hawai‘i relies heavily on funding from partner agencies such as the National Oceanic and Atmospheric Administration (NOAA) to monitor the effectiveness of the aquarium fishery within the WHRFMA to help best manage the fishery. She believes that every fishery in the State of Hawai‘i deserves to have environmental and cultural impact assessment study because even one fish taken from the reef, whether for home consumption or for an aquarium, has the same impact to the reef. She explained that there are, however, different ethical and cultural concerns with respect to collecting fish for subsistence purposes and for the aquarium industry. Megan also contends that the State should look into options to charge marine usage fees for anyone who utilizes the ocean resources, which could then go towards improving the management of Hawai‘i’s fisheries.

Shalan Crysdale: Shalan Crysdale is the Hawai‘i Island Forest Program Coordinator for TNC and has worked in the conservation field for over fifteen years, with some five years in dryland forest management. Born in California, Shalan currently resides in Wai‘ōhinu with his family and has spent much of his time during the 1980s in the coast of South Kona.

When asked if he had any cultural knowledge of the “white-species” list or knew of any traditional practices and beliefs associated with these fish or in the region, he stated that he was unaware of any specific cultural practices. However, Shalan offered his perspective on “protected areas” stating that “when you assign protection to some area, you are necessarily diminishing the status of the areas that are not protected…if you have protection in one area, well, you can assume next door is getting pounded.” Shalan also spoke about the ecological connection between species and noted that we do not fully understand the ecological relationship between different species. Shalan added that from his experience, a large amount of research has focused on species that threaten the broader ecosystem but has

seen limited information on the positive relationships between species. He believes that understanding both positive and negative relationships between species may result in better management practices and regulation policies. Shalan concluded that the recognition to protect Hawai‘i’s resources is a common thread between different agencies, however, varying political agendas inhibit the development of necessary policies and regulations for the best interests of each region.

Lester Gebin: Born and raised in Kona, Lester now lives in Ocean View in Ka‘ū and has been employed with TNC for the past thirteen years. Lester asked, “how many of fish they [aquarium collectors] catch survive?” He noted that depending on the depths at which these fish are caught, may require the air bladders to be manually punctured before they can be brought to the surface. Lester advocated for people to view fish in their natural habitat.

MIKE NAKACHI, LING NAKACHI, AND KAIAKEA NAKACHI

Mike Nakachi accompanied by his father and life-long fisher and waterman Ling Nakachi and his son Kaiakea Nakachi, currently a graduate student in the Tropical Conservation Biology and Environmental Science program at the University of Hawai‘i at Hilo met with Lokelani Brandt on June 26, 2019, to share their insights about traditional cultural uses and knowledge with respect to the WHRFMA. Mike is a fisherman and owner of ‘Ohana Moana, a Kona-based fishing and dive tour company. Mike has also served as a member of the West Hawai‘i Fisheries Council and has on multiple occasions spoke publicly against the illegal take of fish for the aquarium industry. Mike shared that his family has always had a profound respect for the ocean and all of its life forms and that on his father’s side, where his Hawaiian lineage comes from, they were *kahu manō* (caretakers of sharks). Because of years of daily interaction with the ocean in West Hawai‘i, Mike has developed astute observation skills and can detect subtle color gradations, name ocean currents and its characteristics amongst many other attributes of the ocean environment.

When asked about any ongoing traditional cultural practices within the WHRFMA, Mike explained that women have always been the keepers of the cultural knowledge and traditions and that men are often tasked with some of the more physical aspects of these traditions. He spoke of several occasions when he was asked by certain respected women to gather specific fishes that were used ceremonially. He explained that I never questioned why certain species were requested or how it was used, rather I just do as the aunties and *kupuna* ask of me. Kaiakea added to this discussion, explaining that it’s hard for some of the *kupuna* to gather certain resources. Mike also spoke of subsistence gathering of fish and other marine resources, which is used to supply food at traditional *lū‘au* celebrations and for household consumption. Mike also pointed out some of the cultural sites, such as fishponds and historically significant places (which are numerous) along the West Hawai‘i region. In describing another long-standing Hawaiian customary practice, Mike spoke about *mālama ‘āina*, a deeply-rooted belief that was translated into daily practices that made the land and ocean resources *momona* (fertile, fruitful). Mike described these practices which promoted fertility and richness of the land and ocean as *mālama momona*. He stated that the aquarium industry does not apply this cultural practice at all to any part of their industry.

Mike spoke about the practice of showing respect while on the ocean, which includes providing a safe and respectful distance between others who are fishing or diving as well as showing respect for the resources. He described how this has changed over the years as more people that have no sense of the culture or the cultural significance of the ocean utilize it for various ocean activities. He described this new attitude and behavior as carrying an air of entitlement to the ocean resources and not having any sort of give-back to the resources. He noted that this change in attitude and behavior has at times led to intense conflicts between different ocean users. He described during his younger years while fishing with older fishermen, they would encounter collectors and described shouting matches that would occur on the water between aquarium collectors, fishermen, and dive-tour operators.

Mike made several references to the importance of having healthy coral and reef ecosystems explaining that many of the species found in West Hawai‘i are endemic. He noted that in other parts of the Hawaiian archipelago, some reef systems are comprised purely of endemic species. He stressed that this means that these species are not found anywhere else in the world and described how this has led to a highly conflicted values assessment. Mike opined that culturally, preserving and caring for these resources is often motivated by cultural/familial values, uses, and beliefs associated with these resources, whereas the State of Hawai‘i and others are solely motivated by the economic value of these resources. He noted that the Hawaiian cultural value of our reef resources as with other resources is never considered an integral component in management strategies, which as a result, continues to adversely impact Hawaiian cultural traditions, practices, and beliefs. Mike also shared that the reef system in West Hawai‘i have and continue to be impacted by other external stressors such as rising sea temperatures and remarked on the 2015 coral bleaching event that resulted in acres of dead coral. Mike referenced the *Kumulipo* and clarified that the process described in this chant is ongoing, not merely something of the past. He described how healthy fish populations repair damaged

coral reefs noting how certain fish like the *uhu* graze on dead coral thereby providing a clean foundation upon which new coral polyps can form.

With respect to the aquarium industry, Mike disclosed that in the past, he has been approached by several individuals to participate in this industry, but affirmed that he has never participated in it because it never felt right in his *na'au* (guts, moral nature). He expressed that the feelings that come with taking fish to be sold outside of Hawai'i to be placed in someone's tank never felt appropriate to him nor does it contribute to the health of the ocean. He acknowledged knowing several Native Hawaiians that have participated in this industry but stated that many of them have left after learning about the workings of the industry. Mike lamented that in some smaller Hawaiian communities, especially in South Kona where traditional methods of harvesting fish are still practiced, the aquarium industry has created serious discord and tension amongst its members, which he feels is very sad and unfortunate.

Mike worries that since the banning of aquarium collecting in West Hawai'i, many of the collectors have migrated and are now impacting other areas around the island, including eastern Ka'ū and emphasized that the impacts to these areas are not being assessed in this process. Although aquarium collecting is prohibited within the WHRFMA, it is still occurring in other parts of the island, which is worrisome for Mike. He believes that an assessment should be conducted for all of the islands, not just West Hawai'i. He described the aquarium industry as keeping a low-profile and working under the radar and noted that they are not active in any other community issues other than those that pose a direct threat to the viability of their industry. He believes that this type of veiled operation has not lent to the credibility of their industry. Additionally, Mike described several instances when collectors were caught illegally harvesting fish which he believes has led to a degraded public profile. Mike believes that it is important to give back to the communities and to the ecosystem which you depend upon.

Mike also shared his thoughts on the regulatory component and lamented on the fact that there are very few DOCARE officers that patrol this massive region and its resources. He expressed that currently there is not enough enforcement to regulate all of the different kinds of activities that are occurring in West Hawai'i, including the aquarium industry. He stated that the lack of enforcement has led communities to implement Makai Watch, where community members have taken on the responsibility of raising awareness about the resources and reporting illegal activities. Mike expressed that there is little reliance on the State to execute their fiduciary responsibilities to care for and properly manage our resources.

In contrasting the past to the present and looking to the future, Mike strongly believes that we are now in a new time, where cultural traditions are being practiced and Hawaiian youth are actively engaged in their culture in innovative and meaningful ways. He described today, more people being culturally aware and that knowledge of our cultural places are being revitalized, preserved, and passed on to the next generation. Mike hopes that he can continue to pass on his love and knowledge of the ocean to his grandchildren as has been done in his family for generations. He hopes this tradition can be carried on. He described the knowledge of the ocean as understood by *kupuna* as being profound and is still highly applicable to us today. Mike was very earnest in his feelings regarding the capture and selling of Hawai'i's reef fish to places outside of Hawai'i and believes this is not *pono*.

WILFRED KAUPIKO, KA'IMI KAUPIKO, AND GREG ASNER

Lokelani Brandt contacted Ka'imi Kaupiko, a Hawaiian fishing practitioner and educator with long-standing genealogical ties to the Hawaiian fishing village of Miloli'i in South Kona. Ka'imi extended the invitation to other family and community members, to which his father Wilfred "Uncle Willy" Kaupiko, and Greg Asner with the latter residing in the adjacent Miloli'i beach lot subdivision responded to Ka'imi's request. On June 28, 2019, Lokelani Brandt met with these individuals at Miloli'i to discuss past and ongoing traditional cultural practices and beliefs associated with Miloli'i and the adjacent coastal areas including Papa Bay and to get their general thoughts on the proposed action. All of the community members openly expressed that they were not aware that an EIS was being prepared and were disappointed that no community meetings had been held by the applicant to discuss their proposed action. Both Ka'imi and Uncle Willy spoke about their involvement with the 2017 Hawai'i Supreme Court ruling that invalidated all permits issued pursuant to HRS §188-31 until compliance with the Hawai'i Environmental Policy Act (HEPA) is met.

When asked about their knowledge of any past and or ongoing traditional cultural practices, Uncle Willy shared that he comes from a long line of Hawaiian *'ōpelu* fishers, and noted that his father was a *'ōpelu* fisherman and that his uncles were master fishers, having in-depth knowledge of the ocean, fish behavior and habitat, and fishing techniques. He described spending a lot of time with his uncles where he learned how to fish according to the practices of his *kupuna*. He informed that they spoke *'Ōlelo* (Hawaiian language), often times speaking only Hawaiian amongst

each other. He described that while growing up, men were the primary *ʻōpelu* fishers but that women would often accompany the men. He also expressed that some women, particularly those that were skilled and strong *ʻōpelu* fishers would go out on the ocean alone. Uncle Willy recalled memories of his youth where the reef at Miloliʻi Bay was teeming with fish. He reminisced that when the church bell rang, it would cause the fish to flutter on the surface of the sea.

Uncle Willy described in detail how many of the old practices including the enforcement of certain *kapu* were still practiced well into the 20th century and stated that on Sundays, "fishing was *kapu*" and people were encouraged to rest. Uncle Willy described the process of *ka ʻai*, which he described as the feeding and taming of fish. He detailed the preparation of vegetable chum which included locally grown vegetable such as pumpkin and *kalo* that was used to *hānai* (feed) the *ʻōpelu*. Uncle Willy explained how the fishers would load the prepared vegetables on the canoe and take it to the *koʻa* where it was released. He described how each fisher would tap on their canoe in a certain manner to call the fish up from the depths of the ocean. Uncle Willy recalled watching the dark-colored ball of *ʻōpelu* dance in the sea and the efforts of the fishermen to move swiftly to lower the nets, herd the *ʻōpelu*, and raise the nets. He stated that much of the fishing that was done during his youth was for commercial and recalled a time when *ʻōpelu* was sold at ten cents per pound. He stated that any excess fish was cleaned, salted, sun-dried and later sold to customers across the island. Uncle Willy also expressed that women were particularly adept at cleaning and preparing fish. He stated that despite the adoption of more modern fishing technology, one "still needs to know the secrets of the ocean," including the winds and currents. Uncle Willy referred to the ocean current that runs south just outside of Miloliʻi as the *kamaʻāina* current or the Kaʻū current. He stated that when fishing for *ʻōpelu*, one needs to be very aware of the current and winds as certain types create challenges for the *ʻōpelu* fishers.

When asked about cultural uses, traditions, and beliefs associated with any of the "white-list" species, Uncle Willy stated that many of the fish are used for subsistence purposes. Kaʻimi noted the use of *pākuikui* and *kole* in certain ceremonies and that red fish is used in their *Makahiki* ceremonies. Uncle Willy added that yellow tang was and still is used as an important indicator species because it attracts other valued fish such as *maiko*, *manini*, and *uhu*. Kaʻimi added that each fish has a role in the ecosystem and stated that the "white-list" is not *pono*. Uncle Willy described that in West Hawaiʻi, the reefs are short and steep which transition abruptly into very deep water and that this unique environment provided an abundance and diversity of marine resources.

With respect to the adoption and use of fishing technology, Uncle Willy recalled being told by his father to "work smart, not hard" and noted that when gas-powered engines and other fishing devices were introduced to Miloliʻi, the fishermen, including himself adopted some of these technologies which they incorporated into their traditional fishing practices. While *ʻōpelu* fishing occurs in deeper waters, Uncle Willy described several near shore fishing techniques including the use of a crossnet to catch *akule*, lay nets, throw nets, poles, and spears to catch other reef fish. He also spoke about using homemade wire baskets which were used to remove the spines from *wana*. He also noted the use of fishing *imu* which was constructed by each family in the nearshore reefs. He explained that the stones were piled on the reef and that fish like *manini* would dwell in the *imu*. Uncle Willy described the use of a throw net which was placed over the *imu* while the stones were dismantled resulting in the entanglement of the fleeing fish in the net. Of the fishing techniques described by Uncle Willy, he indicated that only the latter is no longer practiced. Uncle Willy stated that although many new technologies have made their way into this fishing village, they still depend heavily on the land and ocean and laughingly stated: "we still use *kukui hele pō* (lanterns) at night." Uncle Willy also spoke about their use of certain plants such as *lehua piha* (fully blossomed *lehua*) and *hala* (pandanus) as indicators for when certain marine species were ready to harvest.

In contrasting the practices he learned as a child to today, Uncle Willy expressed that a lot has changed and stated that in the past things were "real strict." Both Kaʻimi and Uncle Willy described changes to peoples' behavior and attitude towards the ocean resources and noted the gradual changes to the ocean environment and decline in fish abundance at Miloliʻi. Uncle Willy pointed out that while growing up, they were always taught to *mālama* and stay in their respective *ahupuaʻa* and not to *mahaʻoi* (intrude) in other people's places. He stated that today, people fish wherever they can access and take everything they can. He reflected on the traditional preparation of vegetable chum and stated that some people began using meat and noted that meat chum disrupts the fishes' diet. Both Uncle Willy and Kaʻimi expressed that community members who acted out of the cultural norms in the fishing village were held accountable for their actions and were punished by the community.

Kaʻimi added that Miloliʻi was always known for its abundance and is one of the last places to maintain traditional Hawaiian fishing practices, which is why Kaʻimi and his father have played a key role in developing educational programs for the *ʻohana* and youth of Miloliʻi. When asked about the types of educational programs they offer, Kaʻimi stated that they focus on teaching the *keiki* about traditional *ʻōpelu* feeding, net making, developing fluency in traditional Hawaiian fishing related terminology, seasonal changes, Hawaiian moon calendar, and other *pono* ways of

fishing. Uncle Willy and Kaʻimi expressed that many of the *kupuna* and fishing practitioner have passed away but there are "plenty *kamaliʻi*" in the village. They described a pressing need to teach the next generation about the cultural traditions unique to Miloliʻi so that they can *makaʻala* (remain watchful) and *mālama* (care for) these traditions, place, and resources into the future. Kaʻimi stated that today, the Miloliʻi community and its ocean resources are in a "vulnerable state" and expressed that the seasonal patterns are off, which creates challenges for their subsistence lifestyle.

While all four interview participants were aware of the Miloliʻi FRA, which prohibits that taking of reef fish for the aquarium industry, they noted that in the adjacent Pāpā Bay, aquarium collection is allowed. Uncle Willy stated that while growing up, he learned that Pāpā Bay is where the fish are born. Greg Asner, who has been diving and conducting coral and fish surveys at Pāpā Bay for the past twenty-three years highlighted some of his research findings. Greg explained that the science he has been conducting puts numbers to what people like Uncle Willy grew up learning and knowing. Greg described a phenomenon known as "bio slicks" which are visible from land as glass-like, meandering streaks that appear on the ocean surface. Greg explained that these drifting slicks contain larvae fish and invertebrates, algae, and debris and serve as an important habitat during the early growth stages of these organisms. Greg stated that these slicks are common in and near Pāpā Bay but are not generated within Miloliʻi Bay. He emphasized that coastal areas share important biological connections and from his research, he has learned that fish migrate to different areas to live out their life cycle. He went on to explain that Pāpā Bay and Miloliʻi share important biological connections because some of the larvae fish that are carried on these slicks are deposited into adjacent bays. Greg stressed that what happens at Pāpā Bay impacts Miloliʻi and other areas. Both Greg and Gail confirmed fish population crashes at Pāpā Bay and have recorded collectors walking on and damaging coral, which they expressed is key to maintaining a healthy marine ecosystem. The group stated that they have seen aquarium collectors day after day collecting fish from the same areas and feels that this intensive harvesting does not give the fish and the ecosystem a chance to recouperate from previous biological removals. Greg believes that the destructive methods used by certain aquarium collectors are dismantling this integrated system. Additionally, Kaʻimi and Greg described other events, one of which included the 2015 mass coral bleaching which devastated the corals in West Hawaiʻi. Uncle Willy recalled that after this bleaching event, the *ʻōpelu* were missing.

When asked about their thoughts on the proposed action, they explained some of the reasons why they were not in support of the proposed action. The four individuals explained that while aquarium collection is not permitted within Miloliʻi Bay, they noted that aquarium collectors often launch their boats and utilize water at the Miloliʻi dock to fill their tanks. Kaʻimi and Uncle Willy described several instances when they have caught aquarium collectors illegally harvesting fish within the FRA which they reported to DLNR. Uncle Willy stated that for the past ten years and because the State cannot fulfill its duties, the Miloliʻi community has been implementing Makai Watch, a community-based watch and outreach program promoted by DLNR. Despite numerous complaints and reports to DLNR about the illegal taking of fish by collectors, Kaʻimi and Uncle Willy opined that DLNR has failed in their responsibility as they do not follow up or issue citations to violators. For these reasons and many others, Uncle Willy feels that the "State cannot take care of our resources." Greg questioned, how does the "aquarium industry fit into the State's 30x30 initiative" which promotes effective management of 30% of nearshore marine areas by the year 2030? Uncle Willy stated that tropical fish divers *hanaʻino* (cause trouble) in Kona. Uncle Willy added that aquarium collectors take small fish and that this kind of practice is not good for the ocean. He explained that they have wiped out areas in North Kona and have made their way to South Kona. Additionally, Kaʻimi described aquarium collectors driving over the *ʻōpelu koʻa* with their boats which he stated disrupts the fish and the *ʻōpelu* fishing process. Kaʻimi expressed that there are virtually no rules for aquarium collectors and believes that the industry is unsustainable. He also spoke about the mortality rate of aquarium fish and believes that this kind of practice is not *pono*. Because of such events, practices, and interactions, they explained that their relationship with the collectors has been contentious. They believe that these sorts of interactions have ultimately ruined the communities interest and trust in the industry.

Kaʻimi described scuba certifications classes taking place at Miloliʻi, which attracted many local people including family members. He stated that these certification classes were used to simultaneously recruit community members into the industry. He has been saddened by the conflict that the aquarium industry has brought into their community and family. Kaʻimi expressed that while some family members participate in the industry as a way to support their family, many of them struggle with the internal conflict because the practices of the industry run counter to their familial and cultural practices and beliefs. Kaʻimi expressed that some of them have left the industry because of the internal conflict.

Kaʻimi and Uncle Willy shared their future hopes and vision for Miloliʻi. They spoke about their current initiative to develop a Community Based Management Plan for Miloliʻi and the steps they have taken to develop a more in-depth understanding of the breeding and spawning cycles for various marine species. They have partnered with several

scientists and research groups to help establish baseline data which will help with their management plan. Kaʻimi stated that they have a passion to protect their cultural ways so that they and the future generation can fish for the rest of their lives. He expressed that for them, fish are next to kin and is a staple of their diet. Uncle Willy stated that native rights have always been overlooked and that native rights always have to be negotiated. Uncle Willy advocated for the creation of protected areas that are built around the traditional Hawaiian *puʻuhonua* (places of refuge) concept. Uncle Willy would like to see stiffer fines as a way for people to take more seriously their actions and impacts to Hawaiʻi's marine resources. He expressed that many of the current laws are obsolete and need to be revised and that in future management efforts, all parties need to *hana like* (work together).

SHANE PALACAT-NELSON

Shane Palacat-Nelson, who traces his family lineage to the lands of Kealakekua, South Kona for more than 500 years was interviewed by Lokelani Brandt on June 28, 2019. In discussing the potential cultural impacts that may result from the proposed action, Shane emphasized that Cultural Impact Assessments (CIA's), can provide crucial information that can help determine an approach on how to moving forward on controversial issues. In referencing Kealakekua Bay, Shane stated that the current state of the bay is unknown because there is not enough fish count, water quality, or reef health data to provide feedback on the potential impacts to the area. He further related that schools of fish can be depleted in one season, but if there is no data to detect these depletions then communities witnessing the depletion of their own resources are left with no support or evidence to resolve these on-going problems. He believes that restricted areas "are not working properly" and therefore declined to comment until there is a thorough study done within these areas. With the lack of data, he is unable to accept the commercialization of aquatic fisheries until these issues are addressed. With regard to areas where aquarium collecting is allowed, Shane believes that fishery inventory studies need to be updated and assessed more frequently. Shane voiced that he is not against aquarium collecting and shared that "everyone has a place in community," but there needs to be thorough research and community engagement. He added that it has to be more than just developing a set of rules and regulations, rather creating a lifestyle.

KEALOHA PISCIOTTA

On July 5, 2019, Lokelani Brandt met with Kealoha Pisciotta, a Hawaiian practitioner to discuss the proposed action and to identify any past or ongoing cultural practices and belief associated with the WHRFMA as well as any cultural uses and beliefs associated with the forty "white-list" species. Kealoha shared that her family, the Oneha and Kaʻanapeʻa's come from the Island of Kauaʻi and that they were *kahu* (guardians) of Mauna Kea through their worship of the gods ʻIo and Kāne. Kealoha fondly recalled memories of her childhood, where she walked the shores of Waikīkī and developed her knowledge and interest in Hawaiʻi's reef fish and other intertidal species. She vividly recalled her grandmother giving her "*pūʻolu*" (bundle) containing offerings that were used to feed and acknowledge the *akua* as *kinolau* and to acknowledge *ʻaumākua*. She had become so well-acquainted with these species that as a child she became involved with the Waikīkī Aquarium where she was responsible for taking care of the intertidal species and monk seals. Her involvement with the Waikīkī Aquarium began when she was invited by her friend's mama to collect specimens for her reef teaching class. Kealoha playfully recalled gathering different species, delivering and caring for them, then returning them to the ocean after the class. She did this for a number of years before working at Sea Life Park where she helped with taking care of the reef fish tank. Kealoha's family later relocated to Volcano on Hawaiʻi Island at which time she began to develop a personal relationship with the ocean in West Hawaiʻi.

In conveying her cultural connection to the West Hawaiʻi region, Kealoha referenced the *Kumulipo* and noted that upon moving to Hawaiʻi Island as a child, she gave her first *hoʻokupu* (offering) at Kahaluʻu. She explained that because her family lived in Volcano, it was easy for them to travel to the Kona side and for her, the ocean there "felt more like home." Kealoha continued to visit the Kahaluʻu area and noted that she has had bad experiences, particularly with people "who don't understand practitioner use" of the ocean. She described being invited to the ReefTeach program at Kahaluʻu where she educated the volunteers about Article XII of the Hawaiʻi Constitution. She explained that while she supported the ReefTeach initiative of protecting coral reefs, she noted that many of the workers did not have an understanding of the unique cultural environment in which they worked. She related that Article XII codified native rights and that these laws are "about us being able to continue our practice." Kealoha added that while the law spells out the right for Hawaiians, she acknowledged that though she is not a *kamaʻāina* (native-born resident) of Kahaluʻu she is *kamaʻāina* (acquainted) with the *ʻohana* of Kahaluʻu, meaning that she shares a kinship connection to the marine life at Kahaluʻu. She described instances when she was conducting ceremonies in the ocean at Kahaluʻu and being approached and apprehended by people who blatantly stated that she cannot give *hoʻokupu*. Kealoha

emphasized that when people abruptly approach you during a ceremony, it immediately shifts the mental and physical aspects of the ceremony.

With respect to traditional cultural knowledge and practices, Kealoha related that Kūkahauʻula, an *akua* who is associated with Mauka Kea and is one of the lovers of the goddess Poliʻahu "is also an *akua* for the fishermen." She explained that the blue rock used to make *lūheʻe* (octopus lure) was sourced from an area near the summit of Mauna Kea and brought down near Hale Pōhaku where it was refined. Kealoha elaborated on this practice, stating that for this reason, Kūkahauʻula was worshipped by fishermen and is associated with the *heʻe* (octopus) and *mūheʻe* (squid). She explained:

> The rosy hue that he [Kūkahauʻula] is also I think is a signal for the fishers outside. Because where the sun hits on the opposite side is the shadow… so the great shadow of Mauna Kea becomes its own kind of sacred feature that traverses these certain things that make our *kilo* of timing…

Kealoha related that the only time when Kūkahauʻula and Poliʻahu meet is during sunrise and sunset and it is during these times that Kūkahauʻula's great light reaches the low-lying clouds on the Kona coast—clouds that were also favored by the fishermen of Kona. Kealoha also spoke about her experience with watching Hokuleʻa depart from the Kona coast during sunset and how the shadow from Mauna Kea created a unique light formation on the ocean. Kealoha also spoke about the relationships of animals and *ʻaumakua* (family guardian or god) and the deeper connections between *ʻaumakua* and their interactions with *kanaka*, *ʻohana* and communities they care for. She connected this traditional belief to a *moʻolelo* concerning the *hīhīmanu* (stingray) of Māhukona that were fed by the people during times of famine and in return, the *hīhīmanu* drove heaps of fish to the shore to feed the people.

Kealoha stated that each species has key characteristics that associate them with certain *akua.* She spoke particularly of the "animals with spots or that are spiny," such as *hīhīmanu*, the Hawaiian whitespotted puffer (*Canthigaster jactator*), *kala* (*Naso lituratus*), *puhi* (*Gymnothorax ruepelliae*), and their relationship to the *akua* Kāne. She also shared that fish with "pokey" tails or bodies, such as *kala* and pufferfish, are protected under Kāne and are considered *kapu*. These fish were most often avoided but if they were accidentally caught, fishermen immediately asked for forgiveness because they did not want any bad omens to befall upon them or their families and to maintain their relationship with their *akua*. She also shared that species whose bodies resemble a kite are associated with Kanaloa and added that the common fish shape bears this kite-like characteristic and are therefore connected to Kanaloa. *Hīnālea*, or specifically the "rock mover" wrasse were known to be *ʻaumakua* and connected to Pele.

When asked about the use of fish for traditional cultural practices or ceremonies, Kealoha shared that red-colored fish were commonly reserved for *aliʻi*. She shared that her *ʻohana* witnessed and participated in a funeral procession of the queen in which red fish were included in the ceremony. She also shared that fish were placed on a *lele*, or fishing altar, to perpetuate the practice of *ʻāina momona*—traditional practices that promote abundance and fertility of both the land and sea. Kealoha also added that *kala* along with *limu kala* was placed on the altar when asking for forgiveness, as *kala* means to forgive. She also witnessed the use of fish in ceremonies to re-consecrate sacred places including chiefly *heiau* in the Kona region.

With respect to the cultural uses of the nearshore areas, Kealoha explained that traditionally, women were the caretakers of this part of the ocean. She stated that today, this traditional practiced is not acknowledge. She described how the women would create *hīnālea* houses to attract this fish. She described that in areas with heavy reef cover, it was a common practice of the ancient people to carve out trails in the reef. Kealoha opined that "our people did a lot of engineering, but engineering that's different from modern engineering." She stressed that traditional engineering focused on increasing the abundance of a resource and cited the example of the traditional fishpond. In reflecting on the differences between traditional and modern concepts of engineering, Kealoha stated that the current practice of the aquarium industry is purely extractive and added that if they were helping to grow the abundance of Hawaiʻi's marine resources, it would be an entirely different situation. She referenced a recent Stanford University report that provided suggestions on how to improve the fisheries in Hawaiʻi, which explicitly stated the importance of following traditional Hawaiian ocean resource management strategies. Kealoha emphasized that in Precontact times, people who stole resources were severely punished and that these sorts of acts were socially unacceptable. She pointed out that while Hawaiians today no longer follow some of the ancient practices, such as punishable by death, she stressed that there are traditional management strategies that are still highly relevant and applicable.

Kealoha mentioned that fish names serve as indicators of the physical or behavioral attributes of a fish as well as its spiritual or sacred function. The yellow tang, or as her *tūtū* taught her *lauʻīkapu*, were considered fish that were off-limits, made evident from the word "*kapu*" rooted within the name. She added that *lauʻīkapu* are major contributors to the marine eco-system in that it maintains diversity and abundance of the reef thus serving as a key indicator of *ʻāina momona*. Therefore, the cultural perspective surrounding this fish correlates to its significant ecological

relationship and contribution to the reef and the ocean. She also shared that although some Hawaiian fish names have been lost over time, the correlations of modern classification and Hawaiian taxonomy demonstrates that connections between fish were well understood through "thousands of years of observations." Kealoha expressed that all ocean life were *kinolau*, or bodily forms, of *kupuna, ʻaumakua* or *akua*. She stated that the presence of *manini* or *āholehole* in the vicinity indicates that Kanaloa, the deity of the ocean, is present and so one must always be cognizant of these fish and then conduct themselves accordingly to respect this *akua*. She explicated that the *Kumulipo* provides a catalog of life forms that are interconnected with each other and within those listings are *kaona*, or hidden meanings, identifying connections that were both physical and sacred. She added that in the first line of the *Kumulipo*, the *papa* (reef) is acknowledged thus emphasizing the value of the reef to all ocean life.

Kealoha identified *kala* as popular eating fish and *kole,* which she described as a "serious food fish that is very much eaten here on this island [Hawaiʻi Island] more than other places." She also referenced the *hīnālea*, stating that although not a personal favorite, it is a fish regularly caught and consumed by fishermen. Kealoha duly noted *lauwiliwili nukunuku ʻoiʻoi*, although a very beautiful fish, she expressed that it should not be collected at all. She shared that reef fish, despite the threat of diseases such as ciguatera, are still caught for subsistence by fishermen.

Kealoha spoke candidly about her thoughts on the aquarium industry and exclaimed that "it is non-sustainable and it can't be sustained and that it needs to be shut down." While she understands that people are making a living from this industry, she believes that "we can do better" and that "we can figure out better ways of living that don't frustrate our cultural or traditional ways or disrupt the healing of the *ʻāina*." She stressed that "right now, that's [healing the *ʻāina*] the priority and anything that would frustrate the reef recovery on any level…we can't accept." Kealoha explained that systemically, the ocean depends on all of these species. She worries that if we continue to piecemeal management of the ocean, it will no longer be able to provide for us. She stated that the ocean has different ecosystem levels, but it does not have boundaries. She imparts that the industry has detrimental effects on the health and well-being of our ocean environment and as a consequence, instigates mental and traumatic stress on living communities that are witnessing the desecration of their "sacred houses." Kealoha found that issues surrounding the responsibility of caring for these resources often burden folks standing on both ends of the issue, primarily those of Hawaiian descent. She edified that the health of the land is intrinsically tied to the collective health of communities and thus stated within the United States Public Law 103-150, informally known as the Apology Resolution or Bill, she described "that Native Hawaiians are inherently tied to the land. So, what happens to the land, happens to us and what happens to us, happens to the land." She added that by "recovering," or rebuilding the symbiotic relationship between *kanaka* and *ʻāina* is congruent to the health and existence of all living species. Kealoha emphasizes that we need to acknowledge and honor these relationships that clearly outlines the impacts, not only to the environment but to the health and well-being of *kanaka*. Additionally, Kealoha expressed that she is aware that many of the fish on the "white-list" are being removed from the reef in large numbers. She expressed concern for the lack of enforcement by DLNR of these unsustainable fishing practices. She also acknowledged that the lack of enforcement is due mainly in part by not having the capacity to conduct such regulations, such as not having an adequate amount of DOCARE officers. Her concern is also that the aquarium fishing industry is "self-reporting and self-regulating" and modern concepts of "if I don't get mine then someone else going get em," are notions far removed from traditional perspectives. To further explain she shared that her *tūtū* always scolded them about wasting water and wisely explained that "we don't waste the *akua*'s gift." She added that these resources are a valuable gift that requires a reciprocated relationship to maintain the health and well-being of the environment, not only for *kanaka* but for all living forms thus arguing that the industry is:

> Extractive and it's frustrating our ability to heal the ocean but more than heal, but make it *ʻāina momona*. You know, 'fat the land' and that is the point where our rights are being affected because if it is our tradition to make 'fat the land,' when we can't make 'fat the land' its all wrong and it takes us out of our natural way of being and then into a way that's foreign to us and then forces us to possibly have to act in ways against our own cultural beliefs.

Kealoha contends that although there are fish on the "white-list" that may not necessarily be consumed, these fish are still an important component to reef health. Kealoha's observations and interactions with fish and sea animals over the years helped cultivate much of her knowledge of ocean wildlife. These interactions aided her understanding of the various functions within the ecosystem and the connections between all living forms that are directly related to the concept of *ʻāina momona*. Consequently, Kealoha strongly advocates that these relationships need to be protected and that while there are competing interests for these resources, the interest in the "protection of *ʻāina"* should take precedence. Kealoha shared her frustrations with the current environmental review process and stated that "if the process has integrity, so will the outcome." She added that:

> I don't know, I'm very frustrated because my feeling is though, there are *puka*s that people are swimming through…that make it so that it shifting the burden onto the public to regulate, and that, that I think is not fair.

When asked if she had any recommendations to address her concerns, Kealoha expressed that "they need to really work with us to do better." She strongly believes that if businesses are basing their motive on profit margins it will inevitably fail and campaigns that "profits are not a right, it's a privilege." She stated that "if they need us to advocate for them, they need to let us know and stop treating us like we're enemies," because the "rights of the reef precede profit." She also suggested developing a hybrid system that implements traditional *kapu* practices that are established by communities and with the state to assist in regulating those policies. Kealoha believes that in order to move forward genuine conversations need to take place and creating spaces to "maximize our communities' ability to share the impacts." She expressed that through dialogue it can increases awareness, strengthens individual perspectives, and develop respect between opposing views. Kealoha concluded that this process if done correctly and with good intention, will help to overcome cognitive dissonance for all involved.

KUPA O HOʻOKENA: DAMIEN KENISON, JOE BALSIMO, STANFORD CHO, AND HAWILA ALANI

On August 1, 2018, Lokelani Brandt was invited by Damien Kenison to conduct a group interview with members of the non-profit community-based organization Kamaʻāina United to Protect the ʻĀina (KUPA), which consists of roughly ten board members and officers. Participants in this interview were Damien Kenison, Joe Balsimo, Standford Cho, and Hawila Alani, all of whom share genealogical ties to the Hoʻokena and or the greater South Kona District. Damien shared that KUPA was created in 1996 in response to the growing number of aquarium fish collectors who were conducting their operations in the waters fronting Hoʻokena village. Despite the growing conflict between local fishermen and aquarium fish collectors, Damien shared that this conflict prompted the community to get organized. For them, establishing KUPA has resulted in a strong push to improve management of their area in addition to garnering support to ensure the perpetuation of their living cultural practices.

Damien Kenison: When asked about any past or ongoing cultural practices, Damien explained that for them, the ocean and all of its living lifeforms therein are an important part of their Hawaiian cultural identity. He added that fishing and caring for the nearshore waters has always been an important part of their lifeways. Damien exclaimed that coming onshore with fish in their canoes is what makes them feel Hawaiian and he noted that his sense of cultural identity is strongest when he is on his canoe fishing. Damien expressed that fishing is part of a process that maintains and strengthens their family bonds. He explained that catching, cleaning, and eating fish are activities that bring people together and being able to maintain this cultural custom well into the future is important to him.

Damien also related that "all fish are part of the ecosystem" and when parts of that ecosystem are removed, it will have an impact on the ecosystem. Additionally, he shared that when that ecosystem is disrupted, it has a direct impact on their cultural practices. He stressed that reef fish, in particular, play a vital role in maintaining healthy reefs because these fish keep *limu* populations in check. He added that too much *limu* on the reef will overtime, smother and kill the reef altogether. He emphasized that being able to harvest fish from the ocean is highly dependent upon a healthy reef and if the reef life continues to be degraded it will impact their ability to provide for their families in addition to perpetuating their cultural traditions.

Damien stressed that traditionally the values were based on respect for the laws, the resources, and the communities. DLNR does not have the resources to enforce fishing rules. He added that for many years, the aquarium industry had gone unregulated and noted that any "unregulated commercial venture will wipe out the fish."

Damien shared that for him, he feels that the take of fish for aquarium purposes is a "wasteful practice" and expressed that it is a cultural value not to waste fish. He opined that this practice from a Hawaiian perspective is *mahaʻoi* (rude and impudent). He feels that "tropical fish collectors have no respect for the resource and the communities" and described instances when coolers of dead tropical fish were found. He stated that the aquarium industry does not have a stake in the local communities. He expressed that dealing with this growing conflict has been stressful for the community.

Stanford Cho: Stanford explained that caring for natural resources is something that is not unique to Hawaiʻi, but is a common practice seen in many cultures around the world, especially those who rely on such resources. He drew parallels between other parts of the world where sport and commercial fishing has resulted in a serious decline of marine resources. Stanford contends that such examples should prompt us to be more careful in managing fish take from different user groups. In looking at the "white-list" species, Stanford explained that he has grown up having seen all of these fish in the ocean and whether they were eaten or not, seeing them in their natural habitat is something he

is accustomed to. He added that things change and evolve naturally in nature, but when people begin to impact these resources and when there are indicators that show adverse impacts caused by humans, this is concerning to him. Stanford emphasized that these fish have been on this earth longer than we have and we must show respect to these creatures

Stanford also shared his thoughts on the take of fish for the aquarium industry and shared that there's a long history of mistrust and no openness between local fishers and aquarium collectors. He noted that this has escalated the conflict between different user groups. He explained that native Hawaiians are often viewed as hostile and aggressive but clarified that such a view is often a direct result of either not being included in important decision-making processes that directly impact native Hawaiians or their concerns are disregarded. He also spoke about a mentality change and noted that there are people that come here to exploit the resources. Stanford exclaimed that for such people who share the "take mentality," cultural impacts are not of value to them because they have no investment in the communities they take from.

Joe Balsimo: Joe explained that all fish play a role in maintaining a healthy marine ecosystem and that for native Hawaiians the ocean is often referred to as their "refrigerator." Joe does not support the take of fish for aquarium purposes and stated that he "doesn't agree with raiding the refrigerator." He stressed that caring for and improving the state of our marine resources is vital if we hope to have healthy reefs in the future so that they may be enjoyed by future generations. He explained that many Americans today are "apathetic to global and community issues" and that the "take mentality" is resulting in a degraded marine environment and more conflict between those who are trying to improve the state of our resources and those who want to take from it. Joe also raised concerns over the number of casualties associated with the collection of aquarium fish. Joe also spoke about the lack of DOCARE enforcement officers because of their limited resources and stated that ensuring compliance with all laws pertaining to the aquarium industry is a difficult thing to enforce. He added that the lack of enforcement means that the state relies on the "trust system," which for him is unacceptable.

KEVIN AWA

Over the phone, on September 7, 2019, Robert Rechtman interviewed Kevin Awa, a multi-generational fisherman and long-time resident of the South Kona area on Hawai'i Island. Although born in Germany, Kevin moved to Kona at age 9, and his ties to the South Kona area are through his father and grandfather, both of whom were fisherman. His grandfather worked on fishing sampans operating out of Keauhou Bay. Kevin is employed at Kona Coast Marine and provides repair and upgrade work for many of the fishing vessels operating within the WHRFMA. He is a fishing practitioner who is actively engaged in *'ōpelu*, *ahi*, and bottom fishing, making his own *'ōpelu* nets; and recognizes these activities as traditional practices. Kevin has also worked under contract with NOAA, providing local knowledge to scientific researchers with respect to local fishing practices, fish habitat, and environmental factors that affect both practices and habitat. When asked if there were any potential cultural impacts associated with the proposed action, Kevin stated that generally he foresees "no problems" with issuing aquarium fishing permits, but added that cautions should be taken to not overly impact the edible species on the White List, such as *pākukui* and *kole*, which are also target species of subsistence fishing.

JOSEPH "MCGEE" AKIU, JR.

In a brief phone conversation on September 10, 2019, Robert Rechtman interviewed McGee Akiu, a multi-generational fisherman and life-long (42 years) resident of the South Point area. McGee considers himself a "jack of all trades" fisherman. When asked about cultural practices and any potential cultural impacts associated with the proposed action, he was emphatic that there was "nothing bad" about aquarium fishing, and he believed that it could help the environment by controlling the amount of fish that in his view are too abundant. He also suggested that aquarium fishing could help get rid of invasive species such as *ta'ape*. McGee insisted that regulators should let the aquarium fishers be as they have always done a good job, and rather focus on the problem of plastic in the nearshore waters as that is killing more fish than anything else.

CHELSEY FAAVESI

Over the phone, on September 23, 2019, Robert Rechtman interviewed Chelsey Faavesi, who was born (in 1989) and raised, and still resides in the South Kona fishing village of Miloli'i. Chelsey's maternal family is generationally tied to Miloli'i, and her father is of Samoan ancestry. Chelsey described her family as closely tied to the ocean, as fishing is a way of life for them. They are multigenerational commercial fishers and her grandparents procured fish for both

food and to sell to provide for their family. These traditions continue as the family is still involved in commercial fishing and Chelsey has been involved with the aquarium fishing industry for four years as a diver/collector working for a third party business owner. Chelsey insisted that her practice is an extension of the traditions that her family has practiced for generations—making their livelihood from procuring ocean resources. She uses protocols for access to, and takes care of, the collection locations, which she noted are typically not accessed by subsistence collectors. She also suggested that during the winter months, when the sea is rougher and collecting is less frequent, the decreased pressure on the fish leads to increased fish populations. When asked if there were any potential cultural impacts associated with the proposed action, Chelsey indicated that she does not see any impacts as long as the potential permit holders treat the resource habitat respectfully and act responsibly by not overfishing and depleting the resource.

5. IDENTIFICATION AND MITIGATION OF POTENTIAL CULTURAL IMPACTS

The OEQC guidelines identify several possible types of cultural practices and beliefs that are subject to assessment. These include subsistence, commercial, residential, agricultural, access-related, recreational, and religious and spiritual customs. The guidelines also identify the types of potential cultural resources, associated with cultural practices and beliefs that are subject to assessment. Essentially, these are natural features of the landscape and historic sites, including traditional cultural properties. A working definition of traditional cultural property is present here:

> "Traditional cultural property" means any historic property associated with the traditional practices and beliefs of an ethnic community or members of that community for more than fifty years. These traditions shall be founded in an ethnic community's history and contribute to maintaining the ethnic community's cultural identity. Traditional associations are those demonstrating a continuity of practice or belief until present or those documented in historical source materials, or both.

The origin of the concept of traditional cultural property is found in National Register Bulletin 38 published by the U.S. Department of Interior-National Park Service. "Traditional" as it is used, implies a time depth of at least 50 years, and a generalized mode of transmission of information from one generation to the next, either orally or by act. "Cultural" refers to the beliefs, practices, lifeways, and social institutions of a given community. The use of the term "Property" defines this category of resource as an identifiable place. Traditional cultural properties are not intangible, they must have some kind of boundary; and are subject to the same kind of evaluation as any other historic resource, with one very important exception. By definition, the significance of traditional cultural properties should be determined by the community that values them.

It is however with the definition of "Property" wherein there lies an inherent contradiction, and corresponding difficulty in the process of identification and evaluation of potential Hawaiian traditional cultural properties, because it is precisely the concept of boundaries that runs counter to the traditional Hawaiian belief system. The sacredness of a particular landscape feature is often cosmologically tied to the rest of the landscape, as well as to other features on it. To limit a property to a specifically defined area may actually partition it from what makes it significant in the first place. However offensive the concept of boundaries may be, it is nonetheless the regulatory benchmark for defining and assessing traditional cultural properties. As the OEQC guidelines do not contain criteria for assessing the significance for traditional cultural properties, this study will adopt the state criteria for evaluating the significance of historic properties, of which traditional cultural properties are a subset. To be significant the potential historic property, or traditional cultural property, must possess integrity of location, design, setting, materials, workmanship, feeling, and association and meet one or more of the following criteria:

a Be associated with events that have made an important contribution to the broad patterns of our history;

b Be associated with the lives of persons important in our past;

c Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;

d Have yielded, or is likely to yield, information important for research on prehistory or history;

e Have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity.

While it is the practice of the DLNR-SHPD to consider most historic properties significant under Criterion d at a minimum, it is clear that traditional cultural properties by definition would also be significant under Criterion e. A further analytical framework for addressing the preservation and protection of customary and traditional native practices specific to Hawaiian communities resulted from the *Ka Pa'akai O Ka 'Āina* v Land Use Commission court case. The court decision established a three-part process relative to evaluating such potential impacts: first, to identify whether any valued cultural, historical, or natural resources are present, and identify the extent to which any traditional and customary native Hawaiian rights are exercised; second, to identify the extent to which those resources and rights will be affected or impaired; and third, specify any mitigative actions to be taken to reasonably protect native Hawaiian rights if they are found to exist.

Based on a review of the culture-historical background material presented above, and as indicated by many of the consulted parties, the nearshore waters of the WHRFMA have, since Precontact times, served as the foundation for the subsistence lifestyle of the Kānaka Maoli. While the deeper marine environment provided a wealth of pelagic resources, the nearshore waters have and continue to be the primary place where Kānaka Maoli of all ages and genders engage in the long-standing traditional practice of *lawai'a.* Within the nearshore waters, Kānaka Maoli—since their initial arrival to the west coast of Hawai'i Island to the present day—have always utilized an array of harvesting methods and apparatuses to gather a wide variety of nearshore marine resources, including, but not limited to, reef-fish, seaweed, urchin, shellfish, crab, octopus, shrimp, and salt. Although many of the harvesting apparatuses and means of transportation have adapted to the changing times and technologies, the act of fishing, whether for subsistence or commercial use (some of those interviewed for this study place aquarium fishing into this latter category) is an ongoing and ever-evolving cultural practice. Another more specific traditional fishing practice that was identified through the background research, and was discussed by several of the consulted parties, includes the use and maintenance of traditional fishing *ko'a* that are designed to gather certain pelagic species, most notably *'ōpelu*. While the above described practices focus on the tangible elements of past and ongoing traditional fishing practices, the ocean is also culturally valued for its spiritual significance.

As identified during the interview process, and supported by the culture-historical background, the ocean is considered the pathway of the ancient people and gods who, through their episodic migrations from Kahiki, came to settle these islands. In Kānaka Maoli cosmology, the ocean is an embodiment of the male deity Kanaloa, who also assumes other body forms including, but not limited to, certain marine species such as the *hīnālea*, *he'e*, *palaoa*, and others large marine mammals. The nearshore waters are also associated with a number of additional significant deities in the Hawaiian pantheon including Hina (Hinapukui'a), Kū'ula, and their son 'Ai'ai, all of whom figure prominently in the spiritual aspect of Hawaiian fishing practices and the creation of *loko i'a*. Likewise, the *'āko'ako'a* (coral head), as identified in the *Kumulipo*, and as articulated by several consulted parties, is the foundation from which all life is derived. Several of the consulted parties also spoke about the use of the ocean for certain healing and cleansing rituals. Additionally, the nearshore waters of West Hawai'i Island are associated with several significant Historic Period events, including the arrival of the first Europeans and American missionaries, that forever changed the trajectory of Hawaiian culture. The interactions with these early Euro-American arrivals, and with subsequent migrant populations (and their introduced technologies), resulted in opportunistic adaptions of traditional Kānaka Maoli culture and fishing practices; adaptations that allowed them to maintain a leading role in the island's commercial fishing industry into the early 20th century. It is clear that the nearshore waters of West Hawai'i Island, along with all of its contributing tangible and intangible elements and associations, could be considered a traditional cultural property significant under Criteria a, b, and e. Having a comprehension of the traditional cultural significance of nearshore waters of West Hawai'i Island by all of its user constituencies, is a first step in ensuring that the activities of any one user group does not in any significant way conflict with the activities of another user group. As part of any future permitting processes associated with the WHRFMA, it is recommended that DLNR-DAR provide to potential permit issuees a document that provides a synopsis of the traditional cultural significance of the fishery.

Another significant component of this study focused on the cultural uses of the forty white-list species. A review of the culture-historical background material, coupled with the information discussed by multiple consulted parties, resulted in the identification of traditional names, and/or past and/or ongoing cultural uses for thirty-three of the forty fish species. Types of identified cultural uses included subsistence, medicinal, ritual, and ceremonial. The cultural knowledge associated with these fish varies, however, as some are extensively referenced in traditional accounts and ethnographic literature, while others are mentioned only in passing with no additional descriptive details. While all of the thirty-three fish species for which traditional cultural information was found appear to have been eaten, some species, particularly wrasses, tangs, surgeonfishes, and triggerfish were, and still are, more commonly consumed. The *hīnālea 'akilolo* (*Coris gaimard*) and the *lau'īpala* (*Zebrasoma flavescens*), on the other hand, were noted in the culture-historical literature, as well as in the consultation, for their medicinal value. One category of white-list species

in particular, the butterflyfishes (*Chaetodon* sp.), appears to primarily have been used for rituals and ceremonial purposes. Several consulted parties expressed that these fishes was never intentionally caught for subsistence purposes because of their association with the *kauwā* class of people. Given that these particular white-list species are important for sustaining the above-described cultural practices, if the issuance of commercial aquarium permits leads to a significant depletion of the populations of the above mentioned species (either directly or indirectly through habitat disruption), then the result would be a cultural impact. Conversely, if the biological assessments (conducted by others) indicate that the issuance of the fourteen commercial aquarium permits will have no significant effect on either the fishes or their habitat, then the issuance of the permits would not result in a cultural impact.

Additionally, the background information gathered for two of the white-list species—the *Cephalopholis argus* (peacock grouper or *roi*) and the *Lutjanus kasmira* (bluestripe snapper or *ta'ape*)—indicates that these fishes are found in great numbers within the nearshore waters of West Hawai'i Island, and that reducing the overall population of these two species could improve reef-health and potentially yield long-term positive impacts. Although these fish were introduced during the mid-20th century to fill a fishery niche, there has been little success marketing them commercially, which has resulted in steady population growth. Many of the consulted parties saw a reduction in the population of these two species, which can out complete other species, as potentially beneficial for improving the overall health of the reef and fishery.

As part of this CIA, extensive oral interviews were conducted with numerous individuals from multiple user groups (including cultural practitioners, aquarium collectors, subsistence and commercial fishers, charter boat operators, and researchers) who represent various communities within the WHRFMA. While it is often difficult to disentangle each of these user groups from one another (because many, if not all, of the consulted individuals self-identify, or can be placed, with more than one of the groups), all of those interviewed expressed some degree of on-going cultural attachment to the ocean. For many, their introduction to the nearshore waters of West Hawai'i Island stems from long-standing familial ties to the land and the ocean. While some of the consulted individuals expressed specific cultural concerns with respect to the white-list species, others stressed the ecological importance of the fish, and the need for them to live out their life cycles in their natural habitats. As evident in the statements made by multiple individuals, the take of fishes for commercial aquarium purposes within the WHRFMA has a long and contentious history, and it remains a point of conflict. Despite efforts to address these issues, the conflict has diffused into different communities and even caused rifts within some families. While it is not the prerogative of the authors to attempt to explain or resolve these long-standing issues, they are nonetheless, very apparent. Addressing such issues necessitates developing, at a minimum, mutual respect and open dialogue between the different user groups, and amongst different government and private sector agencies who oversee the management of the WHRFMA. Addressing and mitigating potential impacts is one means of bringing diverse groups together in a way that promotes understanding and opens productive dialogues.

With that said, if the analyses in the EIS determine that the conditions of effect are met with respect to the potential cultural impacts described above, then the following recommendations for mitigation are offered. As echoed in the statements made by multiple individuals, extracting marine resources needs to be done with integrity and sensitivity, as the reef-fish and the habitat in which they are found are both ecologically and culturally valued. No matter how or why these fish are extracted, their removal constitutes an irrevocable loss of bio-cultural resources that could potentially have an adverse effect on the overall health and sustainability of the fishery. In light of this, the authors recommend that PIJAC, and any commercial aquarium fishers who intend to conduct their operations within the WHRFMA, consider developing or partnering with governmental and/or local organizations to help improve the management and sustainability of the nearshore fishery as a means to not only sustain, but actually improve reef-fish populations in the take areas. Such marine management practices should be a part of all commercial marine endeavors, and not exclusively imposed on any one user group. To further limit the potential for cultural impacts (through the depletion of culturally significant fish species), it is recommended that the existing bag limits and no-take areas within the WHRFMA remain in-place, but be monitored and adjusted periodically in order to account for fluctuations in the local fish stocks. Furthermore, it is recommended that the applicant (PIJAC) continue to work with the approving agency (DLNR), and the various other user groups within the WHRFMA, to help improve the transparency of the accounting methods for fish takes, and the enforcement of the existing rules and regulations that govern those takes.

With respect to limiting the potential for cultural impacts, DLNR-DAR plays a significant role in managing and enforcing the rules and regulations that are intended to support the sustainability, viability, and fecundity of the WHRFMA. As voiced by many of the consulted parties, the lack of support and funding have hampered DNLR-DAR's ability to fulfill its fiduciary responsibility, namely to enhance, protect, conserve, and manage Hawai'i's unique and limited resources, which are supposed to be held in public trust for the current and future generations of the people of Hawai'i *nei*, and visitors alike. While achieving this goal is not an easy task, and it certainly cannot be achieved by

any single means, DLNR-DAR should be proactive in seeking additional funding sources, and work with the various user groups who are most familiar with the WHRFMA, including the commercial aquarium fishers, to improve its enforcement capacity. As expressed by multiple community members, the lack of enforcement by DLNR-DAR has resulted in community members feeling the need to police their respective areas themselves, which ultimately diverts time and energy from their desire to educate the next generation of Hawai‘i fishers and to perpetuate their own cultural practices. As part of improving enforcement, as expressed by some of the consulted parties, the DLNR-DAR should consider incorporating more traditional Hawaiian fishery resource management practices (as detailed above) into the management of the WHRFMA, and representatives from the aquarium fishing industry should continue to work with the other user constituencies (i.e., Native Hawaiian organizations) that maintain an interest in the WHRFMA.

In summary, the recommendations provided here are intended to help ensure that the proposed issuance of fourteen commercial aquarium permits within the WHRFMA considers the knowledge, concerns, and thoughts shared by the consulted parties. While most people do not, in general, disagree with the practice of making a living from the ocean, these recommendations are also intended to remind those who may receive commercial aquarium fishing permits within the WHFRMA to be mindful of the unique cultural, historical, social, and ecological setting in which they earn their living. If commercial aquarium fishers assume ownership of their *kuleana*—privileges and responsibilities—to utilize the marine resources in a sustainable way, and take into consideration the broader socio-cultural efforts that are underway across the state to *mālama* and *ho‘omomona*—care for and increase abundance of—the marine resources, then any potential for cultural impacts will be lessened. Understanding the cultural resources, cultural practices and cultural beliefs associated with the nearshore waters of West Hawai‘i Island, and implementation of the recommendations presented above with respect to the identified issues, will ultimately help to ensure that no such resources, practices, or beliefs are adversely affected by the proposed issuance of the fourteen commercial aquarium permits within the WHRFMA.

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APPENDIX A.
KA WAI OLA PUBLIC NOTICE

PUBLIC NOTICE

ASM Affiliates is preparing a Cultural Impact Assessment (CIA) in advance of the preparation of an Environmental Impact Statement for the proposed issuance of commercial aquarium permits for areas within the West Hawai'i Regional Fishery Management Area (WHRFMA) extending along the west coast of Hawai'i Island from 'Upolu Point, North Kohala to Ka Lae (South Point), Ka'ū, excluding the following areas: Lapakahi Marine Life Conservation District (MLCD), North Kohala Fish Replenishment Area (FRA), Puakō Bay and Puakō Reef Fisheries Management Area (FMA), Puakō-'Anaeho'omalu FRA, Ka'ūpūlehu FRA, Wāwāloli FMA, Kaloko-Honokohau FRA, Papawai Bay FMA, Old Kona Airport MLCD, Kailua Bay FMA, Kailua-Keauhou FRA, Keauhou Bay FMA, Red Hill FMA/FRA, Kealakekua Bay MLCD, Nāpo'opo'o-Hōnaunau FRA, Ho'okena FRA, Ka'ohe FRA, and the Miloli'i FRA.

We are seeking consultation with any community members that might have knowledge, or who are involved in, any ongoing cultural practices that may be occurring in any of the places outside of the restricted areas listed above. If you have and can share any such information please contact Lokelani Brandt lbrandt@asmaffiliates.com, phone (808) 969-6066, mailing address ASM Affiliates 507A E. Lanikaula Street, Hilo, HI 96720.

APPENDIX B—COORDINATION WITH CONSULTED PARTIES

During development of the Revised Draft Environmental Impact Statement (RDEIS), the Applicant contacted the seven individuals who had previously requested to be a Consulted Party. On December 14, 2020, these parties were sent a letter via email, which sought advice and input on 11 of the concerns raised by the Board of Land and Natural Resources (BLNR) in its June 23, 2020 Final Environmental Impact Statement (FEIS) Acceptance Determination in which the BLNR decided on non-acceptance of the FEIS (3 of the 14 concerns were determined by the Environmental Council to be arbitrary and capricious and therefore were not addressed in the consultation). Consulted Parties were asked to respond within 30 days. The request for coordination, and the response received, are both included in this appendix.

Previous comments received from the consulted parties, and the Applicant's responses to them, are provided in the previous Final Environmental Assessment (FEA), DEIS, and FEIS. The public comment period during the publication of the RDEIS will provide the consulted parties an opportunity to review how their comments were addressed and to provide further comments as necessary. The comments received from the consulted parties were fully considered and incorporated as appropriate into the RDEIS, as described below.

- Determinations of significance have been removed from the RDEIS.
- The RDEIS includes a revised No Action Alternative which accounts for the changes in commercial marine license (CML) issuance that have occurred since the previous Hawai'i Environmental Policy Act (HEPA) documents were published.
- The RDEIS includes a new Preferred Alternative which addresses the concerns raised by the commentors regarding total allowable catch (TAC), and also proposes new enforcement and compliance measures to address concerns about catch verification. This alternative also proposes a reduction in the White List from 40 species down to 8 species and eliminates any species which have shown statistically significant declines. The proposed individual catch quotas may be revised (i.e., increased or decreased) over time during the annual permit renewal period based on re-evaluation by the Department of Land and Natural Resources (DLNR) of each proposed Revised White List species' population status (e.g., new population estimates, new population trend data, etc.).
- Any species which had shown a significant population decline in Open Areas between 1999/2000 and 2017/2018 was not included on the Revised White List, and therefore has a TAC of zero.
- The consulted parties indicated that population data after January 2018 should be excluded from any harvest/population ratios used to demonstrate the impact of past aquarium collecting activities. The population data in the RDEIS has been updated to the most recent estimates available, as that is the population which will be impacted by the proposed action (i.e., the populations from which future collection would occur). This is not used to demonstrate the past impact of aquarium collection, which has already occurred.
- Additional details on the role of herbivores, including the Foo et al. (2020) paper which was published after publication of the FEIS, have been added to the RDEIS.
- Additional information on climate change has been added to the RDEIS.
- The consulted parties requested documented compliance with three items: (1) reduce or stop the take of herbivores, (2) avoid touching or standing on corals, and (3) keep vessel

anchors and chains off corals. As stated in the RDEIS, damage of coral will continue to remain unlawful. The new Preferred Alternative limits collection of aquarium fish to just 8 species, and the RDEIS includes an expanded discussion on the role of herbivores and specifies which of the 40 White List Species are herbivorous.

- The RDEIS includes a better acknowledgement of the potential impacts to cultural resources. The Cultural Impact Assessment (CIA) was prepared between the publications of the Environmental Assessment (EA) and the previous DEIS, and therefore the Draft Environmental Assessment (DEA) and FEA were both publicly available during that time, and thus available to those who were consulted as part of the CIA process. Both documents (DEA and FEA) disclosed the impacts of commercial aquarium collection.
- The consulted parties requested information on which White List species have experienced population increases in the open areas since the October 2017 ban on Aquarium Permits. To the Applicant's knowledge, this information is not available. Nonetheless, the new Preferred Alternative limits collection to just 8 species, which had shown population increases under historic rates of aquarium collection between 2000 and 2017.
- As stated in the RDEIS, the names of the 7 fishers who would receive permits under the Preferred Alternative will be provided in the FEIS. The number of permits is already disclosed for each of the alternatives. Any other fisher or group of fishers can enter the fishery (i.e., the Preferred Alternative is not requesting exclusive access), but would need to complete their own HEPA review analyzing the effects of the additional catch.
- As stated in the RDEIS, historic catch of the 7 fishers who would be issued permits under the Revised White List and Limited Permit Issuance Alternative are not applicable to the analysis due to the proposed implementation of individual catch quotas.
- The cumulative impact of poaching is addressed in the RDEIS. The Preferred Alternative also proposes additional enforcement and compliance measures.
- As stated in previous responses to comments, the enforcement of state laws is within the purview of the state of Hawai'i. Additional enforcement and compliance measures have been proposed under the new Preferred Alternative, including limiting legal collection to just 8 White List Species.

Stantec Consulting Services Inc.
2300 Swan Lake Boulevard, Suite 202, Independence, IA 50644

December 14, 2020

VIA EMAIL

Reference: Request to Become a Consulted Party
Hawai'i Aquarium Fishing Revised Draft Environmental Impact Statement

Dear Consulted Party:

On June 23, 2020, the State of Hawai'i Board of Land and Natural Resources (BLNR) published an FEIS Acceptance Determination in which the BLNR decided on non-acceptance of the Final Environmental Impact Statement (FEIS) for the Hawai'i Aquarium Fishery based on 14 concerns (see attached). The Environmental Council subsequently determined that 3 of the 14 reasons for nonacceptance were arbitrary and capricious. The Pet Industry Joint Advisory Council (PIJAC) is acting as the applicant and has made the decision to prepare a Revised Draft Environmental Impact Statement (DEIS) addressing the 11 remaining reasons for nonacceptance.

You are being contacted because you previously requested to become a "consulted party" under HAR 11-200-15 during development of the prior DEIS and FEIS. The purpose of this letter is to seek your advice and further input as we develop the Revised DEIS prior to its publication. The applicant is specifically seeking your input on nonacceptance reasons 1 – 3, 5 – 10, and 12 – 13 in the attached BLNR document.

To help inform its analysis, the applicant requests any information or advice you have concerning the findings in these 11 reasons. We request that you provide written comments to Stantec by January 14, 2021 at the address shown on the letterhead or by email at terry.vandewalle@stantec.com for review and consideration during development of the Revised DEIS. We will review all information provided and use the information during the development of the Revised DEIS. If you have any questions, or require further information about this request, please feel free to contact me directly at terry.vandewalle@stantec.com or (319) 334-3755.

Sincerely,

STANTEC CONSULTING SERVICES INC.

Terry VanDeWalle
Senior Biologist/Principal

January 14, 2021

Terry VanDeWalle
Stantec Consulting Services Inc.
2300 Swan Lake Boulevard Suite 202
Independence IA 50644-9708

VIA Email: Terry.Vandewall@Stantec.com

RE: Pending Proposed Revised DEIS for the West Hawai'i Aquarium Trade

Mr. VanDeWalle,

Preliminarily, we must note Stantec's past and continued failures to meaningfully consult with us on any of the various iterations of the assessments and statements previously submitted, which contributed to the rejection of the West Hawai'i FEIS in May. Further, we recently learned that the Applicant expects the Revised DEIS (RDEIS) for the West Hawai'i aquarium trade to be published soon after the end of January 2021. Given that Stantec gave us a deadline of January 14, 2021 for receiving the "advice and further input" on development of the Applicant's RDEIS, and with just weeks between those time frames, it is clear that Stantec is, once again, failing to meaningfully consult with us and endeavor to develop a fully acceptable draft EIS prior to the time the draft EIS is filed with the Hawai'i Office of Environmental Quality Control (OEQC), and although it is legally required.[1, 2]

We continue to expect the Applicant to endeavor to develop a fully acceptable RDEIS prior to the time it is filed with the OEQC through a full and complete consultation process that is responsive and not just a perfunctory gesture that ultimately dismisses or ignores our concerns. Despite these objections, we submit this advice and input to inform and improve the forthcoming RDEIS.

First and foremost is our expectation that the erroneous methods, characterizations, and conclusions, which dominated the previous process, are replaced with those that are accurate and appropriate. The RDEIS must properly disclose and discuss the adverse environmental and cultural impacts of the proposed action and subsequently consider alternatives and propose

[1] Consulted Parties Letter (Dec. 2020)
[2] HAR §11-200-1.23 (b)

mitigation to eliminate, reduce, and rectify those impacts. To that point, we believe it would be a serious misstep, which would result in yet another deeply flawed study, should you prepare an RDEIS that solely addresses eleven of the Board of Land and Natural Resources' fourteen Reasons for Nonacceptance (dated May 30, 2020), as described in your Consulted Parties Letter, and that omits nonacceptance reason number 11, which is under judicial review. A properly conducted RDEIS will address all fourteen of the Board's reasons for nonacceptance, as well as additional reasons supported by the testimony and exhibits that were used by the Board in their decision.

Moreover, the entire RDEIS should be revised to account for the Hawai'i First Circuit Court's recent rulings that all commercial aquarium collection—regardless of the take method or gear used—requires environmental review before it proceeds. The April 2020 FEIS was built on the incorrect assumption that commercial aquarium collection may continue "legally" outside of West Hawai'i using gear other than fine-meshed nets. This false premise affected fundamental components of the FEIS, including the alternatives considered and take estimates. The RDEIS should be updated to reflect a possible shift in collected areas and species in light of these rulings.

We are also resubmitting updated versions of the questions we posed in our August 2019 consultation letter to Stantec. We also request that Stantec inform us of areas where your positions have changed in response to our comments. We also expect updated responses to the questions and comments we submitted on the May 2018 DEA, the September 2018 FEA-EISPN, the January 2020 DEIS, and the comments submitted by us and many others to the Board in May of 2020, and to provide updated and complete responses.

Without a thorough response from Stantec to these new and earlier outstanding questions, prior to your submission to OEQC for publication, it will be clear that you are not endeavoring to develop a fully acceptable RDEIS prior to the time it is filed with the OEQC. This suggests that Stantec is once again inadequately evaluating the environmental impacts of this proposed action pursuant to HEPA.

Input regarding reasons for nonacceptance:

1. In order to properly assess the likely impact of the proposed take of the aquarium fish, the FEIS should contain a reasonably reliable estimate of the amount of future take.

> An estimate of the amount of future take should be based upon a proposed maximum level of take, such as a determination of total allowable catch (TAC) for each White List species within a specific aquarium trip report sub-zone, or smaller area.
>
> As we describe more in item 8. below, TACs should be based upon the unique life history traits of each species, the current status of the target species population within the sub-zone or smaller area (i.e. the impact of historical levels of take on the target species), whether or not a state of natural abundance has been achieved since 2018, and factor larval sources and sinks connected to or within that area.

In addition, to ensure compliance, a catch verification system that does not rely upon funding from the Hawai'i Department of Land and Natural Resources (DLNR) for execution should be proposed.

2. Except for the paku'iku'i, or Achilles tang, the FEIS does not contain any daily bag limits on any of the "White List" species which the fishers are allowed to take, and there are no annual limits on the take of any species except that the total take of paku'iku'i would be limited by the fact that only ten permits with a daily limit of five each would be allowed under the proposed action. In addition, there is no scientific basis provided for reducing daily take of paku'iku'i from ten to five per permit, nor any analysis of the impact of that level of take on the population of paku'iku'i.

See our responses to Items 1 and 8.

3. The existing regulations of the WHRFMA do not contain any daily or annual bag limits other than for the paku'iku'i, a "slot limit" for yellow tang, and a limit on kole over 4" long. To project how many fish are likely to be taken, the FEIS relies completely on the historical catch records of these ten fishers for the forty "White List" species. See Tables 5-2 and 5-11. The FEIS concludes that 160,832 fish would be taken annually, based on the maximum number taken by the ten permittees in any year, during the 2000-2017 period. See §5.4.1.5. The assumption that historical catch records adequately predict the future take has a number of shortcomings.

Based on BLNR's reason #3, the Applicant must propose and analyze TACs for each White List species. We note that the Environmental Council also cited major problems with the lack of proposed limits.[3] Further, the Applicant must sufficiently support those proposals with additional data that are not historical catch records.

Also, see our response to Item 1.

5. The FEIS has no information about the level of effort of these 10 fishers in prior years, i.e. whether they collected 100, 200, or 300 days a year, for example, and the amount of time spent collecting. It is possible that they could significantly increase their collection efforts and total take.

See our response to Items 1 and 3.

6. The fishers could also or alternatively change what species they target for collection and increase the impact on some species.

See our response to Items 1 and 3.

7. The data in the FEIS show that these ten fishers take some species at a very different rate than the fishery as a whole. For example, although the percentage taken of all species by the ten in the WHRFMA varies from a low of 7.0% in FY2000 (when only two were active) to

[3] EC appeal at 87. & 89.

46.4% in FY2017 (Table 5-2), their percentage of take of individual species, at least in certain years, has been much higher. Table 5-11 gives the maximum catch in any one year for each of the "White List" species, and the maximum catch in any one year by the ten. The ten fishers took 83.7% of the lei triggerfish (252/301), 95.5% of the milletseed butterflyfish (402/421), and 89.2% of the Fisher's angelfish (257/288), and 54.6% of the kole (23,014/42,122.) On the other hand, they took only 9 .1 % of the ornate wrasse (1130/12,445). This demonstrates that collectors can, and do, selectively target some species more than others. (It is not clear whether the maximum year given for all collectors is the same year as that given for the maximum by the ten fishers. The basic point made here is valid in either case, however.)

See our responses to Items 1, 3, and 8.

8. In order to assess the likely impact of the take, the FEIS should adequately analyze the sustainable level of take. The FEIS relies on Ochavillo and Hodgson (2006) for the proposition that 5-25% of a population is a sustainable level for annual take. The FEIS has an inadequate justification for the reliance on this publication as the best available science. The FEIS does not provide data for nor statistically analyze the sustainability of that level of take for each type of fish, given each fish species' life span, population size, reproductivity rates and age at first reproduction.

As noted by the Environmental Council, the EIS did not define sustainable level of take for each of the White List species individually or cumulatively.[4] The notion of what is or is not sustainable depends upon what it is being measured against. For example, yellow tangs were taken in the WHRFMA Open areas from 2000 – 2017 at a rate that diminished their natural abundance by an estimated average of 60% each year (i.e. natural abundance was not sustained). This corresponded to reduced level of herbivore biomass of these important grazers by tens of thousands of kilograms annually (i.e. herbivore biomass was not sustained). As described below, herbivore biomass is critically low on many West Hawai'i reefs, and for some, it's even below that which is needed to allow Hawai'i's coral reefs to persist into the future. So, while a level of take was "sustained" during that period, abundance and the level of ecosystem services were not.

Consequently, we believe that any sustainable level of take should be measured against the natural abundance level, as found in the MPAs, for each White List species, and for herbivores, should factor the loss of herbivore biomass.

Additionally, proposed levels of take should be determined using life history data for each species along with a thorough analysis of the WHAP dataset through 2017, the CREP data through 2016, and reported catch. Combined, they would provide an essential view of how past levels of take impacted the White List species in the WHRFMA annually and over various time periods. We include the CREP surveys here because we agree with the comments and testimony presented by Asner et al. in their DEIS comments and testimony to the BLNR, that the CREP data for each WHRFMA management area should be analyzed and compared to the WHAP data. Though the CREP surveys include populations outside the most relevant depth range of 30-60 feet,

[4] EC at 109.

where most collecting occurs and therefore was the depth range for the WHAP surveys, they are still informative.

Further, the precautionary approach requires that larval connectivity and dispersal patterns, and the main source and sink areas connected to and within the WHRFMA, are determined for the 40 White List species. This information is necessary for the determination of indirect impacts as well as sustainable levels of take.

Examples of mitigation measures addressing the above issues would be TACs set at zero for species lacking data or those showing significant declines in any of the WHRFMA management areas. According to FEIS Table 5-8, which is based upon DLNR data, populations of the following 12 White List species had declined from 1999 to 2018, despite no legal aquarium collecting occurring in 2018 in the WHRFMA: Achilles Tang, Ornate Wrasse, Saddle Wrasse, Multiband Butterflyfish, Fourspot Butterflyfish, Milletseed Butterflyfish, Eightline Wrasse, Fourline Wrasse, Pyramid Butterflyfish, Blackside Hawkfish, Hawaiian Whitespotted Toby, and Gilded Triggerfish.

9. In § 5 .4.1.5, the FEIS uses Table 5-11 to compare the take of various species to the CREP population estimates, to show that they are well below the claimed 5-25% sustainable level. In Table 4-5, however, the harvest/population ratios of four or five species (depending on the year) in the West Hawai'i open areas at 30'-60' depth exceeded 5% for several species, and are as high as 39.67% for the paku'iku'i in 2017-2018. The West Hawai'i open area population estimates may be more relevant than the island-wide CREP data.

Population data after January 2018 should be excluded from any harvest/population ratios used to demonstrate the impact of past aquarium collecting activities, such as that described above, since no legal aquarium collecting occurred after January 5, 2018. This position was also stated by Asner et al. in their FEIS testimony.

Also, see our answers to Items 1 and 8.

10. The FEIS has an inadequate discussion of the role of herbivores. Many of the "White List" species are herbivores.

Per analyses of the DEIS and FEIS presented by Asner et al. in their DEIS comments and BLNR testimony on the FEIS as well as in Foo et al., a study published since completion of the FEIS.[5] All three are attached in the email and incorporated herein by reference.

According to those documents (paraphrasing):

- Hawai'i is in a new ocean climate regime that renders historical fish data scientifically unpredictive of the reef ecosystem into the future.
- Reef ecosystem response to the marine heatwaves generated by this new climate regime is evolving and in strong disequilibrium.

[5] Foo et al. (2020)

- The ability of Hawai'i's coral reefs to persist when faced with heatwaves that may occur annually by 2035 will be heavily influenced by the abundance and diversity of herbivorous fishes which "are primary determinants of reef algal cover, which competes directly with slow-growing corals for space during and between marine heatwaves."
- Best available science suggests that herbivores at a rate of 250 kg/hectare are necessary to prevent coral reefs from shifting to ecosystems dominated by algae.
- "As of 2018, 74% of shallow coral reefs of West Hawai'i are near or below this threshold, and the biomass of deeper portions of the reef are insufficiently known."
- "West Hawai'i's reefs are not well prepared for repeated marine heatwaves from an herbivore fish standpoint."
- In this new climate regime, it is critical for the near and long-term survival of coral reefs in West Hawai'i that management factors the interactive role between herbivorous fish and corals.
- "Herbivore fish biomass above the critical 250 kg per hectare threshold will be needed moving forward to ensure that West Hawai'i reefs remain intact and biologically productive."
- Pollution in the form of nitrogen-rich effluent and commercial fishing were the main drivers of resource fish decline (which includes a number of White List species).
- "Importantly, non-commercial fishing was not correlated with observed long-term declines in fish biomass in shallow water habitats."

Mitigation measures that reflect the urgent need for more herbivores on Hawai'i's reefs would include TACs set at zero for all White List herbivorous species in all areas/zones where herbivore biomass is below 250 kg per hectare; and, in areas with adequate levels of herbivore biomass, TACs for herbivores would enable a sustained level of herbivore biomass that is above or equal to 250 kg per hectare.

11. The FEIS does not adequately discuss relevant negative findings, for example, the reduced numbers of aquarium fish at collection sites found by Tissot and Hallacher (2003). The FEIS need not agree or disprove the negative findings, but it should discuss them.
Note: this item is included because the Environmental Council's rejection of it is under judicial review, and therefore should not be excluded.

The disclosure and discussion of findings contrary to what is claimed by the Applicant (i.e. negative findings), which in many cases are already contained within the FEIS but neither disclosed, nor described, is key to a legal adequate RDEIS. Numerous examples are found within the comments we've submitted beginning with the DEA and culminating with our testimony to the BLNR on the FEIS. In addition, comments from others describing other negative findings, and new research that has been published, should also be included.

12. The extreme threat of climate change on our reefs warrants extreme caution in reviewing activities that may affect them. The FEIS should further discuss potential effects of present and future levels of climate change including ocean warming, ocean acidification, coral

bleaching, extreme storms, and resulting reef destruction and algae growth, and the potential for mitigating harm (i.e. further regulation) if the proposed fishery has unanticipated or greater negative effects with climate change.

The RDEIS must fully disclose the changing baseline from climate change and the effects of the proposed activities on the reef in light of climate change. It has been projected that Hawai'i's coral reefs could experience severe annual bleaching by 2035 which will result in the loss of 71% of the state's current coral reef cover by mid-century, and 99% by 2100.

The RDEIS should explain how the applicants will specifically comply with the following NOAA and DLNR recommended actions for minimizing stress to Hawai'i's threatened reefs, and, given the extremely limited enforcement resources and capabilities of DLNR, how they will show compliance with these recommended actions.

- Reduce or stop taking herbivorous fishes such as surgeonfish which are needed to keep algae growth under control so as not to smother and kill corals stressed from bleaching
- Avoid touching, standing in corals
- Keep vessel anchors and chains off corals

Also, see our response to Item 10.

13. The FEIS failed to sufficiently consider cultural impacts. The FEIS improperly concluded that the impacts to cultural resources under any of the proposed alternatives would be less than significant based on the flawed premise that cultural impacts would only occur if the proposed action would cause a significant decline in the population of a White List Species considered to be a cultural resource. A number of testimonies expressed misgivings from a cultural standpoint with the proposed activity itself, regardless of impact on resources, and this was not adequately considered in concluding no significant impact.

A critical flaw in the preparation of the original Cultural Impact Assessment (CIA) occurred when those consulted were not informed of the extent and impacts of the Applicants past actions and proposed future actions. Many, but not all, are aware of the impacts, and knowing the extent to which aquarium collecting has or may have contributed to the condition of West Hawai'i reefs, fish abundance, and other cultural resources is crucial. A revised CIA should be prepared and that information should be provided in advance to those who will be consulted. Dismissing the misgivings and concerns of native Hawaiians is not acceptable.

Even if it chooses to re-submit its inherently flawed CIA, the Applicant should aid BLNR's decision making by specifically addressing:

(1) the **full scope** of valued cultural, historical, or natural resources in the project area, not just purported impacts to common subsistence species (which only accounts for some of the "natural" resources noted above): the Applicant must acknowledge and

respect that "cultural resources" encompass a much broader set of topics than just subsistence fishing, and disclose those resources accordingly;

(2) the extent to which all of those resources, including subsistence resources and cultural resources associated with Hawaiian religious views, will be affected or impaired by issuance of the proposed permits; and

(3) feasible actions, if any, that can mitigate those impacts.

Additional input and questions:

1. What are the **environmental benefits** of the No Action Alternative? Specifically, as of December 2020, which White List species experienced population increases in the open areas, relative to the FRAs and MPAs, compared to their January 2018 abundance levels and what was the extent of those increases? What is the estimated increase in biomass for the herbivorous species among that group?

The Proposed RDEIS would provide exclusive access, take and related privileges to an unknown number of individuals that no other person would otherwise have access to. Given these applicants are requesting special permission to access and remove constitutionally protected public trust resources, the below information is needed to explain how and why these specific individuals should be granted this exclusive access, that would otherwise be denied to others.

2. Please identify the individuals represented by the Applicant by name and business name (DBA).

3. How many reef animals were taken by the individuals from 2000 – 2017. If Table 5-11 from the FEIS is the format used, please identify the actual number of individuals represented in the amounts presented.

4. Have any of the individuals been charged with any offense related to the aquarium trade or occurring during the course of aquarium trade activities, or county or state natural resource related offenses? If so, include date, offense and outcome of each offense. Five aquarium collectors have been cited and convicted with poaching related activities. Are or were any of these collectors current or prior Applicants? How will you factor in the removal of potentially thousands of animals via poaching which, of course, is not reported as catch?

5. To what extent will the individuals/applicants 1) specifically comply with the following recommended actions, and, given the extremely limited enforcement resources and capabilities of DLNR, 2) show compliance with these recommended actions?

    - Reduce or stop taking herbivorous fishes such as surgeonfish which are needed to keep algae growth under control so as not to smother and kill corals stressed from bleaching
    - Avoid touching, standing in corals
    - Keep vessel anchors and chains off corals

6. DLNR, specifically the Division of Aquatic Resources and their enforcement arm, the Division of Conservation and Resource Enforcement (DOCARE) has severely restricted resources, such as inadequate staff and funding for enforcement, and there are current statutory restrictions on searches of certain containers carrying marine life and certain vessels.

   How do the individuals/applicants propose that enforcement will be achieved on any proposed limits to their activities, including verifiable compliance with current administrative rules, and state and federal laws, including those listed below. How are the individuals/applicants currently complying?

   - Federal Lacey Act requirements USC Title 16
   - Hawai'i Misdemeanor Cruelty to Animals statute HRS 711-1109

7. The commercial aquarium trade has long operated with fewer regulations, oversight and compliance-verification mechanisms than those that commercial food fisheries must adhere to. Further, while the issuance of aquarium collection permits is discretionary, and subjects the permit holder to certain legal obligations, including inspection of facilities holding marine life, many of these regulations have not been actively enforced. For clarification, do the individuals/applicants cooperate and comply with the following:

   - provide open and immediate access to coolers, containers, vessels and other aquarium related gear, equipment and holding facilities upon request of a DLNR-DOCARE Officer, as per the conditions of their permits?
   - allow observers on their vessels with/without notice?

8. Though we requested it, the FEIS failed to include data and records which are not readily accessible to the public and other interested parties. Please provide the necessary data and response to the following to address our outstanding concerns with enforceability of the above-referenced laws specifically as it relates to animal health, welfare and mortality rates:

   a) For each individual, please provide the following regarding the fishes they captured for aquarium purposes each month from October 2017 to the present:

      - The number of fishes sold to marine dealers on Hawai'i Island, and their identities
      - The number of fishes sold and shipped intrastate to a marine dealer(s) on another island, and their identities
      - The number of fishes shipped interstate or internationally and the identities of the purchaser(s)
      - the mortality rates for each shipment (a) upon arrival and (b) at 14 days post-shipment

   b) For each of the applicants please note whether they are also a marine dealer, and if so, provide the names and CMLs of those they have purchased fish from since 2000. For

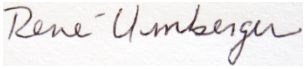
individuals who are not marine dealers, provide the names of the entities they sell their catch to, inside and outside the state;

c) For each of the applicants, please note which collectors engage in the following practices:

- withholding of food (starvation) and for what period of time;
- fizzing or puncturing of the swim bladder;
- cutting of spines or dorsal fins;
- body compression (squeezing animal to forcibly eject fecal matter).

In conclusion, we emphasize that the environmental review must address every phase and aspect of the proposed action to determine the "overall and cumulative effects of an action," Haw. Admin. R. § 11-200-12(a), which may include "ecological effects (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic effects, [] cultural effects, [and] economic effects . . . whether primary, secondary, or cumulative." Haw. Admin. R. § 11-200-2. It is vitally important that the environmental review provide a comprehensive analysis of the environmental and cultural effects of the proposed action. These effects combined with the cumulative effects should be fully mitigated or the actions should not be approved. We also reiterate that thorough answers to the questions posed here, as well as thorough responses to our earlier comments are necessary in order for us to adequately provide consultation on this matter.

Thank you,



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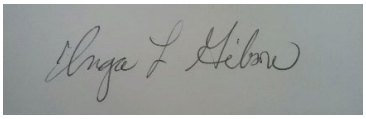

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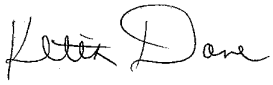

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Ecological Applications, 0(0), 2020, e02213

Impacts of pollution, fishing pressure, and reef rugosity on resource fish biomass in West Hawaii

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Abstract. Human activities and land-use drivers combine in complex ways to affect coral reef health and, in turn, the diversity and abundance of reef fauna. Here we examine the impacts of different marine protected area (MPA) types, and various human and habitat drivers, on resource fish functional groups (i.e., total fish, herbivore, grazer, scraper, and browser biomass) along the 180 km west coast of Hawaii Island. Across survey years from 2008 to 2018, we observed an overall decrease in total fish biomass of 45%, with similar decreases in biomass seen across most fish functional groups. MPAs that prohibited a combination of lay nets, aquarium collection, and spear fishing were most effective in maintaining and/or increasing fish biomass across all functional groups. We also found that pollution, fishing, and habitat drivers all contributed to changes in total fish biomass, where the most negative impact was nitrogen input from land-based sewage disposal. Fish biomass relationships with our study drivers depended on fish functional grouping. For surgeonfish (grazers), changes in biomass linked most strongly to changes in reef rugosity. For parrotfish (scrapers), biomass was better explained by changes in commercial catch where current commercial fishing levels are negatively affecting scraper populations. Our observations suggest that regional management of multiple factors, including habitat, pollution, and fisheries, will benefit resource fish biomass off Hawaii Island.

Key words: fish biomass; functional group; habitat complexity; herbivore; local disturbance; marine protected area.

Introduction

Coral reefs represent one of the most diverse ecosystems in the world, providing invaluable services such as protecting coastlines from erosion and supporting more than 25% of marine species (Moberg and Folke 1999, Burke et al. 2012, Grafeld et al. 2017). Coral reefs and associated fauna are experiencing increased pressure from global stressors, including bleaching events that are projected to occur with greater frequency (van Hooidonk et al. 2016, Hughes et al. 2017). These events occur against a background of variability among local human and habitat influences. Factors such as fishing pressure, reef rugosity, and nitrogen input can all have substantial impacts on coral reef fish assemblages (Friedlander et al. 2017). Understanding the relative influence of these drivers is important in assessing pathways for managing and protecting coral reef systems and reducing secondary stressors during repeated marine heatwaves that cause coral bleaching.

Fish biomass can be used as an indicator of reef status and human disturbance, particularly through fishing impact (McClanahan et al. 2016). Reef fish are a major source of protein that feeds over one billion people worldwide (Duffy et al. 2015). Resource species, targeted fishes ultimately intended for human consumption, are a critically important component in coral reef ecosystems as they consist predominantly of herbivorous species (Division of Aquatic Resources 2018). The role of herbivorous fish in coral reef ecosystems is particularly important in balancing coral-algal dynamics (Heenan and Williams 2013, Smith et al. 2016). Herbivorous fish, such as parrotfishes that scrape algae from coral reef surfaces, are key in promoting reef calcifiers (e.g., Scleractinians and crustose calcifying algae) over fleshy macroalgae (Mumby et al. 2006, Hughes et al. 2007, Topor et al. 2019). This, in turn, is important for reef recovery after bleaching events (Graham et al. 2015). In response to over-harvesting of grazers, coral reefs are highly likely to transition to that of algal dominance in

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areas more impacted by humans (McClanahan et al. 2007, Jessen et al. 2013, Graham et al. 2015).

The physical structure of reefs greatly influences biodiversity and ecosystem functioning. Topographically complex reefs generally support diverse communities (González-Rivero et al. 2017), while disturbances such as climate change, including increased tropical cyclones, can generate decreases in reef rugosity, a metric of reef topography (Smithers et al. 2007). Increasing reef rugosity increases the availability of refuge spaces such as crevices and branches, which in turn can help to increase fish biodiversity (Alvarez-Filip et al. 2011, González-Rivero et al. 2017). An increase in total fish diversity, abundance and biomass is generally observed in more structurally complex and diverse reef habitats (e.g., Gratwicke and Speight 2005, Idjadi and Edmunds 2006, Wilson et al. 2007).

There are substantial differences in reef habitat in the Hawaiian Islands, as well as potentially different influences of human drivers. The bulk of commercial, recreational, and subsistence catch of resource fish, as well as invertebrates and seaweed, are from the near-shore reef habitat (McCoy et al. 2018), where the majority of herbivore biomass is observed at a shallow depth range of 4.3–7.2 m (Friedlander and Parrish 1998). In addition to these factors, nitrogen pollution is prevalent along many parts of the coastline owing to human wastewater that is primarily disposed via onsite sewage disposal systems (OSDS) (Wedding et al. 2018). Additionally, other land-use types such as golf courses increase nutrient runoff and leaching of other pollutants into the nearby reef (for a review, see Carlson et al. 2019). Thus, the influence of local drivers is key in shaping fish biomass in Hawaii, with near-shore ecosystems being particularly vulnerable due to their proximity to land. Changes in reef fish biomass can often be more sensitive to local human impacts than changes in benthic diversity and cover on coral reefs (McClanahan et al. 2011). Furthermore, local impacts can intensify the effect of marine heat waves or prevent areas from recovering after these events (Lapointe et al. 2019).

In Hawaii, marine protected areas (MPAs) are a subset of marine managed areas that focus on protection and conservation of marine ecosystems. Some MPAs restrict some types of gear while very few are full no-take areas or highly protected, representing less than 3.4% of nearshore habitat across the Main Hawaiian Islands (Department of Land and Natural Resources Division of Aquatic Resources State of Hawaii 2019, Friedlander et al. 2019; Fig. 1). Highly protected areas have been effective in increasing fish biomass in Hawaii; however, these gains have been offset in part by their proximity to increased human population, whereas more remote geographies contain some of the greatest fish biomass (Friedlander et al. 2019). Human population density is a common proxy for fishing pressure and is often negatively correlated with reef fish biomass (Stallings 2009, Williams et al. 2015*a*, *b*, Friedlander et al. 2017) although studies have shown that global drivers such as ocean warming, can mask local effects (Bruno and Valdivia 2016). Nonetheless, mitigation of local stressors can help to compensate for climate change impacts (Brown et al. 2013). An understanding of which human impacts most strongly drive changes in fish biomass will therefore be important in driving adaptive policies in local management.

Here we use shallow water resource fish (SWRF) survey data from 2008–2018 collected along the west coast of Hawaii Island (henceforth "West Hawaii") to investigate three main objectives: (1) observe changes in resource fish biomass over survey years, (2) determine the influence of various marine management strategies on fish biomass, and (3) assess the relative importance of pollution, fishing and environmental drivers on fish biomass. We hypothesize that resource fish biomass has decreased over time; however, this decline is likely to be functional group specific. We also hypothesize that no-take reserves will contain the greatest fish biomass, as seen for other no-take areas globally (Sala and Giakoumi 2018). Last, we hypothesize that fishing pressure would most strongly impact standing biomass of resource fishes in comparison to other human and environmental impacts. Understanding drivers behind patterns of functionally important groups of fishes is crucial to understanding where management can be most effective in reducing stressors on coral reef ecosystems.

Methods

Study region

West Hawaii supports a biologically diverse reef ecosystem, housing a contiguous reef of almost 180 km; the largest in the main Hawaiian Islands. The resident population has increased threefold since 1970, where ~45% of Hawaii's population live in West Hawaii; 25% within 1 mile (1 mile = 1.6 km) from the coast (Gove et al. 2019). Reefs in West Hawaii support ecosystem services of tremendous value to local communities. Local stressors such as nutrient runoff, fishing pressure, and coastal development are increasingly impacting near-shore ecosystems, with similar pressures across the entire Hawaiian archipelago. An understanding of the responses of these systems and associated fauna is critically important, where West Hawaii provides a model system for efforts elsewhere in the Main Hawaiian Islands and beyond.

Surveys

We analyzed fish data collected in 2008, 2009, 2011, 2014 and 2018 as part of Hawaii's Department of Land and Natural Resources' Division of Aquatic Resources (DAR) monitoring program of shallow water resource fish, at a total of 349 sites across all survey years (Fig. 1). Resource species are recognized as species

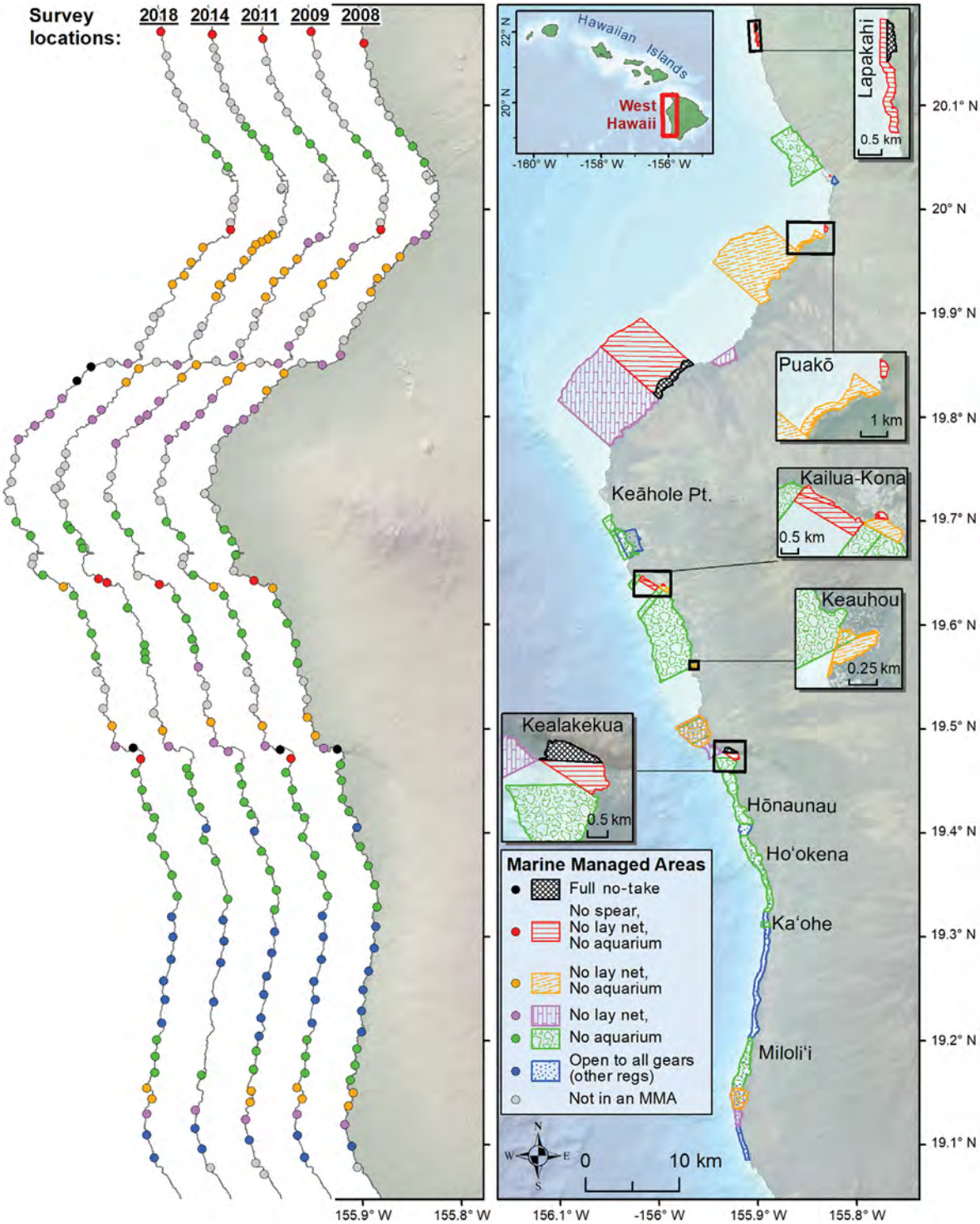

FIG. 1. Shallow water resource fish survey locations for all survey years and marine managed areas in West Hawaii. The left panel shows the survey locations separately for each survey year, where sites were determined by using ArcGIS to generate and evenly distribute sites along the shallow nearshore habitat of West Hawaii. Sites are color coded to match the marine managed area the survey fell within. The right panel shows the marine managed areas in West Hawaii colored by the management types covered by the surveys, where blue and gray marine managed areas are both considered open.

important to local subsistence or cultural sectors (Appendix S1: Table S1; Friedlander et al. 2017), providing substantial benefits for the economy, cultural practices, and food security in Hawaii (Grafeld et al. 2017). Each round of surveys consisted of 68 to 72 sites each survey year that were predetermined by using ArcGIS v 9.2 to generate and evenly distribute survey sites along the West Hawaii coastline between the northern and southernmost ends. Sites were selected within the 2–6 m isobath range within hard-bottom habitat where, generally, each site was surveyed once. Surveys were typically completed across a 2–3 month period, where survey timing varied across years (April to October 2008, February to April 2009, August to September 2011, October to December 2014, February to April 2018). Visual surveys were used to quantify the abundance of resource fish species (e.g., the whitebar surgeonfish *Acanthurus leucopareius* and the bullethead parrotfish *Chlorurus spilurus*) in shallow water habitats during a timed swim (10 minutes). During the surveys, divers remained with the 2–6 m depth range over hard-bottom habitat.

Survey methods of resource fish

The dive survey team consisted of two divers with both divers surveying the same 5 m wide belt, with an assumed central line projected forward along the reef isobath between the two divers. A 10-minute timed swim was used to survey fish (Caldwell et al. 2016) where one diver towed a handheld Garmin GPS (Garmin International, Inc., Olathe, Kansas, USA) and marked the start and end waypoints. ArcGIS was used to determine the area of the survey based on the recorded survey track. The average distance from start to end waypoints across all surveys was 232 m. Throughout the duration of the survey, divers remained within the 2–6 m depth range by following the reef contours. The leading diver was responsible for counting and sizing parrotfishes, wrasses, and other resource fish that were larger than 15 cm total length. The second diver was responsible for counting and sizing surgeonfishes, goatfishes, and introduced species larger than 15 cm in total length. Additionally, convict tang *Acanthurus triostegus*, Achilles tang *Acanthurus achilles*, and goldrim tang *Acanthurus nigricans* were surveyed when larger than 10 cm in total length due to a smaller average size but importance as resource fishes.

The main response variable considered in this study was the estimated biomass of fishes per unit area (g/m^2). The mass of individual fishes was estimated using length to weight conversion parameters from FishBase, a web-based resource (Froese and Pauly 2010). Data were pooled into total fish biomass and into four other fish functional groups. These included herbivores as a single guild that was further subdivided into three functional groupings: scrapers, grazers, and browsers, based on diet information taken from Heenan et al. (2016; Appendix S1: Table S1). Understanding the impacts across different functional groups of fish is important because their individual roles on reefs differ and considering them by their feeding mode can help to quantify herbivory as an indicator of resilience (Heenan and Williams 2013). Additionally, understanding impacts of local drivers on specific functional groups will be important for local management to better adapt policies that protect groups of fish with differing compositions. In this data set, scrapers primarily consisted of parrotfish species such as the palenose parrotfish *Scarus psittacus*, which feed on epilithic algal turf, and some *Chlorurus* species, which remove some component of the reef as they feed, contributing to bioerosion. The grazers from these surveys were all species of surgeonfishes from the genus *Acanthurus* such as the whitespotted surgeonfish *A. guttatus*. They feed on a combination of epilithic algal turf and sediment. In this data set, the browsers consisted of certain unicornfishes and parrotfishes such as bluespine unicornfish *Naso unicornis* and stareye parrotfish *Calotomus carolinus* that primarily feed on macroalgae, removing only algae from the substrate (Green and Bellwood 2009).

Change in resource fish biomass across survey years

To assess change in resource fish biomass across each year, we used bootstrapping with 10,000 iterations to generate 95% confidence intervals (CI) of mean fish biomass for each survey year and functional group. Non-overlapping 95% CIs is an indication that biomass is significantly different between years (Smith 1997, Cumming and Finch 2005).

Effects of protection type on resource fish biomass

For each site, the MPA status was determined (Hawaii State GIS, geodata.hawaii.gov). As SWRF sites were randomly selected with up to 72 sites each survey year, different MPA types were unequally represented, particularly for full no-take areas given that they make up only a very small combined area (~0.6 per km^2) in West Hawai‘i. Across all survey years, the number of sites that were open, i.e., had no protection (n = 144) or only banned aquarium fishing (n = 102) heavily outnumbered the other protection type sites, and therefore there was a lack of statistical power to consider this full analysis. We present total fish biomass across all MPA and open areas in Appendix S1: Fig. S1 for visual comparison only.

For our analysis, we focused on management types that banned different gear types: full no-take areas (n = 5), areas that banned lay nets (n = 39), areas that banned lay nets and aquarium fishing (n = 46), and areas that banned lay nets, aquarium, and spear fishing (n = 13). When a site represented multiple MPA categories, it was categorized as the MPA with the stricter regulations so that each site only represented one category.

Our objective was to determine the effect of protection type on resource fish biomass; however, this can be affected by the age of an MPA, especially since some of the no-take areas were only established in 2016. Thus, an analysis of covariance (ANCOVA) was used to determine whether there were statistical differences among the mean biomass across different MPA types, with MPA age as a covariate. We used the anova function in R to build a model with MPA type as a fixed factor and MPA age as a covariate. We performed five different ANCOVAs for the various functional groups (total fish, herbivores, scrapers, browsers, and grazers). To meet the assumptions of ANCOVA, the cube root across all functional group biomass values were taken. These transformations ensured that data were both normal and homogenous. Tukey's post hoc tests were used to determine which MPA types significantly differed from each other. Untransformed data are presented in Fig. 2 to assist interpretation.

Local drivers of fish biomass

Reef complexity and nutrient levels represent some of the factors that most strongly predict a resilient reef (Graham et al. 2015) and is why these factors were included in our models. We analyzed co-located data on a range of human and habitat variables known to impact reef fish with the SWRF survey data across all years (Table 1). Year was not considered in the final model as the appropriate driver data for the year prior to each survey year was used in the analyses as conducted in multiple studies (Williams et al. 2015, Heenan et al. 2016, Friedlander et al. 2017).

Fishing drivers

Fishing driver data included both commercial and non-commercial catch (Table 1). Data for commercial catch included the total commercial catch in kilograms per hectare of reef fish species calculated for the year prior to each survey year. Non-commercial yield of reef fish was also estimated for the year prior to each survey year in kilograms per hectare. Accessibility was embedded as a layer within the non-commercial catch data (McCoy et al. 2018, Wedding et al. 2018), based on steepness of terrain within 100 m of the shoreline and distance to nearest boat launch. The 2013 data were used for the 2018 surveys because estimates of non-commercial catch for years after 2013 do not exist (Wedding et al. 2018). See Table 1 for full explanations of human drivers, estimations of catch, and spatial resolution.

Pollution drivers

Land-use driver data included nitrogen pollution from golf courses and nitrogen pollution from OSDS such as cesspools, septic tanks, and injection wells, calculated for the year prior to each survey year (Table 1). Nitrogen pollution from golf courses was calculated in kilograms per hectare, proportional to the area of golf course within subwatersheds upslope of each survey site, with an offshore dispersion model. Nitrogen pollution from OSDS (kg/ha) was limited to OSDS located within a modeled 1-yr travel time of ground water to the coast from inland. This represents a conservative estimate as OSDS located further inland than the 1-yr travel time are not included the final value. See Table 1 for explanations of nitrogen flux estimation and spatial resolution.

Habitat driver

A habitat driver variable of reef rugosity was included in our analysis. Bathymetry and benthic rugosity mapping data were collected in 2018 using the Global Airborne Observatory (GAO; formerly the Carnegie Airborne Observatory; Asner et al. 2012). The method is described in Asner et al. 2020, which utilizes airborne high-fidelity imaging spectroscopy to derive bathymetry to 25 m depth at 1 m spatial resolution. Their reported precision was 0.5 m and absolute uncertainty of approximately 1.2 m (Asner et al. 2020). We determined reef rugosity for each transect by using the start and end GPS coordinates recorded for each survey with a 5 m width to represent the area that was covered during the surveys. Using the bathymetric maps, surface area to planar area rugosity was calculated for each transect by dividing the total contoured surface area by the total planar area, where more complex surfaces have a higher value than smooth surfaces. A caveat in our study is that we assumed that the underlying benthic 3D complexity remained similar between survey years despite a bleaching event in 2015. Despite coral mortality from that event, most dead branching and massive coral skeletons remained and continued to provide structure (particularly at the 1 m resolution of the rugosity data), where reef rugosity takes a longer time to degrade (Bozec et al. 2014, Perry and Morgan 2017). This means that, in the data analysis, the rugosity values for each site were all derived from GAO imaging spectroscopy data that was collected between June 2017 and January 2018 (Asner et al. 2020), with the assumption that sites surveyed prior to 2017 would not have changed in rugosity in the interim.

Modeling driver importance

As our objective was to assess the relative importance of pollution, fishing, and environmental drivers on fish biomass, we used multimodel inference paired with generalized additive modeling to quantify the importance of each driver. This methodology has been utilized previously to weight variables of importance and explore nonlinear relationships (Bekkby et al. 2009, Heenan et al. 2016, Fisher et al. 2018, Ravindra et al. 2019). All statistical procedures were performed in R software (v 3.1.2). Collinearity among predictor variables was assessed prior to all analyses using variance inflation

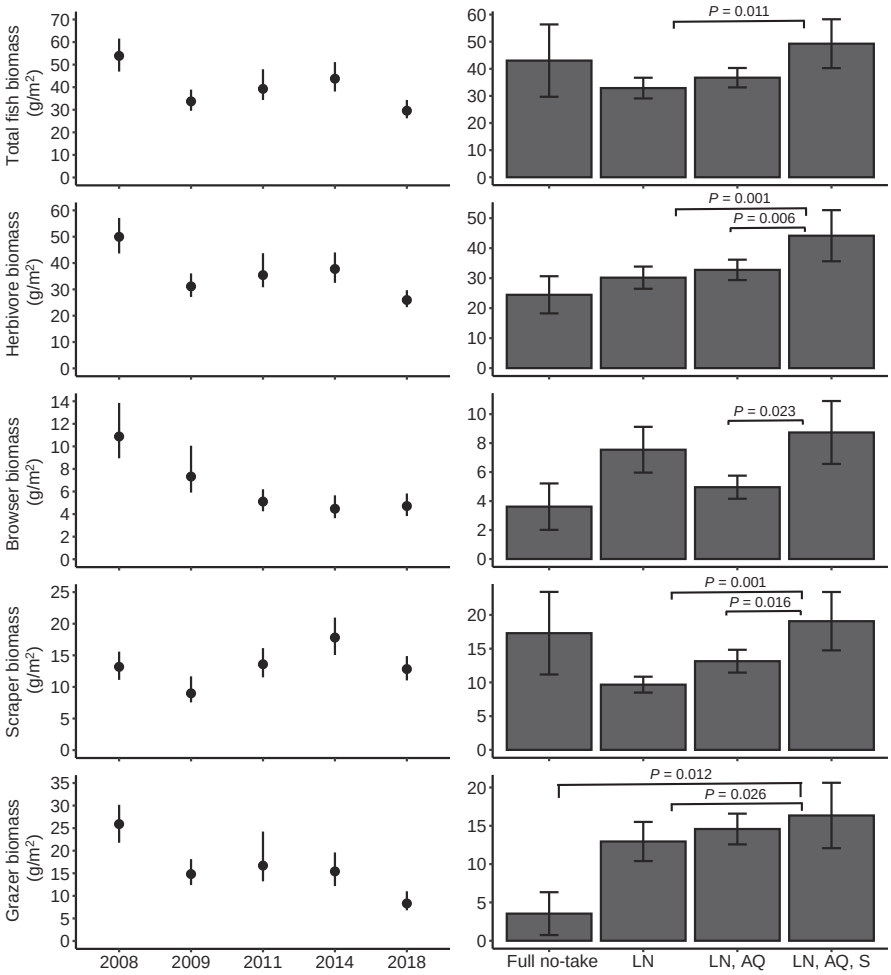

FIG. 2. Change in resource fish biomass over survey years (left panels) and effect of marine protected area (MPA) type on resource fish biomass (right panels) shown by various functional groups. The left panels show mean biomass and 95% confidence intervals. The right panels show mean biomass ± SE across four MPA types: full no-take (n = 5); lay net gear ban (LN, n = 39); lay net and aquarium fishing ban (LN, AQ, n = 46); lay net, aquarium fishing, and spear gear ban (LN, AQ, S, n = 13). An analysis of covariance was used to test the impact of MPA on fish biomass with MPA age as a covariate. MPA types that are significantly different, as tested by Tukey's post hoc tests, are indicated by brackets.

factors (VIF) where the highest VIF for any predictor was 2, lower than our a priori cut-off value of 3 (Zuur 2012). All variables were able to be retained in the models due to low collinearity. Furthermore, we used Moran's I to test for spatial autocorrelation. For all variables, the values were close to 0 and therefore a lack of autocorrelation existed among our variables.

Considering each site across each year as individual data entries, we used generalized additive models (GAM) to model the relationships between various groupings of resource fish biomass and various predictor variables using the mgvc package in R (Wood 2012). Models were fitted with a negative binomial distribution, which suited our over-dispersed count data of fish. Overfitting can be a problem with GAMs (Wood 2008) thus we limited the number of knots to five to prevent overfitting of our models.

We used model selection and averaging procedures from the MuMIn R package (Barton 2013) calculating Akaike's Information Criterion (AIC) corrected for small sample size (AIC_c; Anderson 2008) and the AIC_c-based relative importance weights (w) where, for each response variable, all possible models with the predictor data set were run using the dredge procedure. We retained only models with Akaike weight > 0.05 where the variable importance output (Table 2) gives the total weight of each variable for all models. As models sum to 1, values close to 1 indicate predictor variables that occur in large portions of the models. With the retained models, we generated a weighted model average that we then used for model prediction.

Relationships between response and predictor variables were generated using the predict procedure, which generates visualizations of smoothers of the top-ranked

Table 1. Predictor variables used in this study.

Predictor	Label	Spatial resolution	Description
Commercial Fishing Yield of Reef Fish	Commercial catch	Reporting blocks (Appendix S1: Fig. S2)	Total commercial catch (kg/ha) of reef fish species per hectare, by reporting block clipped to 40 m depth contour, excluding MPAs by gear type, reported by commercial marine fishing license holders including commercial line, net, and spear fishing average annual catch
Non-Commercial Fishing Yield of Reef Fish	Non-commercial catch	100 m	Total non-commercial catch (kg/ha) of reef fish species. Derived from yearly island-scale estimates based on Marine Recreational Information Program data and mapped using the Ocean Tipping Points fishing layer methodology (McCoy et al. 2018, Wedding et al. 2018). Estimates of average annual catch were derived from Marine Recreational Information Program (MRIP) survey data and combined with measures of shoreline accessibility (terrain steepness and presence of roads) to spatially distribute catch offshore and represents the sum of all of the non-commercial boat-based and shore-based fisheries catch
Nitrogen Pollution from Golf Courses	Golf pollution	100 m	Nitrogen flux (kg/ha) from golf course runoff/leaching based on the total area of golf course in drainage basins (derived from USGS ArcHydro Subwatersheds/Catchments) upslope of survey sites. Golf course area was derived from National Oceanic and Atmospheric Administration Coastal Change Analysis Program and LandSat cloud-free composites created with Google Earth Engine. Golf course area is multiplied by nitrogen application rate (585 $kg \cdot ha^{-1} \cdot yr^{-1}$) and then by a leaching rate of (32%) to estimate flux of nitrogen to the ground water. In addition, the impact on nearshore waters is reduced with distance inland of each golf course: Golf courses 0–5 km inland – 100% of leached nutrient reach the coast; 5–10 km inland – linear decay to 0 at 10 km; >10 km inland – 0 nutrients reach the coast (there are no golf courses >10 km inland in West Hawaii). Layer uses a Gaussian decay function with distance offshore - approaching zero at 2 km offshore
Nitrogen Pollution from OSDS and Injection Wells	OSDS pollution	100 m	Nitrogen flux (kg/ha) from Onsite Sewage Disposal Systems (OSDS) and Underground Injection wells within 1-yr groundwater travel time of the shoreline. Nutrient load from each OSDS is assumed to flow to the nearest point on the shoreline and then plume outward from there using a Gaussian decay function with distance from shore approaching zero at 2 km offshore
Reef rugosity	Rugosity	1 m	Rugosity was derived from the GAO bathymetric grids using the Benthic Terrain Modeler for ArcGIS, where the raster cell values reflected the ratio of the seascape surface area to the planimetric area determined in a 3 × 3 neighbourhood analysis

model where the predictor variable of interest has values equally spaced between the variable's minimum and maximum values, and all other predictor variables were set to their means. We used the resulting output to generate smoothers with the response of fish biomass shown against untransformed predictor variables.

Results

Changes in resource fish biomass across survey years

Standardized in biomass units of g/m^2 and averaged within and across the survey years (2008–2018), the grazer *Acanthurus leucopareius* was the largest contributor to fish biomass and was the most abundant fish recorded in surveys. This species was followed by the browser *Naso lituratus* and the scraper *Chlorurus spilurus*. The fourth and fifth most abundant surveyed fish species were the scrapers *Scarus rubroviolaceus* and *S. psittacus*.

Bootstrapped estimates of confidence intervals for resource fish biomass across every year show there was significantly greater biomass of fish in 2008 (53.93 g/m^2) in comparison to 2018 (29.59 g/m^2; Fig. 2). Similarly, for herbivores, browsers, and grazers, there were significantly more fish in 2008 in comparison to 2018, with the lowest biomass across surveys also recorded in 2018 (Fig. 2). For browsers, there was a fairly steady decrease in biomass, while grazers showed a significant decline in biomass between 2014 and 2018, with almost one-third of the biomass in 2018 compared to 2008 (Fig. 2). Scrapers, on the other hand, showed variable increases and decreases throughout the survey years, with the greatest biomass observed in 2014 (Fig. 2).

Effects of MPA status on resource fish biomass

Considering the full data set, the greatest biomass of fish was present in areas that banned a combination of lay nets, spears and aquarium fishing (49.26 g/m^2), with

TABLE 2. Shallow water resource fish generalized additive models (all models with weight >0.05).

	Model terms						Model performance			
	Commercial catch	OSDS pollution	Golf pollution	Non-commercial catch	Rugosity	df	Adj-R^2	AIC_c	Delta	Weight
Total fish biomass models										
	+	+	NA	NA	+	10	0.165	2,418.037	0.000	0.325
	+	+	+	NA	+	11	0.169	2,418.640	0.603	0.241
	NA	+	+	NA	+	7	0.139	2,420.116	2.079	0.115
	+	+	+	+	+	13	0.177	2,420.775	2.738	0.083
	+	+	NA	+	+	12	0.169	2,420.789	2.752	0.082
	NA	+	NA	NA	+	6	0.130	2,420.985	2.948	0.075
Variable importance	0.748	**0.993**	0.489	0.228	0.985					
Herbivore biomass models										
	+	+	NA	+	+	11	0.172	2,365.551	0.000	0.242
	NA	+	+	+	+	8	0.152	2,366.261	0.710	0.170
	NA	+	NA	NA	+	6	0.138	2,366.551	1.000	0.147
	NA	+	+	NA	+	7	0.144	2,366.807	1.257	0.129
	NA	+	NA	+	+	7	0.143	2,367.183	1.632	0.107
	+	+	NA	NA	+	9	0.152	2,367.659	2.108	0.084
	+	+	+	+	+	11	0.160	2,368.610	3.0593	0.052
	+	+	+	NA	+	10	0.154	2,368.640	3.090	0.052
Variable importance	0.444	**0.996**	0.414	0.578	0.986					
Grazer biomass models										
	+	+	+	NA	+	14	0.253	1,998.949	0.000	0.481
	+	+	+	+	+	15	0.259	2,000.624	1.675	0.208
	+	+	NA	NA	+	11	0.225	2,002.281	3.332	0.091
	+	NA	+	NA	+	12	0.233	2,002.497	3.548	0.082
Variable importance	0.937	0.855	0.858	0.306	**0.999**					
Browser biomass models										
	NA	+	+	+	+	10	0.179	1,551.100	0.000	0.488
	+	+	+	+	+	12	0.186	1,553.359	2.259	0.158
	NA	+	NA	+	+	9	0.163	1,553.761	2.661	0.129
	+	+	NA	+	+	11	0.173	1,555.502	4.401	0.054
	NA	+	+	+	NA	6	0.139	1,555.817	4.717	0.046
Variable importance	0.290	**0.999**	0.768	0.925	0.889					
Scraper biomass models										
	+	+	NA	+	NA	8	0.091	1,916.304	0.000	0.173
	+	NA	NA	+	NA	6	0.076	1,916.731	0.427	0.140
	+	NA	NA	NA	NA	5	0.066	1,917.245	0.941	0.108
	+	+	NA	+	+	9	0.091	1,917.707	1.403	0.086
	+	+	NA	NA	NA	7	0.075	1,917.731	1.427	0.085
	+	+	+	+	NA	9	0.091	1,917.956	1.652	0.076
	+	NA	NA	+	+	7	0.078	1,918.444	2.140	0.059
	+	NA	+	+	NA	7	0.077	1,918.632	2.3284	0.054
Variable importance	**0.994**	0.528	0.270	0.641	0.303					

Notes: See Table 1 for explanation of predictor variables. Note weights and variable importance are calculated from all models. Predictors included in the model are indicated by +: predictors not included in the model are indicated by NA. Adj-R^2 (adjusted R^2) is the proportion of variance explained. AIC_c is the Akaike Information Criterion corrected for small sample size. Delta is the difference in AIC_c relative to the top model; weight is the Akaike weight. Variable importance is a measure of the total weight of all models containing that variable where high values (maximum = 1) are indicative of occurring in a large portion of highly ranked models where the predictor with the greatest predictive power is shown in boldface type.

the smallest biomass present in areas that banned lay nets only (32.88 g/m^2; Appendix S1: Fig. S1).

Considering the reduced data set with four different protection types, there were significant differences between protected areas across all groups of fish (Appendix S1: Table S2). For total fish, herbivores, scrapers, and grazers, post hoc tests indicated that there were significantly more fish in areas that banned lay nets, spear fishing, and aquarium fishing in comparison to those that only banned lay nets (P = 0.011, 0.001. 0.001, and 0.026, respectively). Herbivores, browsers, and scrapers had significantly more fish in areas that banned lay nets, spear fishing, and aquarium fishing in comparison to those that banned lay nets and aquarium fishing (P = 0.006, 0.023, and 0.026,

respectively; Fig. 2). Significantly more grazers were also found in areas that banned spear fishing, aquarium fishing, and lay nets in comparison to full no-take regions ($P = 0.028$).

Modeling impacts of drivers on resource fish biomass

A major driver of spatial variation in fish biomass across groups was nitrogen effluent from OSDS and injection wells, as it had the highest variable importance sum weight for the majority of groups and was retained in the model with the lowest AIC for all fish functional groups (Table 2). OSDS pollution was negatively correlated with all fish groups, where biomass decreased with increasing amounts of nitrogen (Fig. 3). Impacts of increasing nitrogen were similar for all functional groups except for grazers where it was fairly level; i.e., increases in nitrogen did not change grazer biomass.

The factor with the highest variable importance differed between functional groups (Table 2, Fig. 4), suggesting different pressures on each group of fish. For example, rugosity was present in most models for

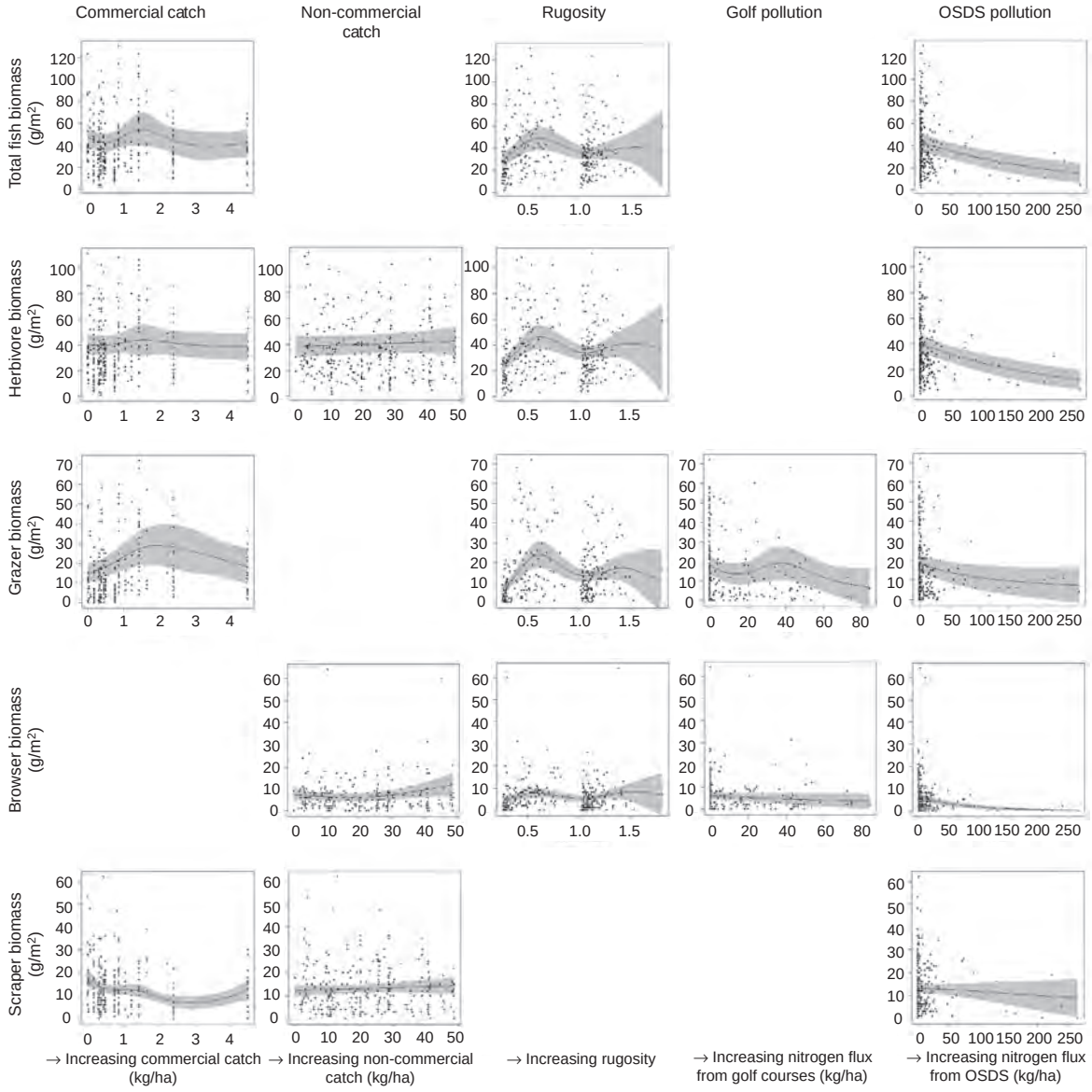

FIG. 3. Smoothers of predictor variables retained in the highest ranked models for resource fish biomass data grouped by various functional groups. Shaded areas show 95% confidence intervals. Data points represent fish biomass data collected from surveys during 2008–2018 for specific sites co-located with various driver data including catch values and OSDS. Fish biomass is shown on the *y*-axis of each plot, with the various drivers on the *x*-axis, with increasing values toward the right edge of each plot. OSDS, onsite sewage disposal systems.

grazers, where large increases in biomass occurred with increases in rugosity up to intermediate rugosity levels. Similar relationships with rugosity were seen for all fish functional groups. On the other hand, OSDS pollution was the most important factor explaining browser biomass, with the similar negative influences of increased nitrogen pollution correlated with decreases in browser biomass (Fig. 3). For scrapers, commercial catch was the variable with the greatest influence where scraper biomass decreased with increases in commercial catch (Table 2). When considering all functional groups of fish, except browsers for which this driver was not retained, the effects of commercial catch was highly variable and was negative for scraper biomass (Fig. 3).

The least important drivers were identified as non-commercial catch and pollution from golf courses; the variables present in the least number of models with the lowest AIC, and with the lowest variable importance across all fish functional groups (Table 2). For non-commercial catch, the relationship was almost level, i.e., biomass did not change with increases in non-commercial catch for most fish functional groups (Fig. 3). Similarly, for browsers, the relationship with golf pollution was fairly level. For grazers, biomass showed a more consistent negative relationship with increases in golf course pollution at levels greater than 40 kg/ha (Fig. 3).

Discussion

Resource fishes in Hawaii are experiencing increasing pressure from a combination of local and global processes including fishing, habitat degradation, coastal pollution, and climate change. Our study focuses on resource species key to local subsistence and culture, contrasting the effectiveness of different MPA types as well as an in-depth investigation of the local factors that influence the nearshore resource fisheries of West Hawaii.

Change in resource fish biomass across time

Total resource fish biomass decreased by about 45% from 2008 to 2018. Decreases in resource fish biomass were not uniform across all fish functional groups. Browsers showed a marked decline in biomass across time, as did grazers. However, scraper biomass, which consisted of only parrotfish species in our study, was more variable over the 2008–2018 period. Interestingly, the highest scraper biomass was recorded in 2014, where scraper biomass recovery was likely assisted by the SCUBA spear fishing ban approved by the State of Hawaii Board of Land and Natural Resources in 2013 as parrotfish are primarily caught by spear fishing. After establishment of the Kahekili Herbivore Fisheries Management Area in Maui, which protects all herbivorous fishes, parrotfish biomass increased rapidly in the first 2 yr of establishment, plateauing after 3 yr (Williams et al. 2016). As 2014 surveys were completed late in the year, parrotfish would have had almost a full year to recover after the spear fishing ban was implemented. This additional form of protection could also explain why scrapers show a different pattern in population dynamics across years in comparison to other functional groups.

A global analysis of reef fish found that browsers showed the greatest declines (80% worldwide) due to their susceptibility to fishing (Edwards et al. 2014), similar to our findings here. As browsers feed almost exclusively on macroalgae and are important in preventing coral to macroalgae phase shifts as seen on the Great Barrier Reef (Cheal et al. 2013), managing the biomass of this key group of fish will be important for increasing reef resilience in Hawaii.

Effects of marine protected areas on resource fish biomass

The effects of MPA type were evident across all groups of fish. For all groups, there was significantly greater biomass in areas that banned spear fishing compared to areas that did not ban spear fishing. This gear ban was particularly impactful for scrapers and browsers, groups that consisted primarily of parrotfish in our study. A compilation of data across ~1,800 reef sites found that for parrotfish, fishing restrictions (gear and access limitations) provided the same conservation gains as fully protected MPAs (Cinner et al. 2020) and thus for this particular group of fish, gear restrictions can be very effective.

For grazers, there was significantly greater biomass in areas that banned multiple gear types when compared to full no-take areas. Similarly seen across all fish functional

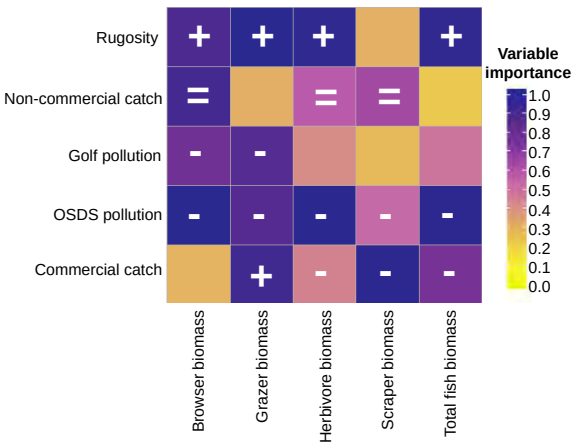

Fig. 4. Variable importance scores from GAM analyses summarizing the importance of each predictor variable for the five functional fish groups. The higher number of models the predictor variable was present in indicates a higher importance metric, indicated by the blue shade. The least important variables are shaded yellow. The initial direction of the GAM smoother, i.e., a positive, negative, or neutral correlation, is indicated for variables retained in the top model for each fish functional group, where a plus sign indicates increasing fish biomass with increases in the respective driver, a negative sign indicates decreasing fish biomass with increases in the respective driver and an equals sign indicates no notable increase or decrease in fish biomass with changes in the respective driver.

groups, the greatest biomass occurred in MPAs that banned lay nets, spears, and aquarium fishing, although not statistically significant for all groups. Our results suggest that banning gear types could be effective for protecting fish biomass in this region. This is similar to a recent analysis of MPAs in Hawaii that showed both full and highly protected (typically limited to pole and line fishing) MPAs had greater fish than in areas of low or intermediate protection (Friedlander et al. 2019). A global synthesis of the effectiveness of MPAs showed that the positive response to protection was primarily driven by targeted fish species (Sciberras et al. 2013). Four of the five most abundant species from the surveys are primarily caught by spear (Appendix S1: Table S1), which helps to explain why MPA types that ban this gear type had greater resource fish biomass in our analyses.

There is considerable evidence that supports that coral reef fishes will recover with reductions in fishing pressure (Campbell et al. 2017). It is important to note, though, that for our study, there were very few sites representing no-take areas, with some fully protected no-take areas only recently established in West Hawai‘i as late as 2016, where prior to 2016, there were only two full MPAs protecting only a small combined area of ~0.6 km^{-2} (Friedlander et al. 2019). Long-term observations of no-take MPAs have shown that effects of MPA establishment can occur within 5 yr but can still take a decade or more to fully develop (Babcock et al. 2010, Friedlander et al. 2019). Thus, the true impacts of no-take areas might not be realized in this study.

The establishment of MPAs can be contentious. Although no-take areas can provide the greatest conservation gains (Cinner et al. 2020), specific gear restrictions may be a socially relevant management strategy in Hawaii that will also support recovery of resource fish biomass (Weijerman et al. 2018). For example, in some regions across Hawaii, permitting only line fishing allowed a balanced trade-off between various stakeholders as well as enhancement of reef recovery (Weijerman et al. 2018).

Drivers of resource fish biomass

Nitrogen input from OSDS was the dominant driver of changes in resource fish biomass in our study. The impacts of OSDS nitrogen effluent differed between fish functional groups, which is especially evident when herbivores were divided into grazers, browsers, and scrapers. Understanding the impacts of drivers on grazers (primarily surgeonfish in these surveys) and scrapers (primarily parrotfish) is important because they have disproportionally large effects on reef processes (Bellwood et al. 2006, Lokrantz et al. 2008). In Hawaii, OSDS are common and are known to contaminate both drinking water and nearshore waters (Swarzenski et al. 2016). Due to Hawaii's volcanic geology, sewage can penetrate the porous surfaces and contaminate groundwater, where the main wastewater nutrient discharged to reefs is nitrogen (Hunt and Rosa 2009, Barnes et al. 2019). Land-based pollutants disrupt normal reef functioning, where elevated nutrient concentrations create additional stress for corals, inducing negative responses such as decreased reproduction and calcification (Loya et al. 2004, Fabricius 2005, Wiedenmann et al. 2013, Carlson et al. 2019). In Fiji, terrestrial run-off affected the hard-bottom benthic habitat, ultimately leading to a decline in fish biomass (Brown et al. 2017). Thus, these deleterious effects on corals likely have cascading impacts on reef fish via habitat alteration (Komyakova et al. 2013).

The State of Hawaii plans to eliminate cesspools by 2050 (DOH 2018), where cesspools, a form of OSDS, consists of raw sewage in underground wells, leaching raw wastewater into groundwater. Further research investigating the prioritization of cesspools to upgrade and minimize pollution as done in West Maui (Barnes et al. 2019) would be valuable for West Hawai‘i, especially to reduce the impact of nitrogen input on resource fish biomass. The influences of nitrogen input from golf courses on resource fish biomass were not as important in our results, likely because nitrogen levels from the golf courses were 10× lower than OSDS levels. However, there were still negative impacts of this driver on grazer biomass at higher levels of nitrogen runoff.

These findings suggest that land-based sources of pollution (LBSP), and more specifically, eutrophication of nearshore coastal waters from OSDS and local injection wells, negatively impact local fish populations. This may mean that current state water quality standards, as advised by The Hawaii Department of Health's Clean Water Branch, are not sufficient to ensure the biological integrity of coral reef ecosystems in West Hawaii. Working in concert with groups such as the Hawaii Department of Land and Natural Resources to appropriately manage LBSP will be especially important for browsers, the functional group for which OSDS was the most dominant driver of biomass. The initiatives and actions planned in the 2030 Hawaii Coral Reef Strategy (The State of Hawaii 2010) that directly address LBSP will be important to prioritize.

Across all groups except scrapers, biomass increased with increasing reef rugosity. Grazer biomass showed the strongest positive relationship with rugosity. It is likely that increased availability of three-dimensional habitat space is especially important for grazers, e.g., by providing predator refuge for species such as *A. leucopareius* and *A. guttatus* (González-Rivero et al. 2017). On the other hand, for scrapers, commercial fishing pressure showed the strongest effects, whereby increased commercial activity caused significant declines in scraper biomass. In 2018, total parrotfish (scraper) commercial catch was 70% of total surgeonfish (grazer) catch (Division of Aquatic Resources 2018). Since scrapers show a decline with increasing commercial catch while grazers initially show an increase, and only decreases when a higher threshold is reached (2 kg/ha), the level of fishing pressure that drives negative changes in biomass appears to be different based

on the functional group. Current commercial fishing levels may not be supporting sustainable scraper populations. This finding highlights the importance of considering driver impacts on fish by their functional group to be able to implement effective management strategies most relevant to that specific group.

Commercial catch more strongly impacted resource fish biomass than non-commercial catch. This is surprising because non-commercial catch is an order of magnitude greater than commercial catch in our model, and the annual value for non-commercial, near-shore fisheries in Hawaii is estimated to be $7.2–12.9 million, much higher than the annual value for commercial near-shore fisheries ($2.97 million licensed + $148,500–$445,500 unlicensed; Grafeld et al. 2017). Our commercial information was derived from reported catch numbers across large spatial commercial reporting blocks, while non-commercial fishing was derived from downscaled island-wide catch estimates based on proxies such as shoreline access and distance to boat ramps. This suggests that more accurate and detailed data on fishing pressure, such as mandatory reporting for non-commercial catch, would undoubtedly improve our results and the ability to assess the relative role of commercial and non-commercial fishing pressure on resource fish biomass.

Our highest performing models explained 26% of the total variance, indicating that there are other factors impacting resource fish biomass remaining to be included in future studies of West Hawai‘i resource fish communities. Information on ocean conditions, such as wave action and ocean temperature, were not included, which may be affecting fish biomass and could account for the limited variance explained by the models. Increased frequency in warming events and resulting coral bleaching has likely contributed to decreases in total fish biomass, where ocean warming has driven declines in fisheries globally with negative effects exacerbated in regions with a history of overfishing (Free et al. 2019). In 2015 in Hawaii, the warmest year on record, 30–50% of coral cover was bleached in West Hawai‘i (Kramer et al. 2016, Gove et al. 2019). As live, healthy coral cover is linked with greater fish abundance (Jones et al. 2004, Komyakova et al. 2013), the 2015 warming event in conjunction with coral death likely contributed to the decline seen for resource fish between 2014 and 2018.

Despite these caveats, our findings for West Hawaii suggest that banning specific gear types can be effective in protecting shallow water resource fish biomass. Furthermore, we find that impacts of nitrogen pollution on resource fish biomass can outweigh other habitat and land-use drivers; however, the effects are specific to particular functional groups of resource fish. Current commercial fishing levels are negatively affecting scraper populations, which suggests that limits on commercial catch of scrapers could help to enhance local populations. All these examined factors interact and exacerbate the negative impacts of climate change on coral reefs, where mitigation of local stressors can help to compensate for impacts of global stressors (Brown et al. 2013, Harvey et al. 2018). Our observations suggest that regional management of multiple stressors would be beneficial in enhancing resource fish biomass in West Hawaii, contributing to increased reef resilience and recovery.

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Supporting Information

Additional supporting information may be found online at: http://onlinelibrary.wiley.com/doi/10.1002/eap.2213/full

Data Availability

Data are available from the Zenodo Digital Repository: http://doi.org/10.5281/zenodo.3901864

Analysis of the Draft Environmental Impact Statement by the Pet Industry Joint Advisory Council, Document Dated 12 November 2019

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EXECUTIVE SUMMARY

The Pet Industry Joint Advisory Council submitted a Draft Environmental Impact Statement (DEIS) to the State of Hawaiʻi Office of Environmental Quality Control on their analysis of the ecological and cultural impacts of reissuing aquarium collection permits for West Hawaiʻi Island. Our review largely focuses on the scientific integrity and validity of data and conclusions provided in the DEIS as it pertains to West Hawaiʻi. We address three particular subject areas in Parts (I) Hawaiʻi ocean climate, (II) Fish resource trends and reporting, and (III) Coral reef damage.

Part I: A new ocean climate regime in the Hawaiian Islands renders the historical fish data collected by the National Oceanic and Atmospheric Administration (NOAA) and State of Hawaiʻi Division of Aquatic Resources (DAR) scientifically unpredictive of the reef ecosystem in 2020 or into the future. NOAA and DAR fish count data span only one marine heatwave in 2014-2015, and the response of the ecosystem continues to evolve and is in strong disequilibrium. Subsequent marine heatwaves such as the 2019 event will continue to repeat, negatively impacting coral, fish and invertebrate communities, and these heatwaves will be increasing in frequency to near-annual events by 2035. A pivotal issue determining the ability of Hawaiʻi's coral reefs to persist in the new ocean climate rests in the abundance and diversity of the herbivore fish community under repeat heatwaves. Herbivore fish are primary determinants of reef algal cover, which competes directly with slow-growing corals for space during and between marine heatwaves. Reef science demonstrates that the probability of a marine heatwave generating a shift from coral to algal dominated reef is reduced to 20% - a key target threshold for management – at an herbivore fish biomass level of 250 kg per hectare. As of 2018, 74% of shallow coral reefs of West Hawaiʻi are near or below this threshold, and the biomass of deeper portions of the reef are insufficiently known. Beyond marine heatwaves, West Hawaiʻi development has rapidly expanded over the past two decades, resulting in numerous additional stressors to the reef ecosystem. A recent study of the shallow water fishery of West Hawaiʻi indicated that the two main sources of resource fish decline from 2008 to 2018 are nitrogen-rich effluent and commercial fishing. West Hawaiʻi's reefs are not well prepared for repeated marine heatwaves from an herbivore fish standpoint.

Part II: The DEIS utilizes two different datasets to estimate fish populations along the west coast of Hawaiʻi Island: (i) Division of Aquatic Resources (DAR) West Hawai'i Aquarium Project (WHAP) surveys and (ii) NOAA Coral Reef Monitoring Program (CREP) surveys. The WHAP data are not spatially representative of West Hawaiʻi because they are not taken from randomly selected sites. The majority of the WHAP survey sites lie within geographically-limited marine managed areas and thus these surveys do not accurately represent fish populations across all of West Hawaiʻi. The DEIS report bases the majority of its estimations using the WHAP surveys, even while acknowledging that the CREP data would be more representative. The DEIS should present both datasets similarly to understand if the same trends in fish populations seen at the WHAP long-term monitoring sites also agree with the island-wide CREP surveys. Our analysis suggests that the WHAP and CREP data tell different stories of aquarium fish trends over time, including weakening fish population trends in CREP compared to those reported for WHAP by the DEIS. Meanwhile, another State of Hawaiʻi DAR report indicates major declines in fish abundance,

ranging from a small relative decline in Yellow Tang (-9%) to an enormous decline in Achilles Tang (-97%). Additionally, State of Hawaiʻi DAR monitoring of shallow water reefs show major declines of certain herbivore fish species from 2008 to 2018.

The DEIS uses invalid estimates of percent catch from the aquarium trade to evaluate the impacts of alternative actions. In particular, the DEIS claims that percent catch should be based on island-wide population estimates for each species by citing evidence for habitat connectivity between protected and open fishing areas around all of Hawaiʻi Island. This is incorrect, and past studies using drifters, larval sampling, genetic analysis, and oceanographic modeling indicate high local retention of larvae, and juvenile and adult fish populations, in West Hawaiʻi. As a result of this major error in the DEIS, the reported percent catch is erroneously low. It should be based on relevant West Hawaii Regional Fishery Management Area sub-populations considering the realistic home ranges of each species, not on island-wide populations.

Part III: The DEIS makes several broad and unsubstantiated claims that aquarium collection does not negatively impact the reef ecosystem. A key question is whether or not aquarium fish collectors make physical contact with the reef via their equipment and their bodily movement. Reports from the public and the conservation community, combined with our own *in-situ* observations, broadly point to common and persistent issues of aquarium collector contact with the reef. The DEIS makes no recommendation to provide third-party oversight of collector activities, and goes as far as to suggest that there is no impact from collection on corals or reef structure. Physical, biological, and chemical damage needs to be documented and prevented. Prevention is the only scientifically sound pathway, either by strong *in-situ* oversight of the industry or via banning of collections.

INTRODUCTION

On November 12, 2019, the Pet Industry Joint Advisory Council submitted a Draft Environmental Impact Statement (DEIS) to the State of Hawaiʻi Office of Environmental Quality Control on their analysis of the ecological and cultural impacts of reissuing aquarium (AQ) collection permits for West Hawaiʻi Island. Our review focuses on the scientific integrity and validity of data and conclusions provided in the DEIS as it pertains to West Hawaiʻi, defined as the area spanning the west or leeward side Districts of N. and S. Kohala, N. and S. Kona, and Kaʻu. We do not address cultural issues in our review of the DEIS.

Our investigation of the DEIS content required the focus and expertise of a panel of marine ecologists and biologists with a collective experience on West Hawaiʻi reef ecosystems of more than 50 person-years. Our review presented here is limited to three particular subject areas, two of which are directly addressed in the DEIS, and one that was not addressed in the document. These subject areas are organized into Parts (I) Hawaiʻi ocean climate, (II) Fish resource trends and reporting, and (III) Coral reef damage.

PART I: HAWAIʻI OCEAN CLIMATE IN 2020 AND BEYOND

Like many regions of the world, the Hawaiian Islands have entered a new ocean climate regime that is less favorable to coral reefs as a whole. As a result, building resilient coral reefs must be a focal point for resource management to give reefs the best chance for persistence. One of the major limitations of the DEIS rests in its narrow analysis of the West Hawaiʻi coral reef ecosystem. Spanning a distance of about 180 km of coastline, the reef is extremely heterogeneous in terms of benthic substrate, coral cover, habitat condition, fish abundances, and accessibility by fishers. These issues alone raise serious concerns about the critically important limitations of an environmental impact study based solely on fish counts.

Adding the new ocean climate regime to the natural complexity of the West Hawaiʻi reef, historical fish data alone are not predictive of the reef ecosystem in 2020 or into the future, whether exposed to aquarium collection or not. Hawaiian reef ecosystems are part of the new ocean climate system that continues to rapidly expand in the Pacific and worldwide. In 2014 and 2015, the Main Hawaiian Islands underwent their first major system-wide ocean climate event, called a marine heatwave, that caused increased water temperatures resulting in large-scale coral bleaching and impacts on fish and invertebrate populations (Bahr et al. 2017; Couch et al. 2017). About half of the corals that bleached in 2015 ultimately died and became algal covered (Kramer et al. 2016). The 2019 marine heatwave again engulfed the Hawaiian Islands, causing up to 50% coral bleaching in some areas, and an average of 10% mortality in West Hawaiʻi (ASU GDCS 2019). Marine heatwaves are the new norm, and will be increasing in intensity and/or frequency in the years to come (Frolicher et al. 2018), putting enormous additional stress on coral reefs of Hawaiʻi.

Ocean temperature in West Hawai'i is projected to increase as a result of climate change. By the middle of the century, average monthly sea surface temperature will be ~1°C (1.8°F) warmer than present-day, and for about 6 months of the year will be warmer than the present-day summertime maximum (27°C; 80.6°F). This increase in ocean temperature is projected to influence the frequency and severity of coral bleaching. For example, severe bleaching is projected to occur on an annual basis in West Hawai'i beginning as early as 2035 (van Hooidonk et al. 2016).

A pivotal issue determining the ability of Hawai'is coral reefs to persist in the new ocean climate rests in the abundance and diversity of the herbivore fish community. Herbivore fish are primary determinants of reef algal cover, which competes directly with slow-growing corals for space. Regular marine heatwaves not only cause coral bleaching and mortality, they also promote algal growth that colonizes dead coral and responds well to increased water temperature (Jessen et al., 2013; Graham et al., 2015). Herbivore fish biomass and diversity have become important combaters of algal growth during and between marine heatwave events.

In a scientifically-acclaimed global analysis and synthesis, Graham et al. (2015) found that the probability of a reef switching from a coral-dominated to an algal-dominated system was more than 50% when herbivore fish biomass dropped below 100 kg per hectare. Importantly, the probability of a regime shift from coral to algal domination decreased to 20% - a key target threshold for management – at an herbivore fish biomass level of 250 kg per hectare (**Figure 1**).

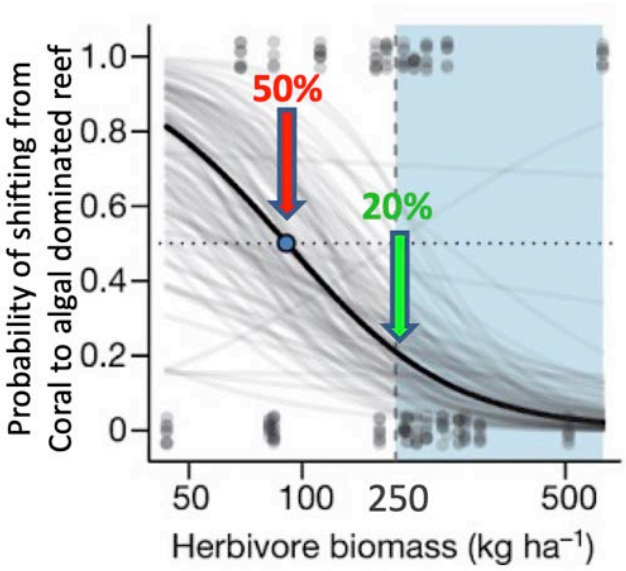


Figure 1. Effects of herbivore fish biomass on the probability of a reef switching from coral to algal dominated during and immediately after a marine heatwave (Graham et al. 2015).

Based on the State of Hawai'i Division of Aquatic Resources shallow water fish survey data, current herbivore biomass levels vary enormously along the coast of West Hawai'i (**Figure 2**). Among 72 sites included in this 2018 survey, 21% are near or below the super-critical 100 kg per hectare threshold for a 50:50 chance of coral-to-algal domination caused by a marine heatwave.

Approximately 64% of sites are currently near or below the critical 250 kg per hectare threshold for a 20% chance of coral-to-algal change from a marine heatwave. Only 19 of 72 sites (26%) are well above this guiding 250 kg per hectare minimum for good herbivore fish management. Numerous countries and jurisdictions are using the 250 kg threshold as the target for increasing reef resilience in the new ocean climate. However, West Hawai'i's reefs are not currently in such a state and are not well prepared for repeated marine heatwaves from an herbivore fish standpoint.

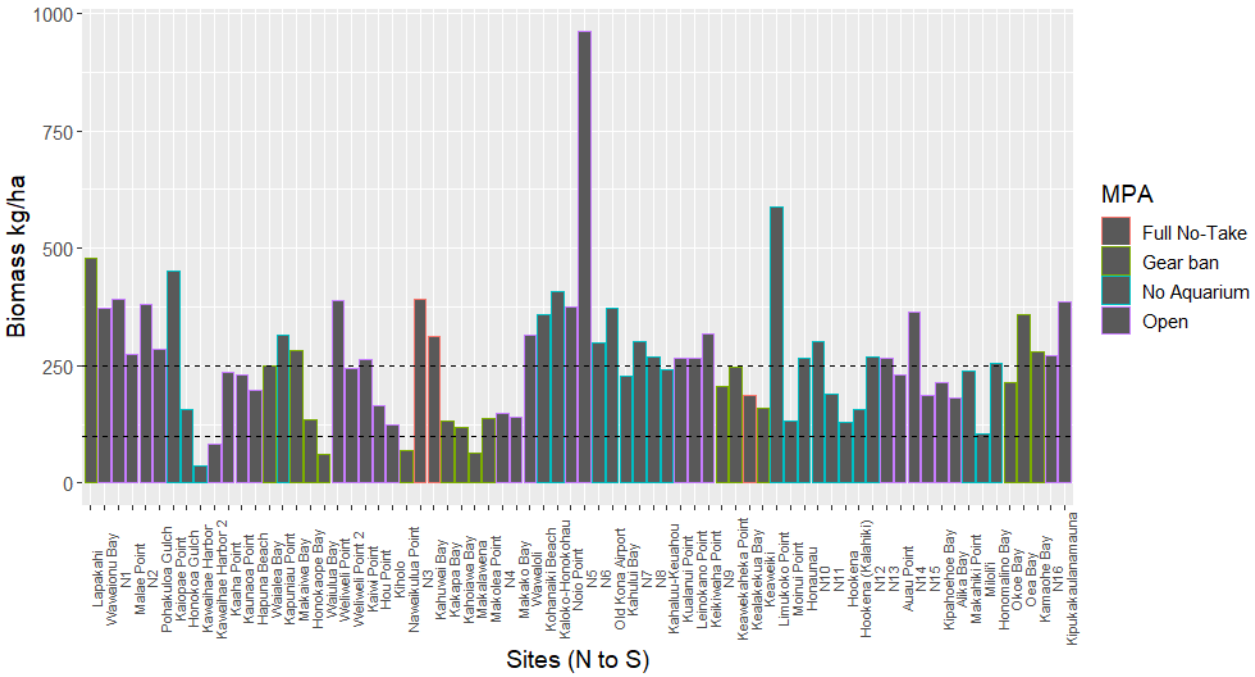


Figure 2. Herbivore biomass in kg per hectare across 72 sites surveyed in 2018 in West Hawai'i. The dashed lines indicate the 100 and 250 kg per hectare levels, the 50% and 20% probability thresholds that Graham et al. 2015 identified. The protection status of each site is indicated in the legend.

Beyond marine heatwaves, development in West Hawai'i has rapidly expanded over the past two decades, resulting in numerous additional stressors to the reef ecosystem (Gove et al. 2019). These include nitrogen-rich effluent from both commercial and non-commercial wastewater discharge and over-fishing. In 2017, West Hawai'i released a total of 680 million gallons of effluent per year and a total of 400,000 pounds of nitrogen per year (Gove et al. 2019). A recent study of the shallow water fishery indicated that the two main sources of resource fish decline from 2008 to 2018 (including four species on the aquarium White List) are nitrogen-rich effluent from onshore disposal sites and commercial fishing. Importantly, non-commercial fishing was not correlated with observed long-term declines in fish biomass in shallow water habitats (Foo et al. in review; *available upon request*). Only commercial fishing was statistically linked to herbivore fish declines.

In accounting for the new ocean climate regime with an increasing number of regional stressors, it has become clear that a new approach to the management of coral reefs in West Hawaiʻi, including the interactive role of herbivore fish and corals, is paramount to their near- and long-term survival. Whether the aquarium industry can guarantee that herbivore fish biomass levels remain above the critical 250 kg per hectare threshold is highly unlikely, but such levels of management will be needed moving forward to ensure that West Hawaiʻi reefs remain intact and biologically productive.

PART II: FISH RESOURCE TRENDS AND REPORTING

Assessment based on inadequate data coverage of West Hawaiʻi

The DEIS utilizes two different datasets to estimate fish populations along the west coast of Hawaiʻi Island: (i) Division of Aquatic Resources (DAR) West Hawai'i Aquarium Project (WHAP) surveys and (ii) NOAA Coral Reef Monitoring Program (CREP) surveys, which we will refer to as WHAP and CREP to distinguish between the two survey types.

The WHAP surveys represent the same 25 study sites surveyed annually from 1999 to 2018. These WHAP sites were originally established to monitor different protection levels – Marine Protected Area (MPA), Fish Replenishment Area (FRA), and Open or unprotected – in order to determine the effectiveness of protected areas on aquarium fish species. The WHAP data are not spatially representative of West Hawaiʻi because they are not taken from randomly selected sites. In fact, the majority of the survey sites lie within marine managed areas and thus WHAP surveys likely do not accurately represent fish populations across all of West Hawaiʻi, especially since FRAs and MPAs have very limited coverage (**Figure 3,** which is Figure 4 in the DEIS, page 79). The CREP data, on the other hand, represent randomly distributed fish surveys of Hawaiʻi Island, with 257 survey locations measured between 2010 and 2016. To ensure better representation of fish populations across West Hawaiʻi, both datasets should be considered equally. A strength of the WHAP surveys is that, because they are permanently monitored sites, the data can be used to track changes over time, but the fact that the data from these sites are not representative of West Hawaiʻi is not discussed in the DEIS. A comparison of the WHAP and CREP data is essential to document the ecological status of fish populations of West Hawaiʻi and needs to be included in the DEIS.

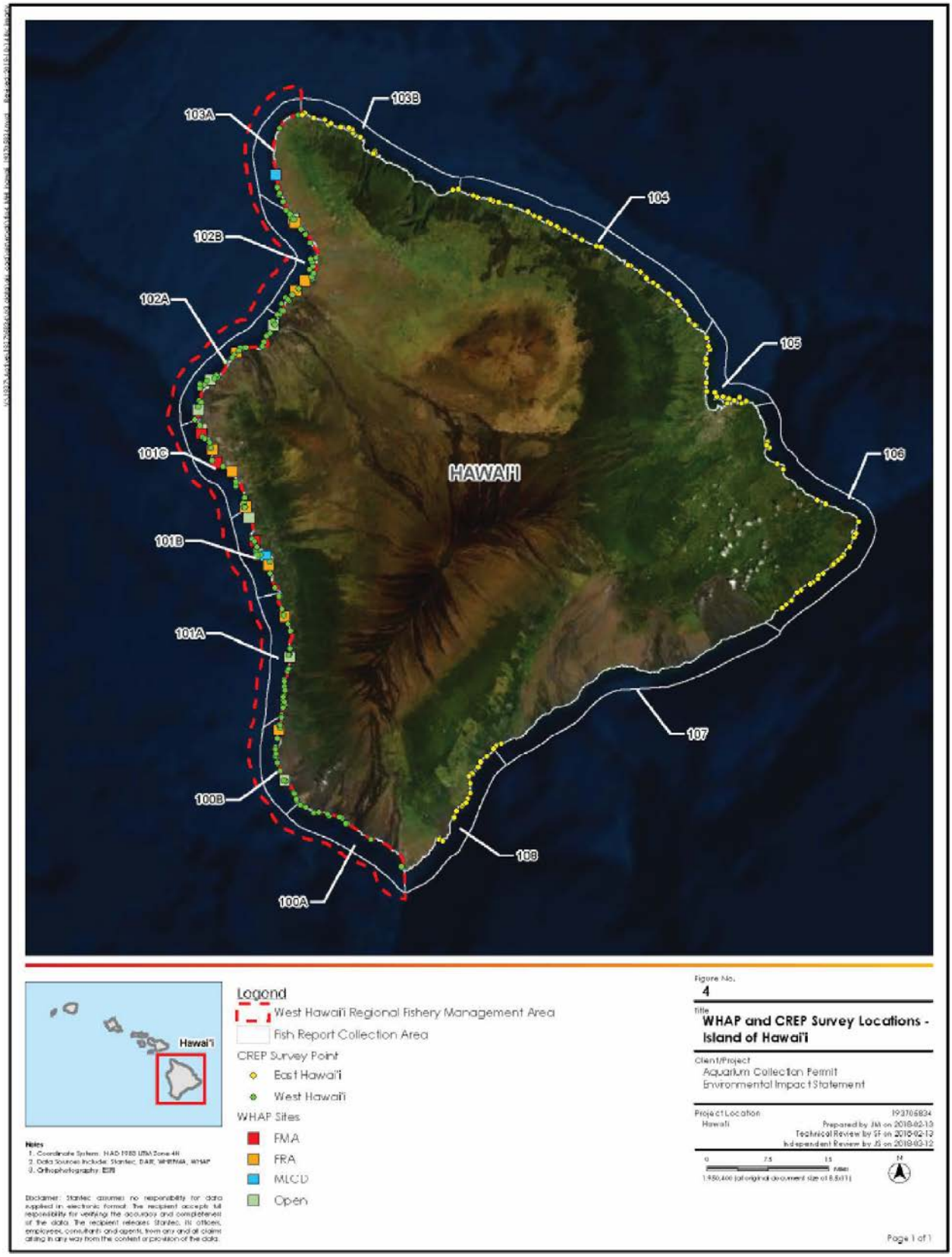


Figure 3. WHAP and CREP survey locations – Island of Hawai'i. This is Figure 4 in the DEIS.

The DEIS report bases the majority of its estimations using the WHAP surveys, even while acknowledging in the executive summary of the report that the CREP data are more representative: "Both data sets are presented and analyzed in this DEIS. However, due to the larger spatial coverage and greater range of depths surveyed by CREP, these data are a better estimator of island-wide fish population size, and therefore serve as the primary basis for the impact analysis in this DEIS." Herein lies the first problem with the data cited in the DEIS: The authors acknowledge the shortcomings of the WHAP surveys yet base the estimations and justifications for aquarium fishing limits mainly on the WHAP surveys.

The DEIS presents the trends in fish biomass for the WHAP permanent monitoring sites, summarized as percentage increases and decreases in fish biomass between the start and end of the monitoring time (**Table 1**, which is Table 5-4 in the DEIS, page 99). On the other hand, the DEIS only reports 2016 CREP surveys for each aquarium fish species, although surveys from 2010 to 2018 do exist and were available to the DEIS authors. The DEIS should present both datasets similarly to understand if the same trends in fish populations seen at the WHAP long-term monitoring sites also agree with the island-wide CREP surveys.

Presented here in **Figure 4** and **Table 2**, we have calculated the average number of aquarium species counted across surveys for each year of CREP data to facilitate the comparison with the WHAP data that was left out of the DEIS. Comparing **Table 1** (Table 5-4 from the DEIS), and **Table 2** provided here, CREP data show moderate overall changes in fish abundance, as well as important decreases in species abundances, which directly contradicts results from the WHAP data alone, which show mostly large fish abundance increases in protected areas. The DEIS had equal access to the CREP data yet decided not to provide these summaries. It appears that the DEIS data have been targeted to show only large increases in fish biomass.

Note also from **Figure 4** that there exists enormous variation in annual patterns of fish abundance. It would be more appropriate for the DEIS to consider annual trends rather than differences between the start and end of surveys, to assess whether long-term increases or decreases in fish populations occur or not.

Table 1. Change in the density of the top 10 collected species in the WHRFMA based on WHAP data. 'Before' = Mean of 1999-2000; 'After' = Mean 2017-2018. Young-of-year (YOY) not included. Bold = statistically significant t-test (DAR 2019a). Table 5-4 in the DEIS.

COMMON NAME	AREA	MEAN DENSITY (NO./100M²)		OVERALL % CHANGE IN DENSITY	ρ
		Before	After		
Yellow Tang	FRA	**12.73**	**33.79**	**+165.4%**	**<0.001**
	Open	**10.24**	**20.53**	**+100.6%**	**<0.001**
	MPA	**23.08**	**40.07**	**+73.6%**	**<0.001**
Kole (Goldring Surgeonfish, Yelloweye, Goldring)	FRA	**28.38**	**52.60**	**+85.4%**	**<0.001**
	Open	**21.18**	**41.65**	**+96.6%**	**<0.001**
	MPA	**28.53**	**62.64**	**+119.6%**	**<0.001**
Orangespine Unicornfish	FRA	0.81	0.67	-16.8%	0.26
	Open	**1.12**	**1.59**	**+42.6%**	**<0.001**
	MPA	**1.59**	**2.88**	**+81.4%**	**<0.001**
Achilles Tang	FRA	**0.26**	**0.05**	**-82.7%**	**<0.001**
	Open	**0.31**	**0.09**	**-70.5%**	**<0.001**
	MPA	0.42	0.22	-48.3%	0.05
Black Surgeonfish	FRA	**0.18**	**0.76**	**+319.2%**	**<0.001**
	Open	**0.17**	**0.84**	**+402.1%**	**<0.001**
	MPA	**0.53**	**0.98**	**+83.7%**	**<0.001**
Potter's Angelfish	FRA	**1.38**	**2.28**	**+66.0%**	**<0.001**
	Open	**1.65**	**2.47**	**+49.9%**	**<0.001**
	MPA	**1.54**	**2.39**	**+55.4%**	**<0.001**
Ornate Wrasse	FRA	**0.94**	**0.66**	**-30.1%**	**<0.001**
	Open	**2.20**	**1.83**	**-16.6%**	**<0.001**
	MPA	**1.24**	**1.59**	**+28.5%**	**<0.05**
Goldrim Surgeonfish	FRA	0.04	0.09	+156.6%	0.46
	Open	0.01	0.06	+605.9%	0.42
	MPA	0.11	0.21	+102.4%	0.45
Orangeband Surgeonfish	FRA	0.13	0.22	+73.9%	0.24
	Open	**0.31**	**0.50**	**+60.0%**	**<0.01**
	MPA	**0.56**	**0.87**	**+56.3%**	**<0.05**
Brown Surgeonfish	FRA	**8.57**	**13.90**	**+62.1%**	**<0.001**
	Open	**11.20**	**25.77**	**+130.1%**	**<0.001**
	MPA	**7.68**	**22.21**	**+189.3%**	**<0.001**

Table 2. Change in fish abundance of the top 10 collected species based on CREP data. Increases are shown highlighted in green, and decreases are highlighted in red.

Common Name	**Mean Density**		**Overall % Change in Density**
	2010	**2016**	
Yellow Tang	32.1	40.8	+27.1
Goldring Surgeonfish	40.4	51.9	+28.5
Orangespine Unicornfish	4.4	3.8	-13.6
Achilles Tang	2.1	2.3	+9.5
Black Surgeonfish	4.5	3.4	-24.4

Potter's Angelfish	5.2	6.6	+26.9
Ornate Wrasse	4.7	3.6	-23.4
Goldrim Surgeonfish	3.4	2.7	-20.6
Orangeband Surgeonfish	4.5	5.4	+20.0
Brown Surgeonfish	29.9	50.4	+68.6

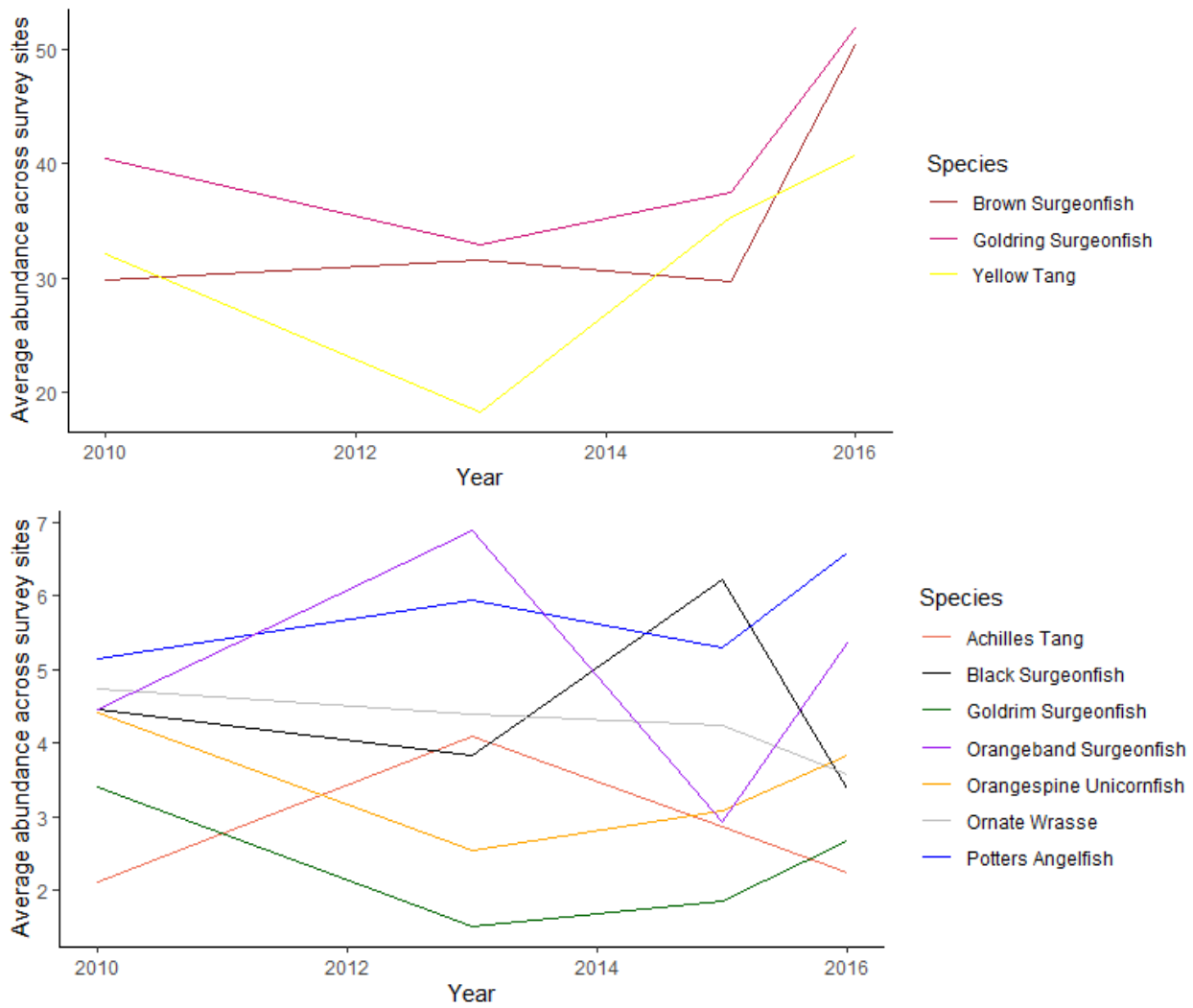


Figure 4. Summary plots of the average abundance across survey sites per year in the CREP surveys. The species are separated to facilitate interpretation as the top panel displays species with a much greater abundance.

There is also a multitude of reports of West Hawai'i fish biomass provided by the Division of Aquatic Resources, available online at https://dlnr.Hawaii.gov/dar/reports/. For example, one report by Walsh et al. (2018) presents the continued, long-term decline of coral reef biota and associated fauna at key sites in West Hawai'i. This report notes major declines in fish abundance between the two survey periods, ranging from a slight relative decline in Yellow Tang (-9%) to an

enormous decline in Achilles Tang (-97%); Both are two key aquarium fish species. The report also includes information on aquarium fish abundance. **Table 3** below (Table 6 in Walsh et al. 2018) shows major declines for most aquarium fish species.

Table 3. Abundance (#/100m^2) of the top ten most abundant aquarium fish species at Puako and Pauoa. Collection rankings were based on FY 2009 aquarium data. The standard error for 2007-2008 surveys is included in Appendices 3 and 5. Δ is the numerical change in density and Δ (%) is the percent change between the two study periods. Species whose abundances have increased at one or both sites are shown in bold. Table 6 form Walsh et al. (2018).

Species	Puakō				Pauoa			
	1979-81	2007-08	Δ	% (Δ)	1979-81	2007-08	Δ	Δ (%)
Zebrasoma flavescens	9.89	9.01	-0.88	-8.9%	**5.86**	**6.73**	**+0.87**	**+14.8%**
Ctenochaetus strigosus	21.00	8.14	-12.86	-61.2%	29.04	8.53	-20.51	-70.6%
Naso lituratus	2.54	0.43	-2.11	-83.1%	0.91	0.29	-0.62	-68.1%
Acanthurus achilles	0.89	0.03	-0.86	-96.6%	0.36	0.06	-0.30	-83.3%
Forcipiger flavissimus	1.45	0.44	-1.01	-69.7%	1.24	0.21	-1.03	-83.1%
Acanthurus nigrofuscus	21.13	4.23	-16.9	-80.0%	31.68	5.63	-25.93	-82.2%
Chaetodon multicinctus	3.56	0.49	-3.07	-86.2%	4.22	0.46	-3.76	-89.1%
Zanclus cornutus	0.52	0.04	-0.48	-92.3%	0.52	0.05	-0.47	-90.4%
Ctenochaetus hawaiiensis	**0.03**	**0.04**	**+0.01**	**+33.3%**	**0.00**	**0.03**	**+0.03**	na
Centropyge potteri	2.68	0.18	-2.50	-93.3%	2.33	0.04	-2.29	-98.3%

Here, the top ten most collected aquarium fishes declined at both sites, except for Yellow Tang, and that aquarium fishing likely contributed to these declines. It is also stated that additional aquarium fish species are not included because of extremely low abundance and the inability to make any meaningful conclusions on changes in abundance over time.

Shallow water resource fish surveys from 2008 to 2018 conducted by DAR include four aquarium species. These data show very different trends in aquarium species population dynamics, all with much less biomass in 2018 in comparison to 2008 (**Figure 5**). As also seen in **Figure 4**, annual trends differ greatly, and whether a population is increasing or decreasing depends on which years are being compared. As discussed earlier, we advocate for the inclusion of annual trends in the DEIS to determine truly whether a species is increasing or decreasing over time.

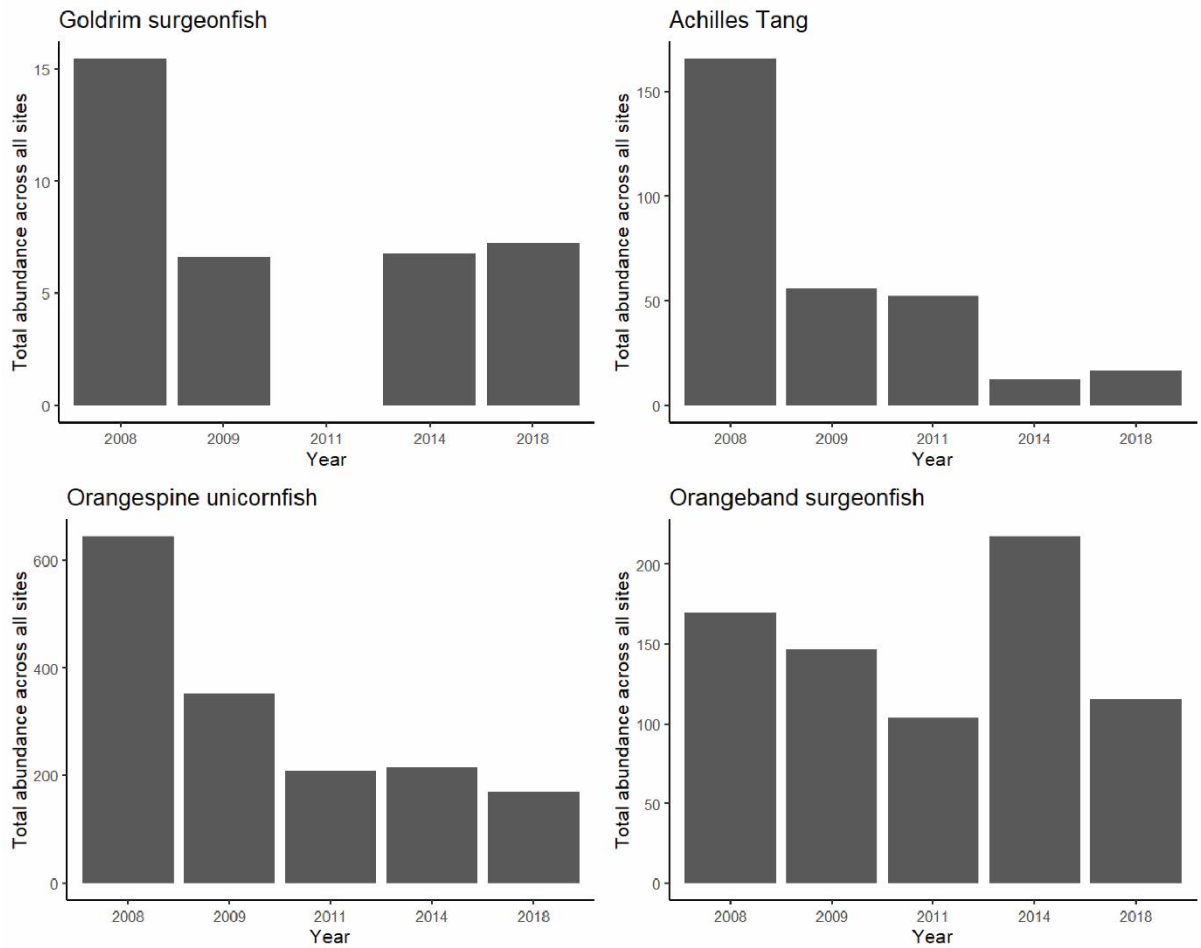


Figure 5. Fish biomass for four aquarium species surveyed between 2008 and 2018 in the shallow water resource fish surveys conducted by DAR.

Changes in aquarium fish populations differ between survey types, locality, and by which years are compared. We have presented two other datasets that show contrasting patterns to those presented in the DEIS. The DEIS should provide summaries of population dynamics for both CREP and WHAP data, as well as an analysis to assess whether individual species agree in the annual population trends observed across both datasets. It is crucially important to assess whether the WHAP long-term surveys at the 25 permanent monitoring sites show the same population patterns as those reported in CREP surveys. This will be key to determining whether the effects of an aquarium ban have only been effective locally, or across all of west Hawaiʻi.

If aquarium fish species show both a clear increase in abundance through WHAP's different management systems and also increases in abundance in the CREP surveys, an alternative to the proposed aquarium fishing plan could be a greatly reduced White List with strict limits on catch of certain fish species. If no data or not enough data exist, a species should not be included in the white list.

Fish populations are extremely variable in time and space depending on reef rugosity, depth, temperature, currents as well as population dynamics such as season, mortality and recruitment. Consideration of the full body of scientific literature available for West Hawaiʻi and then a systematic analysis is needed, instead of basing catch limits on 25 sites across the west coast. Cherry-picking scientific findings to support aquarium fishing will, in the end, lead to poor outcomes for the most extensive reef system in Hawaiʻi.

Assumption of connectivity of fish populations across West Hawaiʻi

The DEIS uses invalid estimates of percent catch from the aquarium trade to evaluate the impacts of alternative actions. In particular, the DEIS claims that percent catch (**Table 4**, which is Table 5-11 from the DEIS) should be based on island-wide population estimates for each species because "There is evidence for connectivity between FRAs and Open Areas around the island of Hawai'i (Christie et al. 2010)." This is incorrect: while neighboring FRAs and Open Areas may display high connectivity, the entire island of Hawaiʻi does not, and limited connectivity exists between East and West Hawaiʻi. The DEIS misinterprets Christie et al. (2010), which demonstrates connectivity across South/West Hawaiʻi. Past studies using drifters, larval sampling, genetic analysis, and oceanographic modeling indicate high local retention of larvae in West Hawaiʻi (Christie et al. 2010; Lobel 2011; Vaz et al. 2013). Critically, and as a result of this major error in the DEIS, the reportʻs percent catch is erroneously low. It should be based on relevant West Hawaii Regional Fishery Management Area sub-populations considering the realistic home ranges of each species, not on island-wide populations.

Table 4. Summary of CREP (2018) population estimates, disclosed catch data from East and West Hawaiʻi since 2000 (DAR 2018a), and the impact of average and maximum annual collection by species for the 40 White List Species. n.d. = Not Disclosed (Section 5.1); NA = Insufficient data available. Table 5-11 from the DEIS.

Common Name	Island of Hawai'i Pop. Mean (lower-upper estimate limit) (CREP 2018)	East Hawai'i (DAR 2018a) (numbers from 14 fishers in parenthesis; DAR 2019b)				WHRFMA (DAR 2018a) (numbers from 14 fishers in parenthesis; DAR 2019b)				Island of Hawai'i (DAR 2018a) (numbers from 14 fishers in parenthesis; DAR 2019b)			
		Average Catch per year	Maximum Catch per Year	Average Percent of Hawai'i Pop.	Max Percent of Hawai'i Pop.	Average Catch per year	Maximum Catch per Year[1]	Average Percent of Hawai'i Pop.	Max Percent of Hawai'i Pop.	Average Catch per year[2]	Maximum Catch per Year[2]	Average Percent of Hawai'i Pop.	Max Percent of Hawai'i Pop.
Achilles Tang[3]	231,377 (113,989-348,765)	703 (337)	1,525 (1,746)	0.30% (0.15%)	0.66% (0.75%)	5,600 (4,058)	5,757 (5,027)	2.42% (1.75%)	2.49% (2.17%)	6,303 (4,395)	7,282 (6,773)	2.72% (1.90%)	3.15% (2.93%)
Bird Wrasse	877,224 (686,135-1,068,313)	n.d. (1)	n.d. (6)	NA (<0.01%)	NA (<0.01%)	345 (146)	624 (224)	0.04% (0.02%)	0.07% (0.03%)	345 (147)	969 (230)	0.04% (0.02%)	0.11% (0.03%)
Black Durgon	1,354,454 (991,054-1,717,854)	n.d. (0)	n.d. (1)	NA (0.00%)	NA (<0.01%)	64 (25)	143 (86)	<0.01% (<0.01%)	0.01% (<0.01%)	64 (25)	207 (87)	<0.01% (<0.01%)	0.02% (0.01%
Black Surgeonfish	549,462 (355,535-743-388)	n.d. (33)	n.d. (181)	NA (0.01%)	NA (0.03%)	3,535 (2,334)	8,598 (4,711)	0.64% (0.42%)	1.56% (0.86%)	3,535 (2,367)	12,133 (4,892)	0.64% (0.43%)	2.21% (0.89%)
Blacklip Butterflyfish	131,260 (53,712-208,807)	n.d. (0)	n.d. (4)	NA (0.00%)	NA (<0.01%)	72 (33)	129 (88)	0.05% (0.03%)	0.10% (0.07%)	72 (33)	201 (92)	0.05% (0.03%)	0.15% (0.07%)

The DEIS also fails to consider that connectivity between FRAs and Open Areas is not absolute. Some areas are more connected than others based on the strength and direction of ocean hydrodynamics (Vaz et al. 2013). Additionally, the DEIS does not mention where fishing will be allowed—if fishing occurs in "upstream" areas that are sources of fish larvae for downstream reefs, this can heavily deplete downstream fish stocks across large areas (Crowder et al. 2000). Lastly, referring back to **Figure 2**, we can see great variability across the different MPA types and across all of West Hawaiʻi. The DEIS assumption that fish connectivity is high is flawed.

To evaluate the *Preferred Alternative*, the DEIS compares its aforementioned, invalid percent catch estimates to a study by Ochavillo and Hodgson (2006) that itemized Total Allowable Catch for reef fish species in the Philippines—species that do not correspond to Hawaiʻi's target aquarium species. However, Total Allowable Catch must always be based on the unique growth and mortality rates and reproductive traits of target species, in this case, for those in West Hawaiʻi, not on non-target species in a distant region. It is an irresponsible false equivalency to base wide-reaching policy decisions on "rules of thumb" for non-target species. In sum, a complete evaluation of the life histories and sustainable catch limits of West Hawaiʻi's target species should underlie this DEIS, weighed against percent catch of relevant, connected populations.

Data analysis is incomplete and insufficient to support DEIS recommendation

In addition to the lack of and bias-selected data cited in the DEIS, the only statistical analysis presented are simple t-tests. The DEIS makes major claims and states multiple times that commercial aquarium fishing is not driving a decline in fish biomass or coral cover. However, the DEIS fails to back up these claims with statistically valid analyses. The DEIS fails to account for confounding variables, biases, tests of the strength and direction of relationships – critical factors that are not captured by bar and line graphs. For example, a generalized linear mixed model considering the abundance of specific aquarium fish species, and the collection of aquarium fish (with year and site as random factors), would show more conclusively whether aquarium fishing impacts fish abundance.

The DEIS biases its selection and use of data to very specific indicators of fish biomass, particularly from Gove et al. (2019) – a comprehensive report on West Hawaiʻi. Specifically, the DEIS states from this report that herbivore biomass increased more in open areas than in FRAs (page 116, 139, 140 of DEIS). However, this was not a significant finding (J. Gove, NOAA, Pers. Comm., Gove et al. 2019) and is one of the instances that the DEIS vacillates between using statistical significance to support their messaging in some cases and then dismisses statistical significance in other instances.

Most importantly, if we examine the fish indicators from Gove et al. (2019), specifically Total Fish Abundance, Total Fish Biomass, Mean Adult Fish Length, and Juvenile Yellow Tang, each indicator had significant increases that were greater in FRAs compared to Open Areas from 2003 – 2017. This directly contradicts what was stated in the DEIS to support their statement that aquarium fishing does not impact fish abundance. These data that were specifically ignored from Gove et

al. (2019) strongly contradict the argument that aquarium fish collection had no impact on the fish community.

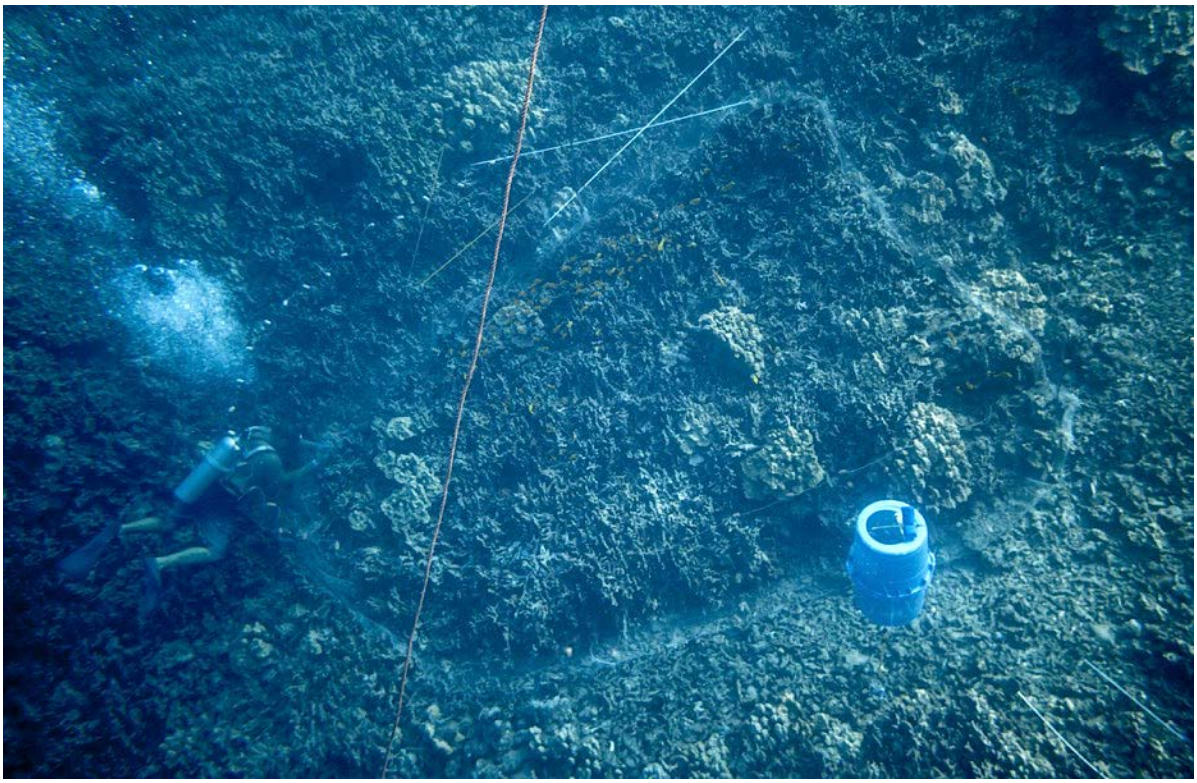
A failure to utilize other highly-available datasets for Hawaiʻi will result in inaccurate estimates of fish populations upon which the DEIS bases its claims. Misrepresentation and selective use of science is dangerous and has the potential to harm Hawaiian ecosystems. These very basic tenets of scientific analysis have not been considered properly in the DEIS.

III. CORAL REEF DAMAGE

The DEIS makes several broad and unsubstantiated claims that aquarium collection does not negatively impact the reef ecosystem. However, a large body of scientific study indicates that making contact with the reef, especially its corals, generates major negative impacts on all aspects of reef condition (Rubec et al. 2001; Barclay and Berkes, 2017; Nichols et al. 2018; Gove et al. 2019). The question then becomes whether or not aquarium fish collectors make physical contact with the reef via their equipment and their bodily movement.

Reports from the public and the conservation community broadly point to common and persistent issues of aquarium collector contact with the reef. Our scientific observations of areas frequented by collectors also indicate areas of increased smashed coral, "troughing" for mesh fencing, staking, and finning. Hard data are challenging to generate since the aquarium industry maintains a semi-clandestine culture and does not offer opportunities for third-party oversight. Nonetheless, numerous photos have been taken of aquarium collector methods in West Hawaiʻi, which reveal divers making direct contact with live corals. The photos below provide a few examples taken from West Hawaiʻi embayments (photos courtesy of Paul Cox).

The DEIS makes no recommendations regarding third-party oversight of collector activities, and goes as far as to suggest that there is no impact from collection on corals or reef structure. Physical, biological, and chemical damage needs to be documented and prevented. Mitigation of reef damage after it occurs has proven to be both financially prohibitive or ecologically unviable (Jokiel and Naughton 2001). Prevention is the only scientifically and financially sound pathway, either by strong *in-situ* oversight of the industry or via banning of collections.



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Analysis of the Final Environmental Impact Statement by the Pet Industry Joint Advisory Council

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In this response, we specifically focus on sections of the Final Environmental Impact Statement by the Pet Industry Joint Advisory Council, heraeafter the FEIS: *Section 4 – Affected Environment* and *Section 5 – Environmental Consequences*. We believe that the FEIS has not adequately covered the relevant topics related to these sections, blatantly ignoring public comments including our professional review dated 3 January 2020, and omitting key facts and data required for an objective review of the impacts of aquarium fish collection. The decision to allow aquarium collection is not a contest of the most discontented, but should be based on sound science, which is lacking in the FEIS.

I. Environmental costs are not accurately or objectively characterized

The FEIS has not accurately outlined the environmental consequences of aquarium collection. Explicitly, they have not adequately covered the impacts of climate change on Hawaiian reefs and the key role of herbivores in coral reef resilience. Additionally, they have not addressed direct impacts of current climate change on aquarium fish species. Continual impacts from climate change as well as local stressors have negatively affected reefs, causing major regime shifts from coral to algal turf-dominated systems (Ateweberhan et al., 2013; Graham et al., 2013; Hoegh-Guldberg et al., 2017; Chung et al 2019). Herbivores are critically important for resisting these regime shifts (Graham et al., 2015), and scientific data show appropriate herbivore management maintains coral reef resiliency through frequent bleaching events (Chung et al., 2019). Hawaiʻi has suffered multiple bleaching events in the past decade, and the U.S. federal government and international organizations predict more frequent and severe bleaching events in the future. Therefore, retaining strong populations of herbivores on Hawaii's reefs must become a central priority to maintain reef condition and associated economic and cultural benefits over the next several decades.

The FEIS omits critically important information on which aquarium fish are herbivorous, thereby demonstrating bias. Each species on the white list targeted by the aquarium fishery has a different and important role in maintaining Hawaiʻi's coral reef ecosystem. The FEIS briefly mentions the importance of herbivores but then dismisses the number of aquarium fish species that represent herbivorous species (Page 117, FEIS). This is a substantial oversight, as herbivorous fish, such as many of the *Acanthurus* species, are targeted by the aquarium industry. Herbivores are the critical maintainers of coral-algal dynamics (Heenan and Williams, 2013; Smith et al., 2016) and are key in promoting reef calcifiers (e.g. Scleractinians and crustose calcifying algae) over fleshy macroalgae (Mumby et al., 2006, Hughes et al., 2007; Topor et al., 2019). This, in turn, is paramount for reef recovery after bleaching events (Graham et al., 2015), especially important for Hawaiʻi which is still recovering from the 2014-2015 and 2019 bleaching events.

Using the 40 white list aquarium species provided in the FEIS, we indicate which are herbivores, classified using data from Heenan et al. (2016). We also indicate which species comprise the top 10 aquarium fish and percentage of total catch (as indicated on page 99 of the FEIS; **Table 1**). Herbivorous fish can be categorized into various groups depending on their feeding preferences such as grazers, detritivores, and browsers, also indicated in **Table 1**. A total of 11 of 40 aquarium fish species are herbivores, but most importantly, 9 of 10 of the top collected aquarium fish species are herbivores representing an 97.7% of total aquarium catch of all fishes collected in 2017 (DAR 2019).

Table 1. An excerpt from the white list of aquarium species indicating which of the original 40 species are herbivores, what type of herbivore they are, and whether they are within the top ten most caught aquarium species.

Common Name	Scientific Name	Type of herbivore	Top 10 aquarium fish?	Percentage of total catch
Orangespine Unicornfish	*Naso lituratus*	Browser	Yes	1.9
Black Surgeonfish	*Ctenochaetus hawaiiensis*	Detritivore	Yes	1.2
Kole	*Ctenochaetus strigosus*	Detritivore	Yes	9.5
Yellow Tang	*Zebrasoma flavescens*	Grazer	Yes	81.6
Achilles Tang	*Acanthurus achilles*	Grazer	Yes	1.7
Goldrim Tang	*Acanthurus nigricans*	Grazer	Yes	0.4
Potter's Angelfish	*Centropyge potteri*	Grazer	Yes	0.7
Orangeband Surgeonfish	*Acanthurus olivaceus*	Grazer	Yes	0.4
Eyestripe Surgeonfish	*Acanthurus dussumieri*	Grazer	No	NA
Brown Surgeonfish	*Acanthurus nigrofuscus*	Grazer	Yes	0.3
Fisher's Angelfish	*Centropyge fisheri*	Grazer	No	NA

The important role of aquarium fish as herbivores as well as their role in reef recovery from bleaching was recognised by a majority of the comments received by the DEIS. Furthermore, our response to the DEIS provided a detailed explanation of the importance of herbivore fish biomass levels. In response, the FEIS states that DAR (2019a) reported that herbivore biomass has not changed since 2003. Note that this is only 8 sites and is not at all representative of the entire west coast of Hawai'i Island. This is not enough of a justification to ignore the role of herbivores as an important aspect of aquarium fish impacts, especially when 97.7% of aquarium fish targeted and caught are herbivores. Preserving and increasing herbivore biomass, and their key interactions with reefs, is what is needed to ensure reefs can recover from continual heat wave events that are projected to occur with greater frequency (van Hooidonk et al., 2016; Hughes et al., 2017).

Furthermore, the FEIS only discusses impacts of climate change on coral cover. Heatwaves will negatively affect fish both directly and indirectly. Healthy coral cover is linked with greater fish abundance (Jones et al., 2004; Komyakova et al., 2013), where deleterious effects on corals likely have cascading impacts on reef fish via habitat alteration (Komyakova et al., 2013). The FEIS fails to acknowledge the impact of warming on fish themselves, where fish are likely to experience physiological stress during heat wave events and that their ability to recover following a heat wave depends on levels of human disturbance (Magel et al., 2020). Elevated water temperature also negatively impacts coral reef fish reproduction (Donelson et al., 2010) where we can expect to see much lower recruitment rates with ongoing climate change. Enhanced protection, not reduced protection or the status quo, are necessary to help these critical fish survive increasing stressors.

II. Problems with fish population trends and reporting

In response to the DEIS, we specifically asked the applicant to present both the WHAP and CREP datasets equally to allow a visualisation of population trends over the length of the survey years. To understand fish population trends, the FEIS must consider recruitment, growth, and mortality rates, which are all absent from the FEIS. Furthermore, assessing fish population dynamics is only achieved using long-term data. Proper resource management requires continuous and repeated observations to allow assessment because influences of various biotic and abiotic factors vary year to year (Brown and Guy 2007). Nonetheless, we understand that detailed information on all these factors is not necessarily available for each white list species, and therefore we asked the FEIS to "present both datasets similarly to understand if the same trends in fish populations seen at the WHAP long-term monitoring sites also agree with the island-wide CREP surveys," i.e. provide an estimation of annual changes in fish populations. We made this suggestion multiple times in our response.

Despite our clear and reasonable, scientifically-based request, the FEIS only presents 2016 CREP data. Furthermore, for the WHAP data, the FEIS presents 2012/2013 data and 2017/2018 data to estimate populations for the white list species. It is not clear why those years were chosen. Furthermore, these data were from eight sites only (Table 4-5, page 76 FEIS), and are not representative of the spatial extent of West Hawai'i. Table 5-4 (page 101 FEIS) shows the change in density between 1999/2000 and 2017/2018. The FEIS not only ignores annual trends, but also fails to display any measures of variance or confidence intervals to allow proper scientific assessment of the data by others. The authors of the FEIS are not transparent with how the 2017/2018 WHAP numbers were calculated. In fact, to demonstrate that aquarium fishing had "no impact" on fish biomass, data earlier than 2017/2018 (before the aquarium moratorium was in place) should have been used. How can the applicant justify using these two years of data when the increase in abundance shown for almost all aquarium species in Table 5-4 could well be due to the aquarium mortarium?

We received the response that the applicant only had 2016 CREP data. This is not true. All CREP data are publicly available and the authors cite the source where they could have obtained the full, publicly available data (CREP, 2018 page 149 of the FEIS). In prior comments, we advocated for analyzing annual trends and contrasts between CREP and WHAP surveys because CREP surveys show declines in key aquarium species and smaller overall changes in fish abundance, which directly contrasts with results shown for the WHAP data. We have included these here (**Table 2**).

Table 2. Change in fish abundance of the top 10 collected species based on CREP data. Increases are shown highlighted in green and decreases are highlighted in red.

Common Name	Mean Density		Overall % Change in Density
	2010	2016	
Yellow Tang	32.1	40.8	+27.1
Goldring Surgeonfish	40.4	51.9	+28.5
Orangespine Unicornfish	4.4	3.8	-13.6
Achilles Tang	2.1	2.3	+9.5
Black Surgeonfish	4.5	3.4	-24.4
Potter's Angelfish	5.2	6.6	+26.9
Ornate Wrasse	4.7	3.6	-23.4
Goldrim Surgeonfish	3.4	2.7	-20.6
Orangeband Surgeonfish	4.5	5.4	+20.0
Brown Surgeonfish	29.9	50.4	+68.6

The FEIS appears to select data that supports a highly baised finding, and misuses statistics, vacillating between using statistical significance to support their messaging in some cases and then dismissing statistical significance in other instances. In one critically important example, the FEIS cites multiple times an excerpt from Gove et al. (2019) that should not be stated as a fact. Specifically, the FEIS uses a comment from Gove et al. (2019) to state that herbivore biomass increased more in open areas than in FRAs (Page 22, 117, 128, 142, 143 of the FEIS). However, this was not a statistically significant finding (interview of J. Gove, NOAA, *pers. comm*. 2020, Gove et al. 2019). We highlighted this error in our response to the DEIS, but the FEIS ignored this and in fact, the applicant increased the number of mentions of this statistically insignificant finding. Most importantly, if we examine the fish indicators from Gove et al. (2019), specifically Total Fish Abundance, Total Fish Biomass, Mean Adult Fish Length, and Juvenile Yellow Tang, each indicator had significant increases that were greater in FRAs compared to Open Areas from 2003 – 2017. This directly contradicts what was stated in the DEIS to support their statement that aquarium fishing does not impact fish abundance. The data from Gove et al. (2019) strongly contradict the argument that aquarium fish collection had no impact on the fish community.

Another instance where the FEIS uses an example to support then contradict themselves is in the estimation of fish populations in the FEIS. Specifically:

"To facilitate analysis in this FEIS, estimated population size for each White List Species for the island of Hawai'i was calculated using CREP data by converting survey counts to abundance per unit area, and then multiplying by the estimated area of hardbottom habitat in <30 meters of water (16,840 Ha)." (Page 81, FEIS)

This is a highly inaccurate way to estimate fish populations, and assumes that fish equally inhabit all hardbottom habitat area across West Hawai'i. Extrapolating based on hardbottom area ignores basic fish ecology and is a highly non-scientific method of estimating island-wide populations. Fish show highly specific spatial distributions. For example, substantial differences occur between reef fish composition and abundances on patch reefs, where on average they are ~50 % different to each other (Sale et al., 1994). Species diversity of coral reef fishes is significantly different between exposed and semi-exposed habitats, where water depth and wave exposure affect the spatial distribution of many reef fish (Nanami et al., 2005). The assumption that the average of surveys from one year can be multiplied across the entire habitat a fish could occur in ignores a huge wealth of literature dedicated to determining spatial distributions of fish. This has also likely resulted in incorrect baselines and overestimations of fish populations in the FEIS. The FEIS then goes on to use this as a justification for the low counts of specific aquarium species:

"… the WHAP focuses on the WHRFMA and does not have full spatial coverage of the island of Hawai'i. In addition, it only estimates population size at depths from 30-60 feet and therefore does not adequately survey shallow- and deep-water species (or life stages of any species) that spend time outside the 30-60-foot depth range…" (Appendix B, FEIS)

"Most of the Longfin Anthias population occurs below the 98-foot depth surveyed by the CREP and the 60-foot depth surveyed by the WHAP, and therefore the species is not observable by the methods of either survey. As such, data are not available to produce a reliable WHRFMA or island-wide population estimate." (Page 64, FEIS)

"Although the most recent DAR report (2019a) suggests there should be concern for the sustained abundance of Achilles Tang in the WHRFMA, the report concedes that WHAP transects are not located in prime habitat for adult Achilles Tang (i.e., high energy shallower surge zones), and therefore the bulk of the Achilles Tang population is not adequately surveyed by WHAP monitoring (DAR 2019a)." (Page 108, FEIS)

On the one hand, the FEIS claims that fish equally inhabit all the hardbottom habitat, but on the other hand, rare species "are not observable" because they occur outside of the survey area. Therefore, population estimates given in the FEIS alternate between inaccurate and biased, and the resulting catch estimates provided cannot be trusted.

The FEIS provides no statistical analysis of population growth compared to fish life span, number of years until sexual maturity against which the annual proposed catch can be measured, representing a true estimation of whether take is sustainable or not. The impact of catch on life history stage, resulting impact on population growth, is not discussed in the FEIS and was brought up by several of the public comments but then ignored by the applicant.

In summary, the estimates of fish populations are based on flawed estimates, and therefore the percentages of aquarium catch presented are not accurate. Long-term data exist for the majority of aquarium fish species yet no actual population modelling was done, which would allow a true estimation of the impacts of aquarium fishing.

III. Inadequate coverage of relevant literature with biased selection of specific findings

The FEIS fails to adequately cover relevant scientific literature, especially Hawai'i specific examples, thereby ignoring the impacts of aquarium collection on the system. We base the examples we discuss here on the main justifications of the applicant for allowing aquarium collection.

IIIa. Biased selection of specific findings and ignoring negative impacts of aquarium fishing

One of the most troubling and subjective examples of cherry picking in the FEIS is its reference to Tissot and Hallacher (2003) seven times. While the applicant uses this reference to support a claim that aquarium fishing does not damage coral, they fail to mention the primary finding of study:

"Seven of the 10 aquarium species surveyed were significantly reduced by collecting. The abundance of aquarium fish at collection sites ranged from 38% lower (*Chaetodon multicinctus*) to 75% lower (*C. quadrimaculatus*) than that at control sites. In contrast, only two of the nonaquarium species displayed a significant collection effect."

This shows that the authors of the FEIS were aware of research that shows the negative impact of aquarium fishing, but chose to ignore it, bias-selecting results from the study to support aquarium fishing.

IIIb. Reporting incorrect information about fish and harmful generalized comments

"In addition, herbivores collected by the aquarium fishery typically consist of the smaller size classes which are the least effective sizes for cropping algae." (Page ii, FEIS)

"Commercial aquarium collection targets juvenile fish leaving behind the adult broodstock." (Page 134, FEIS)

In aquatic systems, body size and individual trophic level are tightly linked (Jennings et al., 2001; Barnes et al., 2008), where fishing degrades the variation in size structure in coral reef fish (Robinson et al., 2017). Smaller fishes are important dietary resources for predatory species. Furthermore, despite small body sizes, grazers can have disproportionately large negative impacts on plant and algal biomass (Silliman et al., 2013), where smaller herbivores can occur in higher densities, having disproportionately higher impacts on algae in comparison to larger, less abundant herbivores (Ng and Micheli, 2020). Therefore, targeting only small fish is not a justification for allowing aquarium collection.

IIIc. Inadequate coverage of aquarium fish species

In Section 4.4 page 35 of the FEIS where each aquarium fish species is discussed, the FEIS fails to mention the ecological role of each fish, anything about its feeding behaviour and what it is important in controlling, e.g. turf algae. Categorising each of the fish into their role as herbivores, mobile invertivores, piscivores etc, should have been done so the reader can understand how removal of that fish would impact the ecosystem as a whole.

Furthermore, the FEIS mentions spawning seasons for some fish but not others. It also does not indicate the size and length until sexual maturity, growth or mortality rates. Beyond this, barely any data was available for some aquarium fish species such as *Pseudanthias hawaiiensis*, *Cirrhilabrus jordani*, *Acanthurus dussumieri*. There is clearly a lack of knowledge for specific fish, so the true impacts of aquarium collection cannot be ascertained without knowing more about the species.

IIId. Reliance on one manual to justify collection rates

"While specific research into sustainable levels of collection has not been conducted for the 40 White List Species, Ochavillo and Hodgson (2006) suggest collection of between 5% and 25% is sustainable for various reef species in the Philippines that are similar to those on the White List (e.g., tang, wrasse, butterflyfish, angelfish, triggerfish). For 37 of the 40 White List Species, the average annual collection under the Pre-Aquarium Collection Ban Alternative would represents less than 1% of the estimated island-wide population, with the remaining three species averaging less than 5% (Table 5-11)." (Page 123, FEIS)

Determining sustainable catch rates is not a straightforward process and involves a deep understanding and long-term record of population size, recruitment, mortality and growth. Other methods using size-structure abundance data and a more data-limited approach, rather than catch-per-unit methods, have been developed, but still vary on a species-by-species basis (Jerald et al., 2018). This recent method was used to assess deep-water snapper sustainability in the Hawaiian Islands and represents a more closely related and regionally relevant publication than that used in the FEIS. Successful management and rebuilding of depleted fish populations has been achieved at local scales but requires solutions tailored to the local context (Duarte et al., 2020). Thus, using a manual that is based on species in the Philippines is not the best way to determine whether aquarium collection catch rate is sustainable, especially as this rate will be specific for each species.

IIIe. Erroneously focused on macroalgae

"One study found there were no increases in the abundance of macroalgae where the abundance of herbivores was reduced by aquarium collecting." (Page ii, FEIS)

This excerpt is one of many that displays the unfamiliarity of the FEIS authors with benthic habitat components in West Hawai'i, specifically the role of macroalgae in relation to turf algae. Macroalgae, which represents larger algal types such as kelp, are rare on Hawaiian reefs and represents a minimal benthic component of reefs in West Hawai'i. On the other hand, turf algae are mats of smaller algae less than 2 cm high, representing the dominant component on Hawaiian reefs (> 50 % benthic cover) and one that aquarium fish species are important in controlling (Jouffray et al., 2016; Williams et al., 2019).

Turf algae is not even mentioned in the FEIS where turf algae are fast growing and responsible for suffocating corals and preventing reefs from recovering after bleaching. The contrast between turf algae and macroalgae was also brought up within the public comments, yet its importance was still ignored.

IIIf. Inadequate characterization of population connectivity

Numerous comments on the DEIS note its inadequate treatment of larval connectivity in assessing the impacts of the aquarium trade on fish populations. The FEIS does little to address these comments, claiming that:

"The EIS recognizes and acknowledges larval connectivity around the Island of Hawaii, which is why it is felt that the island-wide population estimates based on CREP data are the best metric when measuring population impacts." (Page 1730 in response to "For the Fishes")

The use of island-wide population estimates to evaluate impact is only appropriate if larval connectivity around the island is absolute, which is not the case. In reality, numerous publications indicate only minor connectivity between East and West Hawaii (Christie et al. 2010; Lobel 2011; Vaz et al. 2013), and within these regions, ephemeral ocean features concentrate larvae in some areas more than others (Wren and Kobayashi 2016). The FEIS does not define subpopulations relevant to Open Areas and these areas' sources and sinks, which is the most appropriate basis for assessing population impacts. While these

populations are difficult to define, they are likely to be much smaller than island-wide populations and therefore the FEIS' estimate is ecologically unsupported.

IV. Conclusions

The FEIS is highly biased in favor of aquarium collection in a number of ways:

- The FEIS has ignored the impacts of aquarium fishing on the important role of herbivores in the maintenance of reef health.
- The monitoring data have not been represented correctly; multiplying a fish survey by total reef area is not an accurate estimation of fish populations.
- The FEIS incorrectly or insufficiently applies statistical methods to interpret long-term fish data.
- The FEIS does not include a proper literature review, instead selecting a few papers and results that support their viewpoints and ignoring numerous findings that contradict the purported low impact of aquarium collection.

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APPENDIX C— REVISED DEIS COMMENTS AND APPLICANT RESPONSES

April 9, 2021

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Submitted via e-mail: david.sakoda@hawaii.gov

Re: Revised Draft Environmental Impact Statement for Issuance of 7 Commercial Aquarium Permits for the West Hawai'i Regional Fishery Management Area

Dear Mr. Sakoda:

For the Fishes, Center for Biological Diversity, The Humane Society of the United States, and the other undersigned individuals and organizations (collectively, "Commenters"), are conservation and animal protection organizations and individuals with strong interests in preserving the State of Hawai'i's natural resources and protecting its delicate coral reefs. Commenters submit these comments on the Pet Industry Joint Advisory Council's (PIJAC's, or "Applicant's") Revised Draft Environmental Impact Statement (RDEIS) purporting to analyze the environmental impacts of commercial aquarium fish collection by 7 permittees in the West Hawai'i Regional Fishery Management Area (WHRFMA).[1]

Under the Hawai'i Environmental Policy Act (HEPA, Haw. Rev. Chapter 343) and its implementing regulations, the RDEIS was required to fully analyze the environmental impacts of commercial

[1] Office of Environmental Quality and Control, The Environmental Notice at 3 (Feb. 23, 2021), http://oeqc2.doh.hawaii.gov/The_Environmental_Notice/2021-02-23-TEN.pdf; PIJAC, West Hawai'i Regional FMA Commercial Aquarium Permits—Revised Draft EIS (2021), http://oeqc2.doh.hawaii.gov/EA_EIS_Library/2021-02-23-HA-Revised-DEIS-Hawaii-Island-Commercial-Aquarium-Permits.pdf.

aquarium collection in the WHRFMA and specifically address the significance criteria in HAR § 11-200-12, including, but not limited to:

- Involving an irrevocable commitment to loss or destruction of any natural or cultural resource;
- Curtailing the range of beneficial uses of the environment;
- Conflicting with the state's long-term environmental policies or goals and guidelines as expressed in Chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders;
- Substantially affecting the economic or social welfare of the community or State;
- Involving a substantial degradation of environmental quality;
- Cumulatively has considerable effect upon the environment or involves a commitment for larger actions;
- Substantially affects a rare, threatened, or endangered species, or its habitat;
- Affects or is likely to suffer damage by the activity/activities being located in an environmentally sensitive area such as a beach, erosion-prone area or coastal waters.

To this end, we expected the Applicant to comply with the requirement "to develop a fully acceptable draft EIS prior to the time the draft EIS is filed with the office, through a full and complete consultation process, and shall not rely solely upon the review process to expose environmental concerns."[2] However, as with the prior iterations of this document, this RDEIS is fully unacceptable because it remains legally inadequate, despite the Applicant having taken steps toward a valid EIS by proposing limits on take.

As we wrote in our consultation letter, our primary expectation was that the Applicant would stop using the erroneous methods and false characterizations which have dominated the previous process and which led to an entirely inaccurate impact analyses and conclusions. That expectation was based on the requirement for the RDEIS to accurately and adequately evaluate the HEPA significance criteria, to disclose any and all effects (beneficial and adverse) to biological, socioeconomic, and cultural resources and traditional cultural practices, stemming from the proposed alternatives, and, to propose mitigation measures to eliminate, reduce, and rectify those impacts, as set forth in HAR § 11-200-17.

The inaccurate and inadequate impact analyses contained within this RDEIS render it fatally flawed because they lead to patently false conclusions that the Applicant's actions will not result in substantial declines in fish abundance, and that their actions do not involve an irrevocable commitment, loss, or destruction of natural or cultural resources.[3] Not surprisingly, by minimizing the effects of the Applicant's actions on impacted fish species and assemblages, these inaccurate analyses skew toward a favorable outcome for the industry.

I. <u>Introduction</u>

[2] HAR §11-200-15.
[3] RDEIS at iii.

DLNR has the authority to issue permits for the taking of fish and other aquatic life for aquarium purposes.[4] While these permits are limited in duration to one year, neither the aquarium collection statute nor DLNR places any limits on the number of animals that can be captured per commercial permit, nor on the number of permits the Agency issues.[5] In fact, prior to court mandated compliance with HEPA, DLNR automatically granted *every* commercial aquarium permit application and *every* commercial marine license, and allowed the collection of *unlimited* numbers of animals under those permits.[6] DLNR also automatically granted every recreational permit application, which effectively allowed for unlimited recreational collection of nearly 2,000 fish per year per collector.[7] Furthermore, while commercial collectors are required to report their collections (but in practice, do so inaccurately), there is no similar requirement for recreational permits.[8] Therefore, there are no definitive data on how many of each type of fish or other aquatic animal have been taken from the State's delicate coral reef ecosystem each year, nor on what level of take would be sustainable.

The RDEIS is still entirely inadequate under HEPA and its implementing regulations despite the permit, species, and total allowable catch limits proposed in the Preferred Alternative. The RDEIS failed to address these and other notable flaws that we outlined in our prior Environmental Assessment and DEIS comments:

- The RDEIS failed to analyze the impacts of collection over time (i.e. the 5-year scope of the analysis, beyond one year, is inadequate);
- The RDEIS failed to accurately analyze the environmental consequences (i.e. direct, indirect, and cumulative impacts) of the proposed collection of aquatic life to biological, cultural, and socioeconomic resources at the sites in the WHRFMA where the activity would occur, focusing instead on the WHRFMA generally, as a whole;
- The RDEIS failed to accurately analyze the environmental consequences (i.e. direct, indirect, and cumulative impacts) of unlimited collection of aquatic life to biological, cultural, and socioeconomic resources in East Hawai'i and other parts of the State that may be connected via larval dispersal patterns;
- The RDEIS failed to accurately analyze the cumulative impacts of commercial collection along with the take of aquatic resources as food in subsistence, recreational, and commercial fisheries;
- The RDEIS failed to accurately analyze impacts on cultural resources;
- The RDEIS failed to accurately analyze the alternatives presented;
- The RDEIS failed to accurately analyze the impacts of collection practices harmful to corals;
- The RDEIS relied on inaccurate, misleading, and incomplete data;
- The RDEIS failed to propose and analyze mitigation measures; and

[4] Haw. Rev. Stat. § 188-31(a).
[5] Haw. Rev. Stat. § 188-31(a); HAR § 13-75-14(4).
[6] *See Umberger v. Dep't of Land and Nat. Resources*, 403 P.3d 225, 300, 304 (Haw. 2017).
[7] HAR § 13-75-14(4); *Umberger*, 403 P.3d at 300, 304.
[8] *See* Haw. Rev. Stat. § 189-3; *Umberger*, 403 P.3d at 283, 295.

- The RDEIS failed to adequately incorporate input of Native Hawaiian groups, experts, affected citizens, and consulted parties.

The Applicant's Preferred Alternative does not ensure that commercial aquarium fish collection is lawful, responsible, and sustainable for any of the White List fish species from nearshore habitats in the WHRFMA. Nor for any species taken elsewhere in the state where collection is allowed under the current geographic scope of the aquarium permits. The RDEIS's continued conclusion that the aquarium fishery in the WHRFMA is not anticipated to impact targeted reef fish species, coral reefs, and the human communities that rely on them is unsupportable. The RDEIS failed to accurately evaluate the primary, secondary, cumulative, short-term and long-term effects of the Preferred Alternative and failed to propose any proper mitigation.

II. Reliance on Flawed and Inadequate Science and Data

The fundamental errors occurring in the impact analyses include, but are not limited to, 1) the use of an incorrect baseline and 2) an exaggerated spatial scale against which impacts are measured. These errors serve to minimize, rather than accurately assess the impacts. These failures serve to obscure the irrefutable evidence of impacts and contribute to erroneous conclusions and improper evaluations of HEPA significance criteria.

A. The use of an improper baseline.

A critical component in any DEIS is the establishment of proper baseline against which to compare the impacts of the proposed action. Any analysis stemming from an improper baseline cannot be considered accurate or relevant. The RDEIS assumes that current targeted fish population estimates are healthy and not impacted and this represents a shifting in baselines. Population abundance of most of these fish species has declined over the past decades due to overexploitation and habitat degradation and thus they cannot be considered baselines. Strong scientific evidence shows that coral reefs of the main Hawaiian Islands, especially near higher human population densities (where exploitation pressure is the highest), have significantly less abundance and biomass of reef fish species than more isolated islands due to overfishing.[9]

A proper baseline reflects pre-project environmental conditions, and is spatially relevant. Here, a proper baseline is found in the conservation districts and managed areas, collectively referred to as Marine Protected Areas (MPAs), within the WHRFMA where aquarium collecting has been prohibited for over 30 years. MPAs have been used as the pre-aquarium collection baseline, for example, in the West Hawai'i Aquarium Project (WHAP) which was designed to gauge changes in FRAs and Open Areas by comparing them to MPAs.

The WHAP utilized a powerful experimental design that is often used in environmental impact studies, called the BACI (before-after-control-impact) method and which "is considered optimal to help isolate the effect of the proposed action from natural variability."[10] Using the MPAs as the controls in the BACI method, the WHAP design has been able to separate out any changes due to

[9] Friedlander & DeMartini (2002); Williams et al. (2008); Nadon et al. (2015); Nadon (2017); Friedlander et al. (2018).
[10] Smokorowski et al. 2017.

natural occurrences that would be expected to impact fish abundance in all 3 WHRFMA management areas from those that are human caused and thus allows the impacts of aquarium collecting in the Open Areas to be accurately estimated.[11] The importance of the WHAP BACI design for exposing natural vs. human caused changes in aquarium targeted species can be understood through these examples (see Figure 15):

- 2003: Yellow tang abundance soared in the FRAs 3.5 years after collection was halted in those areas.
    - MPA and Open Area abundance increased by less than half as much.
- 2014: An anomalous recruitment pulse (aka "juvenile fish bloom") occurred across the state and caused an unprecedented increase in yellow tang abundance in FRAs and MPAs.
    - Collection pressure kept populations in the Open Areas suppressed.
- 2018: Yellow tang abundance soared in the Open Areas in an unprecedented single year increase that resulted after aquarium collecting was halted in late 2017.
    - MPA abundance was unchanged and FRAs decreased.

The WHAP isn't the only study to separate out natural variances and measure impacts through comparisons between control and impacted areas:

- Two MPAs were used in 1997-1998 to document the magnitude of the effect of aquarium collecting on natural populations in West Hawai'i:
    - "The magnitude of the effect was estimated by comparing fish abundance at collection sites where aquarium fish collecting was known to occur and control sites where collecting was prohibited. Because the study was initiated after collection had begun, we assumed there were no differences between control and collection sites in the abundance of aquarium fishes *prior to the onset of aquarium harvesting* (i.e. their natural abundances were similar." (emphasis added).[12]
    - Using this method, the authors concluded "that aquarium collectors have a significant effect on the abundance of targeted aquarium fishes."
- A 2019 National Oceanic and Atmospheric Administration (NOAA) coral reef ecosystem status report used comparisons between WHRFMA management areas to describe the impacts of activities such as aquarium collecting.[13]
    - They found that, for aquarium collecting, in particular, "In 2017, MPAs and FRAs had 66.2% and 90.2% more juvenile yellow tang than in open areas;" and,
    - For all reef fish indicators, "Total abundance and biomass, adult fish length, species richness, herbivore biomass, juvenile yellow tang were 1.1–2.0 times higher in MPAs over open areas in 2017."
- The WHAP included six MPAs among the 25 study sites in their BACI design to measure the effects of aquarium collecting and/or its removal in the WHRFMA. The MPAs were key, because at the time (1999), they had been closed to aquarium collecting for at least 9 years (31 years as of 2021) and were presumed to have close to "natural" levels of aquarium fish abundances and,

[11] DLNR (2010) at 10.
[12] Tissot and Hallacher (2003)
[13] Gove et al. (2019).

thus, "serve[d] as a reference or 'control' to compare with the FRAs and open areas."[14] They further noted, "changes in FRAs and open areas can best be estimated by comparing them to other areas which have been protected for relatively long periods of time. These areas (MPAs) serve as control areas. . ."[15]

It is noteworthy that although the NOAA report (Gove et al. 2019) was cited over a dozen times in the RDEIS, nowhere did it disclose these effects of aquarium collecting in the WHRFMA. The Applicant avoided disclosing the inconvenient truths found in the NOAA and the WHAP data described above by claiming that aquarium collecting is part of the baseline.

Table 1, adapted from WHAP data, shows the impacts of aquarium collectors on the 8 species (see Figure 1) the Applicant has proposed in the Preferred Alternative. In 2017/2018 the effect of aquarium collecting on five of the species was significant. Reduced abundance in the Open Areas ranged from 14.3% to 59.5% lower than the MPAs. Note that populations in the 2012/2013 columns reflect abundances prior to the 2014 anomaly and that the 2017/2018 column encompasses the period *following* the Oct.2017 closure of legal aquarium collecting.

Table. 1. Difference in abundance between MPAs and Open Areas in the WHRFMA for the 8 species proposed in the Preferred Alternative. 3 time-frames, based on WHAP data. Note: 2017/2018 includes 15 months when no legal aquarium collecting occurred in the WHRFMA.

Common Name	Mean Density (No./100m^2)								
	1999/2000			2012/2013			2017/2018		
	MPA	Open	Diff.	MPA	Open	Diff.	MPA	Open	Diff.
Yellow Tang	23.08	10.24	**-55.6%**	25.32	9.75	**-61.5%**	40.07	20.53	**-48.8%**
Black Surgeonfish	0.53	0.17	**-68%**	0.48	0.25	**-47.9%**	0.98	0.84	**-14.3%**
Orangespine Unicornfish	1.59	1.12	**-29.6%**	1.57	1.31	**-16.6%**	2.88	1.59	**-44.8%**
Kole	28.53	21.18	**-25.8%**	40.56	26.99	**-33.5%**	62.64	41.65	**-33.6%**
Bird Wrasse	1.04	0.64	**-38.5%**	1.16	0.40	**-65.5%**	1.53	0.62	**-59.5%**
Potter's Angelfish	1.54	1.65	**+7.1%**	1.84	2.21	**+20.1%**	2.39	2.47	**+3.3%**
Thompson's Surgeonfish	0.66	0.69	**+4.5%**	0.88	0.85	**-3.4%**	1.55	2.53	**+63.2%**
Brown Surgeonfish	7.68	11.20	**+45.8%**	10.16	14.23	**+40.1%**	22.21	25.77	**+16.0%**

[14] RDEIS at 87; Walsh et al. (2010).
[15] Walsh et al. (2010).

Figure 1. Images of the Proposed 8 White List Species, from top left: yellow tang, orangespine unicornfish, black surgeonfish (aka chevron tang), *kole*, brown surgeonfish, bird wrasse, Thompson's surgeonfish, Potter's angelfish.

Rather than using the WHAP data to describe the impacts of aquarium collecting, as it was designed, in part, to do, the Applicant has chosen, again and again, to use a baseline that incorporates decades of aquarium collecting that occurred without environmental review and in violation of HEPA. The Applicant asserts that this extractive industry is a *part of the natural environment*, attempting to justify this absurd claim as follows: "the evaluation includes past use and potential impacts by the commercial aquarium fishery because it has been a part of the baseline condition of these resources since the late 1940s," and "permitted commercial aquarium fishing has been a part of the socioeconomic, cultural, physical, and biological resources for decades and is considered a part of the baseline condition of the affected environment."[16] Commenters reiterate that in all of those decades the industry has been allowed to operate, the impacts to the environment have—*still*—never been openly addressed by the industry itself, despite the data being widely available.

The Applicant refused to substantively respond to our comments on this critically important issue.[17] Instead, PIJAC merely repeated its refrain that trade exploitation is the baseline condition, and neglected to explain how or why the MPAs are *not* the proper baseline.[18] Frankly, we believe such an explanation does not exist: MPAs are the only logical control group for assessing the trade's impacts. In the related context of protecting habitat for endangered salmon, federal courts require that trade degradation of baseline conditions be incorporated into the analysis of potential future jeopardy.[19] In other words, the trade's past degradation of fish populations cannot be "rolled into" the *status quo* as PIJAC insists; that defeats HEPA's purpose by obfuscating the true impacts of the permits requested.

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[16] RDEIS at 25 and 33.
[17] FEIS at 1719.
[18] FEIS at 17 and 1719.
[19] *National Wildlife Federation v. National Marine Fisheries Service*, 524 F.3d 917, 929 (9th Cir. 2008).

It appears that the Applicant's reluctance to properly use the WHAP data stems from the fact that to do so illuminates the significant effects aquarium collectors have on the abundance of targeted aquarium fishes, and that, for a number of species, those effects have only grown worse over time, despite the 2014 recruitment pulse (see Table 1). Ignoring the data and pretending aquarium trade impacts are anything other than highly significant renders the RDEIS functionally useless and runs counter to HEPA's core requirement to consider the proposed action's environmental effects, including cumulative impacts "which result[] from the incremental impact of the action when added to other *past*, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions."[20]

The Applicant subsequently used a before-after method to reframe the impacts of aquarium collecting by comparing the abundances of aquarium targeted fishes in 1999/2000 *before* the establishment of the FRAs, to sometime *after*. This method is useful and part of the WHAP BACI design to determine the effectiveness of the FRAs themselves, however, it fails for the purpose of an EIS because it doesn't in any way illuminate the impacts of aquarium collection itself, as the RDEIS must.

The years 1999/2000 do not represent the time *before* aquarium collecting began in West Hawai'i. Aquarium collecting had been occurring along that coastline, without environmental review and in violation of HEPA, for decades prior. In fact, it was "observed declines in reef fishes due to the aquarium trade [that] triggered the establishment of FRAs and associated monitoring surveys in West Hawai'i in 1999."[21]

Furthermore, while 1999/2000 was the beginning of reduced impacts in the newly protected FRAs, it also signaled the beginning of increased impacts in Open Areas, as increased levels of collection were focused in fewer legal places to collect.

Additionally, the Applicant appeared to use the increased abundance in targeted species stemming from the anomalous recruitment pulse and the cessation of aquarium collection in late 2017 as a smoke screen to avoid disclosing the Open Area decreases in fish abundance that aquarium collecting has caused for decades under illegally issued permits and licenses, likely by some of the 7 collectors now seeking these permits. It is evident that any increased fish populations have nothing to do with "sustainable aquarium collecting," but that did not stop the Applicant from implying that it does, through dozens of references in the RDEIS to significant increases in abundance since 2000.

Under this RDEIS, the impacts of the Applicant's actions would continue to be undisclosed, and unmitigated.

B. Hypothetical Scenarios and Exaggerated Spatial Scales

In determining the level of impact to the 8 targeted (i.e. White List) species that would occur under the Preferred Alternative, the RDEIS employs 3 hypothetical scenarios to compare the annual total

[20] HAR § 11-200-2 (emphasis added).
[21] Gove et al. (2019).

potential catch of those species, by 7 aquarium collectors, to their estimated populations, with the following results:

- Using WHAP Open Area population estimates (30-60-foot depth, Open Areas only), the annual collection would be no more than 7.0% of any of the 8 species
- Using WHAP WHRFMA population estimates (30-60-foot depth, and including areas open *and* closed to collection), the annual collection would be no more than 3.5% of any of the 8 species
- Using PIFSC-ESD WHRFMA population estimates (0-98-foot depth, and including areas open *and* closed to collection), the annual collection would be no more than 3.3% of any of the 8 species

Used properly, this basic analysis using harvest/population ratios can be useful in describing impacts of past actions and in setting future management goals.[22, 23] However, when used to describe hypothetical scenarios and applied to exaggerated spatial scales, as is done in the RDEIS, the results will fail to accurately assess *current* impacts or properly mitigate them.

1. Affected Environment/Directly Affected Area

We appreciate that the RDEIS no longer used island-wide fish populations to assess aquarium collection impacts. However, for the reasons below, impacts can only be accurately assessed at a scale that is much smaller than is used in this RDEIS, the WHRFMA Open Areas as a whole, and/or WHRFMA in its entirety.

Across the WHRFMA, the main factors in determining aquarium collecting impacts—fish abundance/assemblages and aquarium collection pressure—are far from uniform. It is well established that population abundances of reef fish species in Hawaiʻi, especially relatively small-size species that are targeted by the aquarium industry, are highly variable in space depending on reef complexity, depth and wave exposure, and in time (within and among years) depending on the season, mortality, recruitment to the population, and environmental factors.[24] In addition, scientific evidence shows that collecting activities substantially affect targeted species in Hawaiʻi and fishing intensity remains high even when stocks are depleted or recruitment is weak.

The RDEIS determines impacts by comparing proposed total allowable take to Open Area populations, as a whole, or to the WHRFMA, as a whole. This analysis is deeply flawed both because these areas vary widely in fish populations and other ecological characteristics, and because it fails to accurately capture the industry's impacts at the scale on which they actually occur. Attempting to assess impacts using this overly broad and generalized spatial scale minimizes, obscures, or omits the harsh impacts that are occurring—in reality—in a much more geographically targeted fashion. The WHRFMA is not one uniform whole and treating it as such results in an impact analyses that is far too generalized to be meaningful.

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[22] Walsh et al. (2010); Walsh et al. (2013); DLNR (2010); DLNR (2015).
[23] Bozec et al. (2016).
[24] Friedlander & Parrish (1998a, 1998b).

Additionally, the RDEIS failed to properly assess what would be allowed under the Applicant's Preferred Alternative whereby:

> "DLNR would issue Aquarium Permits and CMLs to seven aquarium fishers in the WHRFMA, thereby allowing these seven individuals to resume commercial aquarium fish collection in the WHRFMA, including the use of fine mesh nets. No Aquarium Permits or CMLs for aquarium collection would be issued for areas outside of the WHRMA, and therefore no commercial aquarium collection would be allowed in East Hawai'i. In addition, the 40 White List Species would be reduced to 8 species and each fisher would be allocated an individual catch quota for each species.
>
> It is assumed that, upon issuance of an Aquarium Permit, permit conditions would be included in each permit limiting the geographic area covered by the permit to the WHRFMA, limiting collection to the eight species on the proposed Revised White List, and implementing individual catch quotas for each of those eight species. Permittees would abide by all rules and regulations set forth in HRS 189-2,3 (Commercial Marine Permit; Section 1.2.2), HRS-188-31 (Section 1.2.1), governing Aquarium Permit use, and would obtain a West Hawai'i Aquarium Permit as required under HAR 13-60.4 (Section 1.2.4.2). Existing slot limits for Yellow Tang and Kole would remain in effect in addition to the individual catch quotas for all 8 Revised White List Species. Collection of Achilles Tang would not be permitted under this Alternative."[25]

The Applicant's Preferred Alternative includes assumptions, stated, as above, and also unstated. A key unstated assumption appears to be that, under this scenario, take of the total allotment of 246,560 fish would occur in equal amounts across the Open Areas within the WHRFMA. This is evident by the RDEISs consideration of just one scenario, the WHRFMA as a whole, without any discussion of collection occurring in any other fashion.

Additionally, as the Applicant is well aware, for resource management purposes, the WHRFMA is divided by DLNR into 8 aquarium collection trip report zones (AQ zone), that aquarium collectors are required to use when reporting aquarium catch.[26] Despite that knowledge, the RDEIS omits any discussion of where the proposed total allowable take would be distributed: would it be among the 8 AQ zones, evenly, perhaps just a few, or just one?

Instead, it focused on the individuals, giving them quotas, but ignored the environment which would be impacted entirely differently should all 246,560 fish be taken from just one AQ zone.

The importance of the 8 AQ zones is explained in a 2011 letter from DLNR to commercial aquarium collectors outlining the need to increase focus and gather more data by aquarium trip zone, to better monitor and analyze management of the fishery due to what was, at the time, a growing interest in the aquarium fishery (See Figure 2).[27] As further emphasis of the importance of gathering information by zone, the updated Aquarium Trip Fish Report included the instructions,

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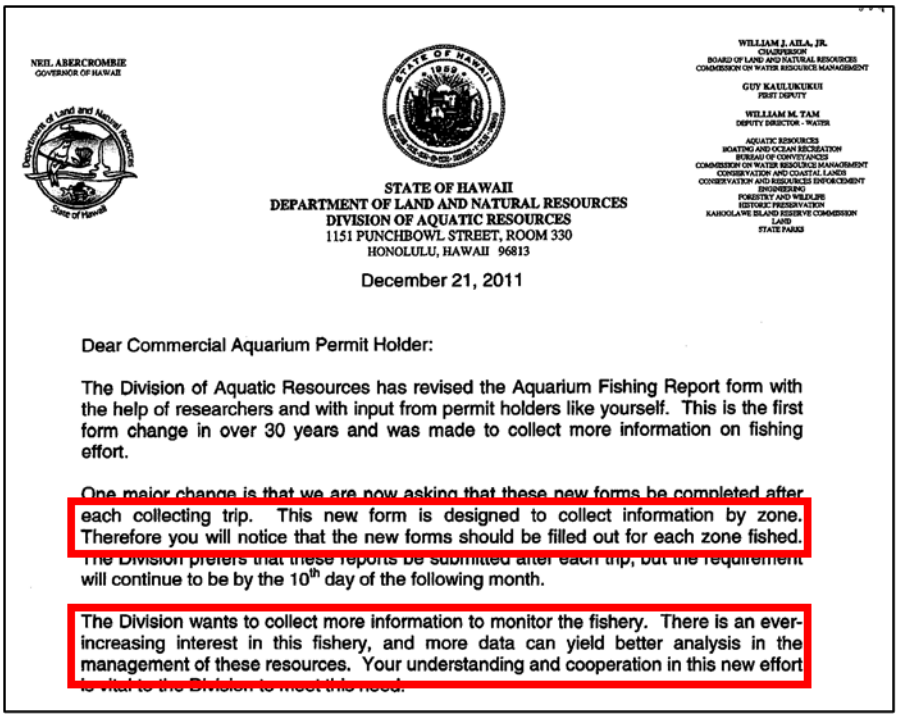
[25] RDEIS at 29 and 30.
[26] RDEIS at 17 and 97.
[27] DLNR (2011).

"DO NOT COMBINE ZONES" and noting that a separate report is required for each zone, even for catch taken on the same day (see Figure 3.).[28]

Figure 2. Excerpt from DAR letter to commercial aquarium permit holders [29]



NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

GUY KAULUKUKUI
FIRST DEPUTY

WILLIAM M. TAM
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF AQUATIC RESOURCES
1151 PUNCHBOWL STREET, ROOM 330
HONOLULU, HAWAII 96813

December 21, 2011

Dear Commercial Aquarium Permit Holder:

The Division of Aquatic Resources has revised the Aquarium Fishing Report form with the help of researchers and with input from permit holders like yourself. This is the first form change in over 30 years and was made to collect more information on fishing effort.

One major change is that we are now asking that these new forms be completed after each collecting trip. This new form is designed to collect information by zone. Therefore you will notice that the new forms should be filled out for each zone fished. The Division prefers that these reports be submitted after each trip, but the requirement will continue to be by the 10th day of the following month.

The Division wants to collect more information to monitor the fishery. There is an ever-increasing interest in this fishery, and more data can yield better analysis in the management of these resources. Your understanding and cooperation in this new effort is vital to the Division to meet this need.

[28] DLNR (2012).
[29] DLNR (2011).

Figure 3. Excerpt from Aquarium Fish Trip Report Instructions [30]

AQUARIUM FISHING TRIP REPORT INSTRUCTIONS

Header

1. **"Licensee"** – Print your full name as it appears on your commercial marine license.
2. **"Other Licensee(s)"** – Print the full name of additional divers as it appears on their commercial marine license.
3. **"CML#"** – Enter commercial marine license number(s) in the column.
4. **"Dealer"** – Enter the name(s) of the State of Hawaii commercial dealer(s) where you sold your catch.
5. **"Delayed Sale" checkbox** – Check the box if your sales information (i.e. sold and value) will be reported later. Upon receiving the sales information at a later date, use another form to report sales. DO NOT re-enter catch information.
6. **"Multiple sale" checkbox** – Check the box if you sold to more than one dealer. Complete the sold, price, and value columns for your sale to the dealer listed. Use another form for each additional sale. Include dealer name and complete the sold, price, and value columns. DO NOT re-enter catch information.
7. **"Exported/peddled" checkbox** – Check the box if you directly exported or peddled your catch outside the State of Hawaii (i.e. shipping, auction websites, etc.) or to persons within the State of Hawaii (i.e. friends, family, cash basis, etc.). **This will require submission of the Personal Aquarium Cash Sales report.**

Fishing Effort

1. **"Date"** – Enter the date of the fishing trip (i.e. month/day/year).
2. **"Vessel ID #"** – Enter the Hawaii State (HA) or U.S. Coast Guard (UCSG) vessel registration/documentation number.

3. **"Zone"** – Print only one form for each zone fished (i.e., if you fish three zones in a single day, you will complete three forms for that day). **DO NOT COMBINE ZONES.**
4. **"Total Dive Time"** – Enter the amount of time you spent actively hunting fish, which includes reconnaissance (*e.g.*, the use of tow boards or scooters to locate fishing sites). This starts from when you entered the water until you surface. It should not include travel time on land or water. If you work in a group, the time should cover all individuals (if three collectors each dove one hour, write "3.00").
5. **Fishing Method Effort Percentage** – Effort information should be estimated to the nearest 10%, and the sum of all values combined must add up to 100%.
   a. **"% Time Barrier Net"** – Percentage of time the net is deployed (even if you collect with other methods at the same time). Also provide the "Net Length (ft)"

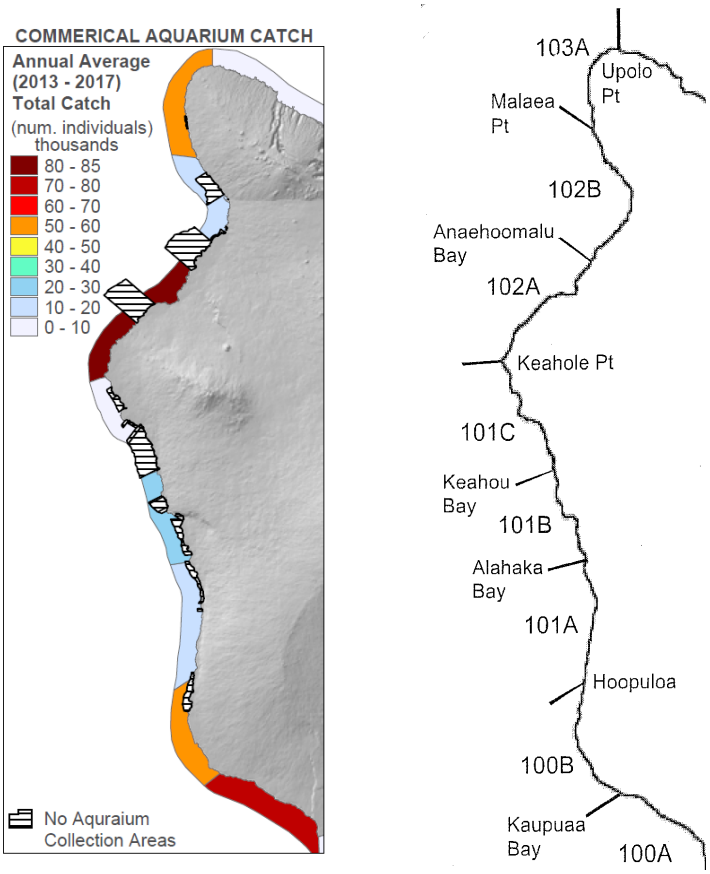
We agree with DLNR that more data yields a better analysis and that for proper management, the level of catch must be understood at the spatial scale represented in the AQ zones.

If aquarium collectors cannot combine zones for reporting purposes, the RDEIS should not combine and conflate the zones when analyzing impacts.

The importance of analyzing impacts and setting limits for each zone are revealed in DLNR catch report data which show large variances in overall collection pressure between the 8 zones. For example, during one 5-year time frame (2013-2017) average annual take ranged from fewer than 10,000 to 85,000 within the various zones (see Figure 4). These large variances, together with the potential for all 246,560 fish to be taken from one zone must be addressed.

[30] DLNR (2012).

Figure 4. Map of WH indicating the spatial distribution of average annual commercial aquarium catch per DLNR with zone map for reporting aquarium catch. [31]



The data also reveal that it's not uncommon for large volumes of a single species, such as yellow tangs, to be taken from a single zone. For example:[32]

- 84,313 yellow tangs from zone 103a in 2017 (7 collectors reporting)
- 74,445 yellow tangs from zone 102a in 2012 (14 collectors reporting)
- 66,456 yellow tangs from zone 100a in 2012 (13 collectors reporting)

Under the Preferred Alternative, the amounts above, taken from single zones, represent 33% - 42% of the proposed total allowable take of 200,000 yellow tangs *within the entire WHRFMA*. More importantly, nothing in the Applicant's proposal would prevent 100% of allowable yellow tang catch to come from a single zone.

Further, the impacts that such collection pressure would have on yellow tangs in those zones would depend, in large part, on their abundance. For example, intense collection where abundance is 10

[31] Gove et al. (2019).
[32] DLNR aquarium catch reports.

yellow tangs per 100m² would result in a significantly different impact than where abundance is 20 per 100m². The absence of these fundamental analyses in the RDEIS must be addressed.

Under the Preferred Alternative, nothing prevents the 7 aquarium collectors from focusing all of their collection effort in a single zone in response to impacts in other zones such as habitat destruction from storms and climate change, or changes in abundance of the target species (under a "get it while you can" rationale).[33] As we explain below, this is not mere speculation, as it has already happened on Oʻahu (see Figures 5 and 6).

Figure 5. Catch reports document the collapse of yellow tang populations along Oʻahu's SW coastline.[34]

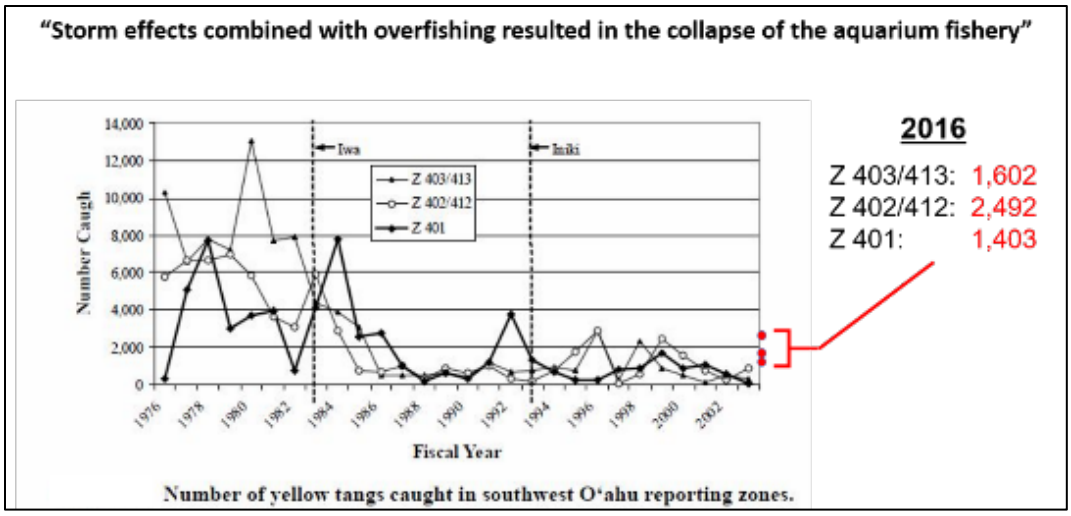
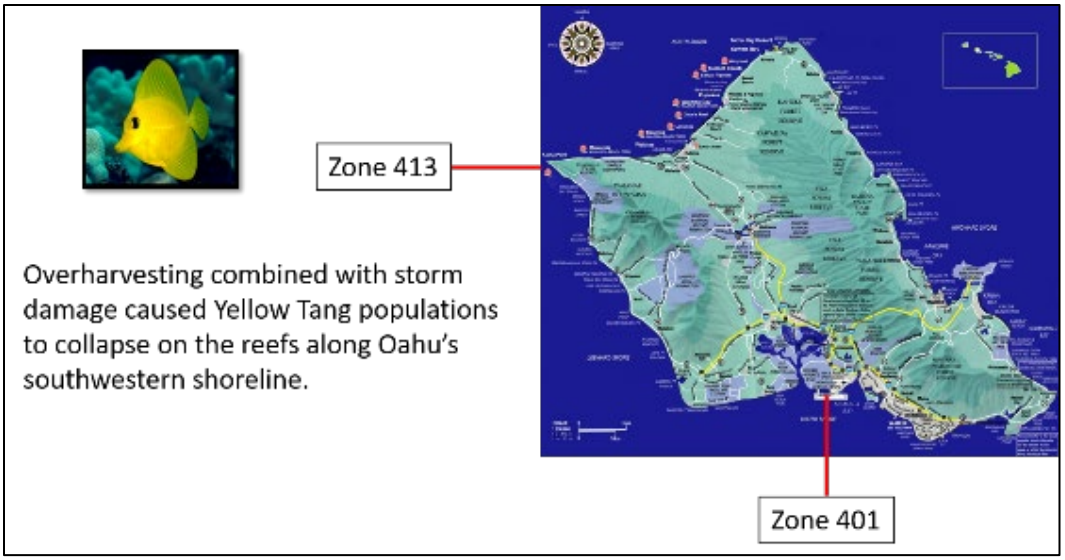


Figure 6. Map of area encompassed within aquarium catch reporting zones 401 - 413.[35]

[33] Friedlander et al. (2008); Stevenson et al. (2011).
[34] Walsh et al. (2004).
[35] Walsh et al. (2004).



Taking all fish from one zone would allow impacts greater than occurred under the prior scenario with unlimited permits and unlimited fish taken. Any such level of concentrated take could very likely lead to degradation of fish populations and habitats, contrary to the assertions made in the RDEIS that no degradation would occur.[36]

Further, HEPA requires that an EIS assess the potential cumulative impacts of what State regulations allow, not just what some permittees may claim they *intend* to do, or have historically done, with their permits. As the Hawai'i Supreme Court clearly stated, "the properly defined activity for the purposes of the HEPA analysis must encompass the outer limits of what the permits allow and not only the most restrictive hypothetical manner in which the permits may be used."[37] The RDEIS failed to address this.

The real potential exists for as much as 100% of the total allowable catch (246,560 fish) to be taken from a single zone. Similarly, the potential exists for take of 100% of the populations of any, or all, of the 8 species within a single zone. Each of these scenarios would result in impacts substantially greater than collection pressure distributed among the 8 AQ zones, according to the unique fish assemblages, reef zones, and other characteristics found within each zone.

Neither of the above scenarios have been addressed in the RDEIS, but require analysis and mitigation to prevent the significant impacts that would result from each. The RDEIS, does, however analyze the impacts of take under hypothetical distributions of harvest and fish abundance whereby both are spread equally across the entire WHRMFA. A subsequent determination of harvest/population ratios flows from those distributions. Although such equal distributions are unfounded and highly improbable, the RDEIS provides no justification for their use.

Below, we hypothesize an equally improbable distribution of fish populations—8 equal parts, representing 8 AQ zones—to provide additional examples of potential impacts under the outer

[36] RDEIS at 30.
[37] *Umberger*, 403 P.3d at 294.

limits of the permits would allow in the Preferred Alternative: we apply the harvest to one AQ zone containing a hypothetical 1/8th of the WHAP Open Area population (see Table 2.).

Table 2. Hypothetical Harvest/population ratios for 8 fish species in Preferred Alternative: WHAP Open Areas, as a whole; and, WHAP Open Areas, in 8 equal parts.

Species	Annual Limit	2017/2018 WHAP Open Area Populations	2017/2018 WHAP Open Area Populations Divided by 8
Yellow Tang	200,000	6.9% (2,867,048)	**55.8%** (358,381)
Orangespine Unicornfish	5,872	3.3% (180,099)	**26.0%** (22,512)
Black Surgeonfish	3,152	3.2% (98,067)	**25.7%** (12,258)
Potter's Angelfish	4,376	1.6% (265,488)	**13.2%** (33,186)
Thompson's Surgeonfish	2,016	0.74% (271,693)	**5.9%** (33,962)
Kole	30,000	0.56% (5,312,745)	4.5% (664,093)
Bird Wrasse	344	<0.1% (66,581)	4.1% (8,323)
Brown Surgeonfish	800	.02% (2,980,402)	0.20% (372,550)

The Applicant should not dismiss these points as mere speculation as they have done in the past. It is predicted and foreseeable that natural disasters such as coral bleaching and hurricanes will kill corals and destroy habitat for reef fishes in the coming years, with increasing frequency and intensity. Following hurricanes Iwa and Iniki and the resulting habitat destruction, Hawaiʻi aquarium collectors have already shown the propensity to over-harvest yellow tangs to the point of collapse along an entire Hawaiʻi coastline, and safeguards must be put in place to ensure that never happens again.[38]

An adequate environmental statement requires much more than the hasty review of potential impacts found in PIJAC's oversimplified harvest/population ratios. Each AQ zone is comprised of unique reefs with equally unique fish assemblages, populations of the 8 White List species, population ratios, and communities. Thus, the impacts of collection in the different AQ zones will also be unique. Moreover, because DLNR insists—and rightly so—on zone-specific reporting, zone-specific data was readily available to the Applicant, and the RDEIS provides no justification for neglecting to address impacts with the same specificity by which the WHRFMA is regulated. The level of detail required in an EIS "depends upon the nature and scope of the proposed action," and

[38] Walsh et al. (2004).

"if it is *reasonably possible* to analyze the environmental consequences of a particular type at a particular stage," the party seeking environmental review "*is required* to perform that analysis."[39]

Here, PIJAC (1) knew that DLNR mandates zone-specific reporting, (2) had access to a plethora of zone-specific data, and (3) is preparing the RDEIS on behalf of long-operating individual West Hawaiʻi collectors who could easily have conveyed their collection practices and patterns to the consultants preparing the RDEIS. The Applicant has no excuse for wielding such a broad brush when the agency prioritizes and mandates site-specific reporting and the AQ zone take reports are so readily available.

2. Additional Considerations for Determining Sustainable Take

Beyond harvest/population ratios, by zone, allowable levels of take for each species should be determined for each zone by factoring the following:

- The current level of depletion within each zone and for each White List species, determined by a comparison between the MPAs and Open Areas within said zone (see Table 1.).
- The DLNR management goal and related sustainable level of take, determined by the maximum allowable reduction in natural (i.e. unfished) abundance, per metric (e.g. herbivorous surgeonfish biomass, species abundance, female/male ratio, etc..).
- Species life span, population size, reproductivity rates, and age at first reproduction.
- What the larval connectivity and dispersal patterns are for the White List species within the zone (i.e. is it primarily a source or sink area?) and what are the implications for each?
- What any continued reduction in herbivore biomass and structure means for any future necessary reduction of same for food fishers.
- The strong preferences of Hawaiʻi residents and visitors who desire that fish populations are restored to their natural abundance on the majority of Hawaiʻi reefs.
- The cultural importance of those species for native Hawaiians dwelling in or with ties to ahupuaʻa that are potentially affected by take of fish in or adjacent to the AQ zones.

Quotas for the White List species must be set for each of the 8 AQ zones and should be based upon the above factors. The RDEIS erred by setting arbitrary take quotas for the 7 fishers while disregarding the primary purpose of the EIS. Assessing and describing the differences between the AQ zones, and the proposed impacts to each of those zones is essential for an adequate and informative RDEIS. There is no excuse for this information to continue to be omitted from the EIS. DLNR can provide the necessary WHAP data at the scale needed as evidenced by their ability to pool the data at an even smaller scale, the individual FRAs. The PIFSC-ESD may also be pooled at smaller scales for comparisons.

The Preferred Alternative applies the take limits to the entire WHRFMA and the RDEIS provides (flawed) impact analyses for that broad area, alone. However, the RDEIS failed to provide impact

[39] *Northern Alaska Environmental Center v. U.S. Department of the Interior*, 983 F.3d 1077, 1088 (9th Cir. 2020) (emphases added).

analyses for other scenarios that would be allowed under the permits, such as take that is focused in much smaller areas.

Without an additional condition in the Preferred Alternative defining relevant take limits for each AQ zone, the impacts of taking 246,560 fish from each of the 8 zones must be analyzed, since it is what the permits would allow.

Moreover, PIJAC appears to be relying on an escape hatch to increase its proposed quotas at will in stating: "the individual catch quotas may be revised (i.e., increased or decreased) over time during the annual permit renewal period based on re-evaluation by the DLNR of each proposed Revised White List species' population status (e.g., new population estimates, new population trend data, etc.)."[40] This view is legally inaccurate; HEPA's implementing regulations specifically require supplemental environmental review "[i]f there is a change in any of these characteristics which may have a significant effect," in which case, "the original EIS . . . shall no longer be valid."[41]

C. Unrepresentative Data Used

The PIFSC-ESD data set includes fish abundance collected from 257 stationary point count locations around Hawaiʻi between depths of 0-98 feet, representing 176 surveys since 2010 in West Hawaiʻi . In contrast, the WHAP data set collected data from 25 transect survey sites within the three WHRFMA management areas between depths of 30-60 feet, representing 8,712 surveys since 1999. Neither data set encompassing the entire WHRFMA are representative of regional population abundance that occurs within each of the 8 AQ zones, and should not be used to assess the impacts of aquarium collecting, via harvest/population ratios, in this RDEIS.

The use of unrepresentative data expands the affected environment in the impact analysis to include the fish populations in the protected MPAs and FRAs. While this may be appropriate for assessing indirect and cumulative impacts, it fails to accurately capture the direct effects, because the action would not occur throughout the entire WHRFMA, including the protected areas, but, *only* on reefs in the WHRFMA Open Areas.

The Open Areas are where the direct (and greatest) impacts occur. The FRAs and MPAs likely experience indirect impacts as does East Hawaiʻi (i.e. Hawaiʻi Island as a whole), but those impacts would be eclipsed by the direct impacts occurring in the actual areas where the activity would take place.

While the PIFSC-ESD data are useful for comparisons, they are problematic for a number of reasons, including the apparent inability to be pooled by management status, and therefore the inability to separate out natural variability from the human-induced characteristics such as reduced abundance from decades of heavy aquarium trade pressure on targeted species.

[40] RDEIS at 30.

The WHAP data is most relevant and representative because, as noted in the RDEIS, WHAP was designed to "gauge the effects of the aquarium fishing industry" in the WHRFMA.[42] To do so, WHAP surveys are conducted within the 30-60 foot depth range because it represents the depths from which the fish are taken (i.e. the directly affected area).[43] Additionally, WHAP data can be pooled by AQ zone, and in doing so, the most detailed view of aquarium collecting impacts are made visible in a direct comparison with reported catch from those zones. Note that for the 2017/2018 WHAP data, PIJAC cites to "Dr. Bill Walsh, personal communication" as a reference. Such data should come from publicly available sources, not personal communications, or, at minimum, these personal communications should be fully disclosed in the RDEIS.

D. Further Necessary Data Excluded is Needed for an EIS

The Agency must conduct stock assessments of species before it is able to determine a sustainable rate of take. Clearly the Agency has not done so, as DLNR personnel have stated that to do so would take over a decade for just 40 fish species targeted by the trade.[44] Without such data, the Agency cannot meaningfully assess the environmental impacts of commercial aquarium collection. Such assessments must be completed prior to the issuance of the EIS, and in the face of any uncertainty, the EIS's analyses must err on the side of caution to protect these vulnerable species.

E. Other Omissions, Misleading and Incorrect Data Sets in the RDEIS

The RDEIS ignores the largest single year surge in fish abundance that has ever been recorded in the WHRFMA which has occurred in the Open Areas in 2018 after aquarium collecting was prohibited in the area (Figure 15). Note that the increase occurred solely in the areas recently closed to aquarium collecting: a similar increase did not occur in the areas long closed to the trade. This significant increase, once collection pressure is removed, is further indisputable evidence of major aquarium collecting impact on heavily targeted species.

At the foundation of every assessment made in the RDEIS are flaws stemming from the use of an incorrect baseline, extreme hypothetical scenarios and an exaggerated spatial scale. Each of these flaws lead to unfounded and plainly biased conclusions regarding the trade's impacts. Additionally, the RDEIS failed to consider cumulative impacts, both short- and long-term. HEPA requires that "agencies shall consider the sum of effects on the quality of the environment and shall evaluate the overall and cumulative effects of an action."[45] Furthermore, the Agency must consider "both primary and secondary [consequences] and the cumulative as well as short-term and long-term effects of an action."[46] Notably, "cumulative impact" is defined as the impact resulting from "the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions," and "[c]umulative impacts can result from individually minor but collectively significant actions taking place over a period of time."[47]

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[42] RDEIS at 87.
[43] Walsh et al. (2010); Walsh et al. (2013); DLNR (2010); DLNR (2015).
[44] DLNR (2017); Eagle (2017).
[45] HAR § 11-200-12.
[46] HAR. § 11-200-12.
[47] HAR. § 11-200-2.

III. All Impacts Improperly/Inadequately Analyzed

A. Failure to Adequately Analyze Long-Term Impacts

The Applicant unlawfully limited its analyses to the time period of five years.[48] The Applicant's reasoning for this 5-year temporal scope is that it corresponds with DLNRs 5-year review of its WHRFMA management plan while noting that each permit lasts only one year, and therefore, as they "come up for renewal each year, DLNR will presumably evaluate whether there significant new circumstances or information relevant to environmental concerns and bearing on the commercial aquarium fishery or its impacts requiring a supplemental HEPA review." [49, 50]

While Commenters agree that it is critical for the Agency to continue to monitor the impacts that aquarium collection is having over time, the one-year duration of the requested permits does not nullify HEPA's clear requirement for considering the long-term effects of that activity.[51] For example, a large excavation project could destroy habitat in an area of an island that takes decades to regrow—and even if the excavation itself was only for a year, HEPA would clearly require consideration of the impacts to the environment during the decades of regrowth. Similarly, the use of a pesticide could have known impacts on a species where serious or lethal effects are felt far beyond the time frame of the actual application of the pesticides—yet HEPA would clearly require consideration of those expected impacts. Thus, the Applicant's claim that a five-year projection is sufficient to disclose the cumulative impacts of a year of substantial collection simply does not hold up, particularly considering that, under the Applicant's assumption of yearly renewal, the impact of each permit itself would be compounded annually.

Further, the Applicant asserts that "supplemental HEPA review would be triggered if WHAP monitoring data indicate a substantial decline (as determined by DAR) in the population of one or more of the proposed Revised White List species. If this happened, then a temporary moratorium could be instituted until the species rebounds. Under this approach, any changes in resource data (e.g., increase or decrease in population estimates, unforeseen circumstances, etc.) would be addressed, as necessary, by supplemental HEPA documents, allowing for the HEPA process to quickly recognize and address any potential issues."[52] Stating that the Agency can simply reevaluate the consequences of a year-long permit *after* that year is up entirely contradicts HEPA's mandate to evaluate the potential consequences of an action *before* the Agency authorizes the action. The purpose of an EIS is to anticipate an event such as the substantial decline of a target species, and propose a plan for it. Something unforeseen and beyond what has been anticipated should trigger full, not supplemental, HEPA review.

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[48] RDEIS at 24
[49] RDEIS at 96
[50] RDEIS at 24
[51] HAR. § 11-200-12.
[52] RDEIS at 24

Additionally, the Applicant's suggested approach is an example of an unresolved issue that HEPA requires must be addressed.[53] The Applicant's suggested approach contains numerous faulty assumptions, and does not appear to be a workable solution based on the following:

- Analysis of potential permit outcomes such as a "substantial decline" in one of the 8 permitted species should be included in the Preferred Alternative and accompanied by proposed mitigation measures to be incorporated into permit terms and conditions. Even though DLNR has the authority to refuse to renew permits, and to adopt emergency rule(s) for no longer than 120 days if the agency finds imminent peril to natural resources, this process is rarely used by DLNR/BLNR and is considered an option of last resort: the Applicant should have provided for such foreseeable outcomes in its RDEIS.
- The RDEIS does not define "substantial decline." We propose the following: 'Substantial decline' means Open Area abundance that is less than 95% of natural abundance (i.e. MPA abundance); or natural abundance that has declined by more than 10% since the start of the current calendar year.

An example of a workable solution based on the above would be a mitigation measure that is automatically triggered when any "substantial decline" threshold is crossed, as follows: using our proposed definition for "substantial decline," if real-time WHAP monitoring indicated such a decline at any point in time within a permitting period, collection of that species would immediately cease within that AQ zone.

Additionally, a 5-year timeframe that analyzes impacts is inadequate because the impact of fish removal will accumulate over time. For example, though collection pressure has been removed from the White List species in the FRAs, populations of once heavily targeted species in those areas, such as yellow tangs, have yet to return to natural levels of abundance, as reflected in the baseline MPAs, even after 20 years of protections. For very long-lived species such as the yellow tang and other surgeonfishes heavily targeted by aquarium collection, which have lifespans measuring decades, and which may not reproduce until they are at least 5 years old, a 5-year analysis period is far too short.

Furthermore, the RDEIS is for 7 collectors, however, nothing prevents more collectors from seeking permits through additional HEPA reviews. The relationship between the number of participants in a fishery and impacts to fish populations is well-established in the literature. The importance of restricting access to fisheries has been acknowledged and used for thousands of years to conserve and help sustain fish populations.[54]

Further, the RDEIS also failed to acknowledge the beneficial impact that would continue to occur in the WHRFMA under the No Action Alternative as is evident by the Open Area increases in White List species that have occurred since Oct. 2017 when all legal aquarium collecting was prohibited within the WHRFMA. Further evidence is found in the 2018 surge in yellow tang abundance which was the largest ever recorded in the WHRFMA. That significant increase occurred only in the Open

[53] HAR 11-200-17(n)
[54] Dewees and Weber (2001).

Areas: FRA and MPA populations changed very little between 2017 and 2018, proving that the increase was due solely to the removal of collection pressure, and was unrelated to any natural variance.

The failure of the RDEIS to conduct proper analyses, as described throughout this document, is not only a legal flaw but also the main reason that the RDEIS inaccurately anticipated no impacts to targeted populations and their habitat. In addition, by limiting the timeframe of their analysis to five years, the RDEIS failed to accurately consider the impacts of one-year collection permits cumulatively with other "past, present, and reasonably foreseeable actions" "over a period of time." [55]

B. Failure to Analyze Indirect and Cumulative Impacts

Coral reefs are connected by currents which carry and disperse fish larvae to other areas, both near and far. Most fishes on Hawai'i's reefs are the result of other fishes upstream of that reef.[56] The currents and conditions that control larval connectivity and dispersal processes are complex. The larvae of some species are able to travel between islands, while others do so to a lesser extent. For example, in one study, some yellow tang larvae on Hawai'i Island travelled on ocean currents for 15 km before settling on a reef while others traveled 184 km.[57]

Recent research into two species of small bodied surgeonfishes, including *kole* which is heavily targeted by the aquarium trade, has determined that populations of these fishes are genetically distinct on each of the main Hawaiian Islands. This means that, for at least these two species, there is little genetic mixing between islands, and once species are depleted on any given island, there is no other source for population replenishment. Further, connectivity and dispersal studies on the island scale for certain species have identified important spawning source areas that are essential for maintaining populations on other reefs across the island.

This larval connectivity between coral reefs serves to highlight areas where secondary or indirect impacts of the Applicant's actions will manifest. Regardless of whether larval connectivity exists mainly intra-island or extends inter-island, reduced populations of reef fishes in their source areas will seriously impact reef fish abundance in their downstream, sink reefs, and thus the entire island.[58] The RDEIS failed to account for this critically important reproductive strategy used by Hawai'i's reef fishes. The precautionary approach requires the determination of source areas for the White List species on Hawai'i Island and the establishment of protections for those populations to ensure local species survival, which was not provided in the RDEIS.

We reiterate here that HEPA requires that an EIS assess the potential cumulative impacts of what State regulations allow, not just what some permittees may claim they *intend* to do, or have historically done, with their permits. The RDEIS failed to address this.

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[55] HAR. § 11-200-2.
[56] Noland (1978); Christie et al. (2010); Coleman (2019).
[57] Christie et al. (2010).
[58] Coleman (2019).

The analysis of cumulative impacts included the impact of the commercial aquarium fishery combined with non-aquarium commercial and recreational fisheries and other activities that impact population abundance, but reached a conclusion that is erroneous. Commercial and recreational fishing combined with the aquarium fishery have a substantial impact on targeted species. The RDEIS failed to determine the cumulative impact of all fishing on target species. In addition, the RDEIS failed to analyze indirect impacts from collection such as vessel traffic and accumulated reef damage due to vessel anchoring and collection practices.

Also, the RDEIS failed to adequately evaluate the potential of cumulative impacts of climate change (warming, coral bleaching, and ocean acidification) on targeted fish species such as declining coral coverage which have been demonstrated to influence reef fish species diversity and abundance.[59] The RDEIS recognized that climate change poses serious threats to Hawai'i's coral reefs and the species targeted by the Applicant, claimed that "the Preferred Alternative was specifically designed to help buffer climate change by creating individual catch quotas,"[60] yet failed to quantify and evaluate the impacts of implementing the Preferred Alternative which includes the annual removal of 246,216 herbivores from reefs that are located within anywhere from 1 to 8 AQ zones.

It is clear from an analysis of cumulative impacts that many of HEPA's "significance criteria" apply.[61] Had proper analyses been conducted, the Preferred Alternative most certainly would have shown significant effects on the environment due to at the least, the following: the loss or destruction of natural and cultural resources; curtailing the range of beneficial uses of the environment; substantial degradation of environmental quality; cumulative effects on the environment; and potentially substantially affecting rare, threatened or endangered species, or its habitat.[62]

Flawed analyses prevented the RDEIS from accurately assessing and addressing these effects, in part, because the RDEIS used as a baseline, current conditions, which have been impacted by decades of the aquarium collecting activity.[63] Therefore, the scope fails to factor the impacts of collection pressure over time. Proper examination of the magnitude of the effect of aquarium collecting on natural populations and the coral reef ecosystem over time requires a proper baseline such as occur in MPAs, which reflect natural populations, before they were depleted by this activity, and have been used as such in numerous studies.[64]

C. <u>Failure to Accurately Analyze Costs and Benefits</u>

The RDEIS contains a faulty cost and benefit analysis (CBA) that is skewed heavily in favor of commercial aquarium collecting and omits essential information. Properly conducted, CBAs are

[59] Jones et al. (2004); Friedlander et al. (2018).
[60] RDEIS at 164 and 177.
[61] Haw. Rev. Stat. § 11-200-12(b).
[62] Haw. Rev. Stat. § 11-200-12(b)(1), (2), (7), (8), (9).
[63] RDEIS at 25 and 33.
[64] Walsh et al. (2010); Walsh et al. (2013); DLNR (2010); DLNR (2015).

useful in environmental impact studies and provides decision-makers "the balance required in complex regulatory decisions."[65]

A recent, independent CBA of the aquarium trade in Hawaiʻi (Schaar & Cox 2021) was conducted to provide necessary information to decision makers. Costs and benefits for various scenarios were determined and their distribution across stakeholder groups was assessed. Four past, current, and proposed management scenarios were explored, and the CBA results were compared to the recommendations and conclusions of the Applicant's initial EIS for the WHRFMA.

The independent CBA of the Hawaiʻi aquarium trade determined that ending the trade was the only option that yielded positive annual benefits, and in addition, it negatively impacted the fewest stakeholders.[66]

- The **annual net positive benefit** of banning the aquarium trade was upwards of $440,294,770 - factoring in potential costs, including on-reef tourism impacts which the RDEIS chose to exclude due to "limited data".

The CBA included potential impacts on on-reef tourism – deferring to the precautionary principle articulated by the Hawaiʻi Supreme Court, where the Court concluded that, related to public trust resources, "where [scientific] uncertainty exists, a trustee's duty to protect the resource mitigates in favor of choosing presumptions that also protect the resource."[67] Whereas, the initial EIS chose to omit these potential impacts and costs, by deferring to the lack of data, the independent CBA followed the precautionary principles set-forth by the Hawaiʻi Supreme Court and erred on the side of caution when making these critical assessments that ultimately impact public trust resources.

Further, the independent CBA determined that the initial EIS did not assess the costs and benefits of the aquarium trade and their distribution across stakeholder groups. Again, the independent CBA deferred to the judicial authority of the Hawaiʻi Supreme Court, which reaffirmed "that all public resources are to benefit Hawaiʻi's people and that private or commercial use should receive a 'high' level of scrutiny" making "the size of the stakeholder group" of interest.[68] While the estimated market *benefits* of the aquarium trade were similar between the independent CBA and the initial EIS, the estimated costs were not:

- The initial EIS estimated the *costs* of the trade to Native Hawaiians and other stakeholder groups were negligible, and the EIS provided no justification for that estimation.
- The independent CBA estimated that aquarium collecting scenarios resulted **in annual net losses** upwards of $440,594,770.

Importantly, under PIJACs various EISs, the comparatively small market benefit of the aquarium trade in Hawaiʻi accrued to a small group of collectors, wholesalers and dealers (including 7 collectors in the RDEIS) while 1,415,872 residents, 83% of whom want to see an end to the trade

[65] Schaar and Cox (2021).
[66] Ibid.
[67] Schaar and Cox (2021); In re Water Use Permit Applications, 94 Haw. 97, 123–25, 9 P.3d 409, 466, 2000.
[68] Schaar and Cox (2021); In re Water Use Permit Applications, 94 Haw. 97, 123–25, 9 P.3d 409, 466, 2000.

due to environmental, cultural and ethical concerns with capturing marine life for the pet trade outside Hawai'i, suffer the losses.[69]

The independent CBA concluded that "sustainable management requires that the costs and benefits accruing to all stakeholder groups be investigated to ensure policies are equitable. Relying on EIS recommendations that aim to support one group of stakeholders at the expense of others to determine policy could be considered biased."[70] Because the RDEIS uses the same biased method that it used in the initial EIS to evaluate costs and benefits, it is deeply flawed and should be revised to consider costs and benefits to the multiple stakeholder groups who rely on our reef ecosystems.

IV. Failure to Adequately Analyze and Address Significance Criteria and Other Unresolved Areas of Concern Proposed by DLNR in their NOD dated July 26, 2018

DLNR, in the Final Environmental Assessment, Notice of Determination, described five HEPA significance criteria and eleven additional areas requiring further analysis by the Applicant. In this RDEIS, a number of critically important areas remain unresolved as they are either incomplete, not properly analyzed, or patently false.

A. HEPA Significance Criteria #1: To the question of "whether the annual take of cumulative numbers of fish as a percentage of estimated population results in irrevocable loss or destruction of populations of fish," the RDEIS wrongly concluded "the Preferred Alternative (i.e., Revised White List and Limited Permit Issuance Alternative) does not involve an irrevocable commitment or loss or destruction of any natural, historic, or cultural resource."

Fish Populations: Any and all substantial reductions in natural abundance of White List species in West Hawai'i indicate lost natural and cultural resources. The reduced populations of yellow tangs and other White List species in the FRAs, compared to baseline, natural populations found in the MPAs, even after 19 years of no aquarium collecting, is evidence of irrevocable losses that have occurred.

Furthermore, severe coral bleaching caused by climate change has already reduced coral cover in West Hawai'i and is only expected to worsen, with annual bleaching, similar to that which occurred in 2015, expected to begin in 2040, and which will result in the loss of 70% of Hawai'i's reefs. This loss of White List habitat virtually assures that a depleted population will not be able to rebound to the same extent, or at all, in the future, though it may have in the past.

Further evidence is found throughout this document and all combined point to significant adverse impacts and irrevocable losses to fish populations as a result of all proposed alternatives with the exception of the No Action alternative, which, according to DLNR data, is having a significant beneficial impact in the WHRFMA.

In their first FEIS, the Applicant responded to our DEIS comments on this matter as follows:

[69] HSUS (2017).
[70] Schaar and Cox (2021).

> *"The term "irrevocable" is defined by Webster's dictionary to mean "not able to be changed, reversed or recovered; final." The preferred alternative does not meet this definition because available scientific data indicate that the populations targeted by the fishery are naturally self-sustaining, and population levels for many of the species are stable or increasing. For species that are decreasing, they are decreasing in areas both open and closed to aquarium collection, indicating that aquarium collection is not driving the decline, and that banning aquarium collection would not reverse this decline. Consequently, the impacts of the fishery are will not cause an irreversible impact on either the populations or the ecosystems they inhabit.*[71]

With the exception of Webster's definition, every statement in the above paragraph is false or skewed to the extreme. Available scientific data actually indicates that 19 years after aquarium collection pressure was removed, and including the 2014 anomalous fish recruitment pulse, the FRA populations of 7 of the 8 Preferred Alternative species **have not recovered**. Their abundance levels in the FRAs appear to have been permanently altered, having failed to return to natural, unfished abundance as is reflected by their populations in the MPAs, even after 19 years of no aquarium collection. The abundance levels of these species in the FRAs range from 45.1% to 4.6% **lower** than is found in the MPAs (see Table 3).

Additionally, for 5 of the 8 species, the differences in abundance between the MPAs and FRAs has grown since 1999/2000 which is further indication of their inability to recover and an irrevocable commitment (see Table 3).

Table 3. Difference in abundance between MPAs and FRAs in the WHRFMA for the 8 species proposed in the Preferred Alternative. Asterisk indicates declines since 1999/2000.[72]

Common Name	Mean Density (No./100m^2)					
	1999/2000			2017/2018		
	MPA	FRA	Diff. (%)	MPA	FRA	Diff. (%)
Yellow Tang	23.08	12.73	**-44.84**	40.07	33.79	**-15.7**
Black Surgeonfish	0.53	0.18	**-66.0**	0.98	0.76	**-22.4**
Orangespine Unicornfish	1.59	0.81	**-49.1**	2.88	0.67	**-76.7***
Kole	28.53	28.38	**-0.53**	62.64	52.60	**-16.0***
Bird Wrasse	1.04	0.67	**-35.6**	1.53	0.84	**-45.1***
Potter's Angelfish	1.54	1.38	**-10.4**	2.39	2.28	**-4.6**
Thompson's Surgeonfish	0.66	0.72	**+9.1**	1.55	1.64	**+5.8***
Brown Surgeonfish	7.68	8.57	**+11.6**	22.21	13.90	**-37.4***

Further, the Applicant's statement that "*scientific data indicate that the populations targeted by the fishery are naturally self-sustaining..."* is patently false and refuted by logic as well as by DLNR data and reports on aquarium trade impacts. Oxford languages defines "self-sustaining" as "able to continue in a healthy state without outside assistance." Obviously if this were the case for species

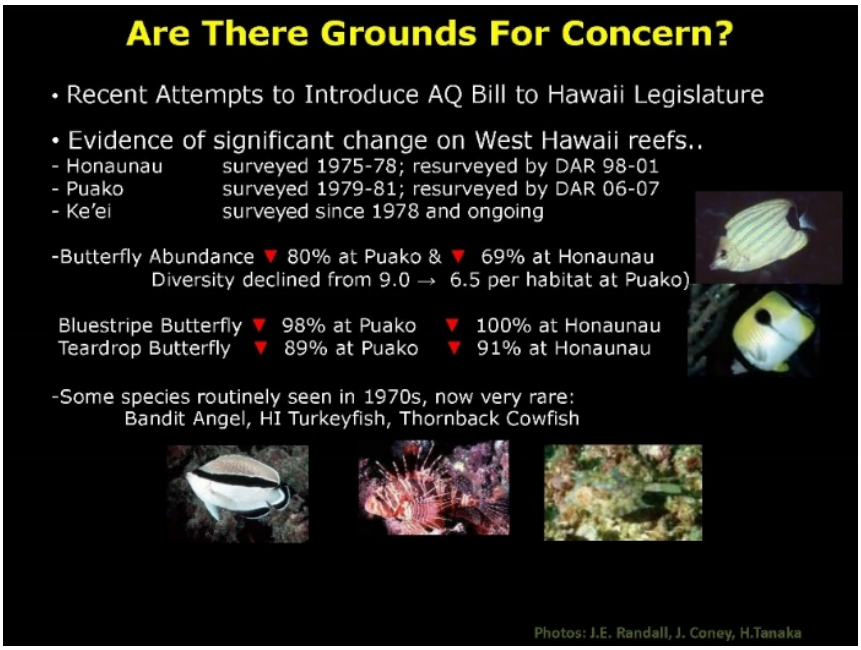
[71] FEIS at 1743.
[72] Adapted from RDEIS Table 5-7.

targeted by the aquarium trade in West Hawaiʻi, there would have been no need to establish the WHRFMA fish *replenishment* areas.

Moreover, if populations of aquarium-targeted species were naturally self-sustaining, DLNR would not have created an aquarium trade list of Species of Special Concern, which included a number of species that were "routinely seen in the 1970's, but are now rare."[73] Those species included the Bandit Angelfish, Hawaiian Turkeyfish and Thornback Cowfish (see Figure 7). Also included in the presentation were species of butterflyfishes which had been heavily targeted by aquarium collectors for decades.[74] The presentation showed that butterflyfish diversity and abundance had significantly declined, with particularly alarming declines in abundance at Puako and Honaunau ranging from 89% - 100% for the Teardrop Butterflyfish and the Bluestripe Butterflyfish which is a highly unique, endemic species, and is one of two Hawaiʻi reef fish species that have no sister species elsewhere in the Indo-Pacific, and are also known as relics (see Figure 7).[75, 76]

Figure 7. Aquarium trade species of special concern in West Hawaiʻi.[77]

[73] Williams and Walsh (2008).
[74] DLNR catch reports.
[75] Williams & Walsh (2008).
[76] Randall (1996).
[77] Williams & Walsh (2008).



Additionally, the Applicant's claim that for species experiencing decreasing abundance in both open and closed areas, aquarium collecting is not driving the declines, and that banning aquarium collection would not reverse the decline is erroneous and unfounded. DLNR refers to two such species, both among the top 10 most collected by the trade, the Achilles tang and the ornate wrasse, writing in "[t]he fact that these two species had declines in both Open and protected areas (FRAs) suggests that factors other than aquarium collecting were **also** affecting their populations" (emphasis added).[78] Nowhere does DLNR write that aquarium collecting had zero impact on their populations, which is understandable given that, for example, elsewhere DLNR reported that aquarium collecting removed upwards of 80% of Achilles tangs in the Open Area 30' – 60' range. [79]

The Applicant's claim that "commercial aquarium collection under the Preferred Alternative is anticipated to have minimal impacts on populations in general is not supported by research which has found that aquarium collecting in West Hawai'i significantly impacts targeted populations.[80] As explained throughout these comments, the existing and potential for even greater irrevocable losses of natural abundance caused by Applicant actions is irrefutable.

<u>Reef Habitat</u>: The RDEIS claimed collection under the Preferred Alternative would be lower than the collection pressure that occurred under a 2003 study that found no significant differences in damaged coral or increases in macroalgae between control and collected sites.[81] However, as detailed below there are numerous issues with those statements.

During the Tissot survey years of 1997 to 1998, reported aquarium catch was approximately 8% higher than the 246,560 proposed under the Preferred Alternative.[82] However, the collection

[78] DLNR 2020 at 25.
[79] Walsh et al. (2010) at 112.
[80] RDEIS at iii and 178.
[81] RDEIS at 178.
[82] DLNR (2019).

pressure the preceded that study for over two decades was significantly lower: averaging approximately 181,600 fishes annually in the decade prior to Tissot's first survey year and 33,000 fishes annually in the decade before that (see Figure 11).

Given that the impacts of aquarium collection certainly result from a combination of direct, indirect and cumulative effects of impacts, spanning years and decades, any conclusion that under the Preferred Alternative, reef habitat (or any) impacts would be less than found by Tissot and Hallacher is unsupportable. This is especially true, given that the collection pressure that has occurred since Tissot and Hallacher has significantly increased (e.g. was nearly double the Preferred Alternative a decade later).

The RDEIS also claimed that "the pressures from commercial aquarium collection under the Preferred Alternative are anticipated to be lower than rates seen prior to the October 2017 ban on commercial aquarium collection; therefore, it is not anticipated that a significant impact on reef habitat as a result of the Preferred Alternative would occur." As explained above, under the Preferred Alternative, all 246,560 fish could be taken from a single zone. This distinct possibility was neither anticipated, nor analyzed in the RDEIS.

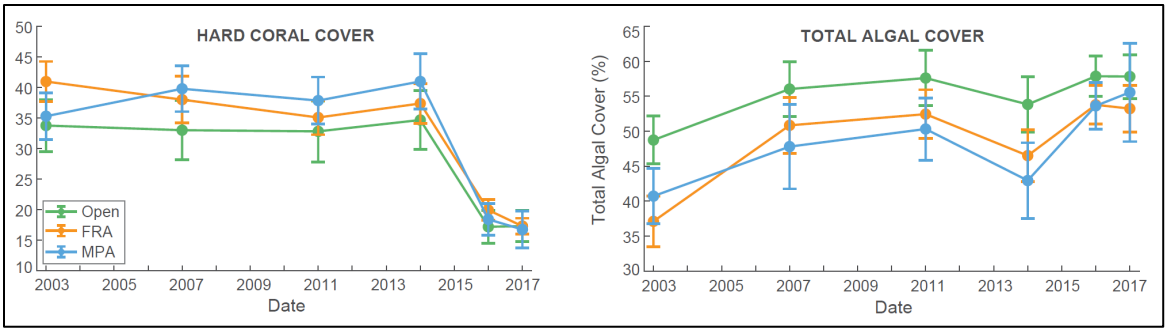
Further, despite the claim of no coral damage by the 2003 study, damage to reef habitat from commercial aquarium collection is well documented. See "Damage to Reef Habitat" later in this document and also Appendix 2 where photographs of these practices and their effects can be found.

Additionally, the Applicant relied upon the 2003 study to prove that aquarium collection of herbivores does not impact algae control, which does not stand up to scrutiny. Not only did the author's admit that further study was warranted because aquarium-targeted species primarily consume turf, not macro, algae, but macroalgae accounts for <2% of algal cover in West Hawai'i – the majority is turf algae, which renders the referenced study fairly irrelevant regarding algae, although it remains highly relevant regarding reduced fish abundance stemming from aquarium collecting.[83, 84]

The RDEIS cited a study that reported no significant differences between management areas for coral cover, total algal cover, or calcifying: non-calcifying ratio as of 2017, but that wasn't always the case.[85] Prior to the 2015 catastrophic bleaching event, Open Areas had the lowest coral cover and the highest algal cover. Additionally, *after* that bleaching event, algal cover in both MPAs and FRAs increased to similar levels found in the Open Areas. (see Figure 8).

Figure 8. Hard coral cover and total algal cover in West Hawai'i, per DAR WHAP data [86]

[83] Gove et al. (2019).
[84] Tissot and Hallacher (2003).
[85] Gove et al. (2019).
[86] Gove et al. (2019).



The Applicant stated that the Preferred Alternative would lessen the impact of aquarium fishing on herbivores via catch quotas, but did not quantify the so-called reduced impact.[87] We estimate that under the Preferred Alternative collection of herbivore biomass would be approximately 6% less than occurred prior to the cessation of aquarium collecting in October 2017, but only under the hypothetical scenario where collection is spread evenly throughout the Open Areas (see Table 4). The fact is, that it could also increase within any of the AQ zones, should collection pressure increase compared to past pressure.

The RDEIS referred to the increase in herbivore biomass within the WHRFMA that has occurred since 2003.[88] However, the RDEIS omitted the connection between that increase and the 2014 anomalous recruitment pulse, and importantly, omitted the fact that herbivore biomass is still far below that which is needed to increase resilience and the chances for Hawai'i's coral reefs to persist with the climate catastrophe barreling down upon us. The aquarium trade's portion of reef fish biomass removal each year is substantial, and nearly 100% of it is herbivore biomass. Under prior collection rates it averaged 27% of the total reef fish biomass taken annually, and under the Preferred Alternative would represent 21% of the biomass. The RDEIS failed to analyze this significant reduction in herbivore biomass.

Evidence throughout this comment document points to significant adverse impacts to reef habitat as a result of all proposed Alternatives with the exception of the No Action alternative, which is having a beneficial impact in the WHRFMA due to increased fish abundance since 2017.

<u>Cultural Resources</u>: The flawed analyses used throughout the RDEIS, described in detail throughout these comments, led the RDEIS to anticipate no significant decline in the populations of the 8 White List species under the Preferred Alternative. However, that anticipation is unfounded given, for example, that the Preferred Alternative would allow collection of all 246,560 fish from a single zone—a scenario that was not analyzed. It therefore follows that cultural resources within or adjacent to a zone experiencing such pressure would be impacted.

Moreover, the RDEIS acknowledged that for some native Hawaiians, any collection for aquarium purposes is contrary to cultural practices and beliefs, and that the Preferred Alternative may impact cultural practices, but then claimed that the extent of the impact is unknown. The Applicant may claim the extent of the impact is unknown, but that doesn't mean it can't be determined. White List

[87] RDEIS at 163.
[88] RDEIS at 178.

species are currently in decline as a direct result of aquarium collecting and will continue to be for as long as aquarium collecting occurs on Hawai'i Island. Had the native Hawaiians who were consulted for the CIA been accurately informed in that process of the past and proposed impacts of the Applicant actions, the extent of the impacts to cultural practices would be better understood.

Further evidence is found in the CIA which includes descriptions of significant adverse impacts to cultural resources as a result of all proposed alternatives with the exception of the No Action alternative, which is having a significant beneficial impact in the WHRFMA.

The reduction of natural populations of species taken by the aquarium trade in any area (e.g. specific site, zone, coastline, island or statewide), and by any amount, whether one or one hundred percent, indicates an irrevocable commitment and loss of a natural and cultural resource.[89] This very loss curtails the range of beneficial uses that would otherwise be provided by the natural abundance of these populations.[90]

The RDEIS failed to accurately analyze the impacts of all alternatives, including the No Action alternative, which is having a beneficial impact in the WHRFMA. For example, the Preferred Alternative would allow 100% of the total allowable take to occur within one AQ zone. The RDEIS failed to analyze the impacts of that level of take in any of the 8 AQ zones and also failed to identify and factor the larval connectivity and dispersal patterns for the 8 White List species. Therefore, the question of whether the take of cumulative numbers of fish results in irrevocable loss or destruction of populations of fish, and how that loss relates to reef habitat and cultural resources, has not been adequately described.

B. HEPA Significance Criteria #2: To the question of whether "the take of aquarium fish curtails the uses of the environment, including aquatic invasive algae control, the tourism industry, and the overall integrity of diverse aquatic ecosystems," the RDEIS wrongly concluded "the Preferred Alternative does not curtail the range of beneficial uses of the environment."

<u>Aquatic invasive algae control</u>: The RDEIS claimed collection under the Preferred Alternative would be lower than the collection pressure that occurred under a 2003 study that found no increases in macroalgae between control and collected sites.[91] However, as detailed above, the numerous issues with those statements include historical collection pressure prior to the 2003 study that was far lower than proposed in the Preferred Alternative, and the facts that the Open Areas had the highest levels of total algal cover and the lowest levels of coral cover until the 2015 catastrophic coral bleaching event that killed substantial amounts of corals and subsequently algal cover increased in the MPAs and FRAs.

Reductions in herbivore biomass drive an increase of algae abundance. In West Hawai'i, herbivore biomass is as much as 2 times higher in the baseline MPAs than in the Open Areas and FRAs.[92] Historically, 26.5% of the total biomass removed from West Hawai'i reefs in fishing and other

[89] Haw. Rev. Stat. § 11-200-12(b)(1).
[90] Haw. Rev. Stat. § 11-200-12(b)(2).
[91] RDEIS at 178.
[92] Gove et al. (2019).

extractive uses has been aquarium take, 98% of which are herbivores.[93] Logically, it follows that algae control is being significantly curtailed by aquarium take in the Open Areas.

Tourism: The RDEIS claimed that "populations of the White List Species are not anticipated to significantly decline, therefore not significantly impacting viewing opportunities." The RDEIS failed to describe the significant population declines and viewing opportunities that have already occurred under decades of aquarium collecting: along 65% of the West Hawaiʻi coastline, Hawaiʻi's most iconic and brightly colored fish species, such as yellow tangs, Moorish Idols, and various butterflyfishes, have been reduced by staggering amounts ranging from 50% to upwards of 90% in some areas.

Additionally, the RDEIS failed to propose mitigation that would restore populations diminished by decades of over-collecting and would also prevent potentially significant declines that would occur within AQ trip zones that experience greater pressure than has occurred in the past.

The annual "on-reef" tourism value for Hawaiʻi Island is estimated at $16,921,000, and that value is linked to the health and beauty of Hawaiʻi's reefs.[94] As described below, viewing opportunities and "on-reef" tourism revenue losses resulting from depleted populations of brightly colored and beautiful fishes are captured in studies documenting willingness to pay and consumer surplus losses.

Integrity of Diverse Aquatic Ecosystems: The RDEIS claimed that "populations of the eight species on the proposed Revised White List are not anticipated to significantly decline."[95] As described throughout this document, White List species are currently in decline as a direct result of aquarium collecting and will continue as such as long as aquarium collecting occurs on Hawaiʻi Island. Additionally, local extirpation has already been identified for some aquarium targeted species, which have been described by DAR and former aquarium collectors as "once common, now rare," a condition that likely exists for other species, as well.[96]

The RDEIS failed to accurately analyze the impacts of all alternatives, including the No Action alternative, which is having a beneficial impact in the WHRFMA. For example, the Preferred Alternative would allow 100% of the total allowable take to occur within one AQ zone. The RDEIS failed to analyze the impacts of that level of take in any of the 8 AQ zones and also failed to identify and factor the larval connectivity and dispersal patterns for the 8 White List species. Therefore, the extent to which the take of aquarium fish curtails "the uses of the environment, including aquatic invasive algae control, the tourism industry, and the overall integrity of diverse aquatic ecosystems," has not been adequately described.

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[93] DLNR 2019; RDEIS at 115.
[94] Schaar and Cox (2021).
[95] RDEIS at 180.
[96] Williams & Walsh (2008); Former aquarium collectors personal communications to R. Umberger (Dec. 16, 2019).

Abundant and diverse coral reefs—put at risk by the Preferred Alternative—have a range of beneficial uses. The RDEIS failed to adequately assess the curtailment of the range of beneficial uses of the environment.[97]

C. HEPA Significance Criteria #3: To the question regarding the extent to which the take of aquarium fish conflicts with the state's long-term environmental goals, the RDEIS wrongly concluded that "the Preferred Alternative does not conflict with the State's long-term environmental goals as established by law."

Among the state's long-term environmental goals, as plainly established in the Hawaiʻi Constitution, are to "conserve and protect Hawaiʻi's natural beauty and all natural resources" for the "benefit of present and future generations."[98] Another of the state's long-term environmental goals is, unsurprisingly, provided for in HEPA itself: to "ensure that environmental concerns are given appropriate consideration in decision making."[99] As an example of how the Applicant's RDEIS conflicts with these goals, the limited temporal scope of the Applicant's impacts analysis and failure to faithfully disclose the full range of impacts caused by the fishery pay no heed to the generational scope of state resource law, and certainly fall short of HEPA's disclosure requirements.

Moreover, the RDEIS failed to appropriately consider the impacts of all alternatives, including the No Action alternative, which is having a beneficial impact in the WHRFMA. For example, the Preferred Alternative would allow 100% of the total allowable take to occur within one AQ zone. The RDEIS failed to analyze the impacts of that level of take in any of the 8 AQ zones and also failed to identify and factor the larval connectivity and dispersal patterns for the 8 White List species. Therefore, the extent to which the take of aquarium fish conflicts with the state's long-term environmental goals has not been adequately described.

D. HEPA Significance Criteria #4: To the question of the impact of the take of aquarium fish on cultural practices in the state, the RDEIS wrongly claimed that "the Preferred Alternative does not substantially affect the economic welfare, social welfare, and cultural practices of the community or State, but plays an important role as a nearshore fishery in the State."[100] The RDEIS failed to describe exactly how the conclusion was reached that the aquarium fishery, whereby 7 people profit through the taking and subsequent diminishment of populations of culturally important species, from culturally significant places, is more important than the cultural practices and concerns expressed by the dozens of people who participated in the CIA interviews.

The RDEIS failed to accurately analyze the impacts of all alternatives, including the No Action alternative, which is having a beneficial impact in the WHRFMA. For example, the Preferred Alternative would allow 100% of the total allowable take to occur within one AQ zone, each of which is comprised of numerous ahupuaʻa. The RDEIS failed to analyze the impacts of that level of take in any of the 8 AQ zones and ahupuaʻa, and also failed to identify and factor the larval connectivity and dispersal patterns for the 8 White List species. Therefore, the impact on cultural

[97] HAR. § 11-200-12(b)(2).
[98] Haw. Const. art. XI, § 1.
[99] Haw. Rev. Stat. § 343-1.
[100] RDEIS at 181

subsistence practices has not been adequately described. Moreover, this misrepresentation of impacts to subsistence resources is then used to dismiss any concerns regarding non-subsistence cultural resources. One of the Applicant's fundamental errors, now and in previous iterations of its HEPA documents, is to equate "cultural impacts" with population counts for specific subsistence species, which is a false equivalency. The Applicant has never seriously addressed the aquarium trade's cultural impacts.

E. HEPA Significance Criteria #8: To the question regarding the cumulative effect of the commercial take of aquarium fish using fine mesh nets when combined with the effects of: the commercial take of aquarium fish by other legal methods; the take of aquarium fish for recreational purposes; and, the commercial and non-commercial take of aquarium fish species for consumption as food, particularly including Achilles Tang and *kole*, the RDEIS wrongly concluded the Preferred Alternative does not involve a commitment for larger actions, because although there is a significant cumulative impact to some White List Species, the Preferred Alternative is not anticipated to be a significant contributor."[101]

The RDEIS failed to accurately analyze the impacts of all alternatives, including the No Action alternative, which is having a beneficial impact in the WHRFMA. For example, the Preferred Alternative would allow 100% of the total allowable take to occur within one AQ zone. The RDEIS failed to analyze the impacts of that level of take in any of the 8 AQ zones and also failed to identify and factor the larval connectivity and dispersal patterns for the 8 White List species. Therefore, the cumulative effect of the commercial take of aquarium fish has not been adequately described.

As described throughout this document, fundamental errors in the RDEIS's impact analyses resulted in failures to properly identify the varied and significant effects of commercial aquarium collection and led to erroneous conclusions and improper evaluations of these HEPA significance criteria.

F. Additional Areas Requiring Further Analysis as Described in the DLNR NOD:

1) "*The FEA identifies the scope of the analysis as one year and states that an EA with updated data and analysis would need to be completed on an annual basis. This improperly segments the analysis which must include the long-term and cumulative impacts over time of aquarium collection*."

   The RDEIS failed to address this issue. See our detailed comment in the section, *Failure to Adequately Analyze Long-Term Impacts*

2) "*We appreciate that as an applicant action, the applicant can propose but not ensure regulations aimed at protecting and restoring populations of aquarium fish. We are interested in proposals for self-regulation by aquarium permit holders which could be incorporated into permit conditions even in the absence of or prior to establishing other regulations to accomplish the same purposes*."

[101] RDEIS at 182

The RDEIS assumed that the Preferred Alternative would be implemented though the aquarium permit terms and conditions.[102] We note here that contrary to DLNRs above statement in the NOD, permit terms and conditions are legally binding, and are not simply a form of self-regulation.

3) "*Overall, we appreciate that certain alternatives have been proposed, but believe they are more appropriately proposed as mitigation measures in an environmental impact statement to mitigate potential environmental impacts, rather than as alternatives in an environmental assessment, which, if implemented, might result in a finding of no significant impact. The Department of Land and Natural Resources is obligated to ensure full analysis under HRS Chapter 343 of potential environmental impacts of its actions in issuing aquarium permits. We believe this is most appropriate in an environmental impact statement.*"

The RDEIS failed to address this issue and proposed no mitigation measures because their flawed analyses led the Applicants to anticipate no impacts to populations of White List Species.

V. Failure to Adequately Analyze and Address BLNRs Reasons for Nonacceptance of First DEIS

The Board of Land and Natural Resources (BLNR), which oversees DLNR, published a Final Environmental Impact Statement (FEIS) Acceptance Determination in which they outlined 14 reasons for their non-acceptance of the Applicant's FEIS for the West Hawai'i Aquarium Fishery. Citing the Environmental Council's determinations that 3 of the reasons were arbitrary and capricious, the Applicant chose to address just 11 of the 14 reasons. The Applicant did so despite our advice to them that because the 3 so-called "arbitrary and capricious" reasons are pending further review by the court and Environmental Council, all 14 should be addressed in the RDEIS.

As detailed below, a surprising number of the reasons for nonacceptance were not resolved in the RDEIS, which continued to fall far short of providing proper analyses, and failed to reach conclusions that are supported by the evidence.

1. *In order to properly assess the likely impact of the proposed take of the aquarium fish, the FEIS should contain a reasonably reliable estimate of the amount of future take.*

The RDEIS met the requirement to estimate the amount of future take, but failed to provide the constraints necessary to properly assess the likely impact. For example, the 246,560 fishes annually allowed under the Preferred Alternative might be taken from all 8 AQ zones within the WHRFMA, or from just one. Taking all 246,560 fishes from just one zone would have a significantly greater impact. This was not properly assessed.

[102] RDEIS at 30.

Commenters have repeatedly explained why this is essential, including in our consultation input to the Applicant, as follows:

"An estimate of the amount of future take should be based upon a proposed maximum level of take, such as a determination of total allowable catch (TAC) for each White List species within a specific aquarium trip report sub-zone [AQ zone], or smaller area."

As described more in item 8. below, TACs should be based upon the unique life history traits of each species, the current status of the target species population within the AQ zone or smaller area (i.e. the impact of historical levels of take on the target species), whether or not a state of natural abundance has been achieved since 2018, and factor larval sources and sinks connected to or within that area.

In addition, to ensure compliance, a catch verification system that does not rely upon funding from the Hawai'i Department of Land and Natural Resources (DLNR) for execution should be proposed.

3. *The existing regulations of the WHRFMA do not contain any daily or annual bag limits other than for the paku'iku'i, a "slot limit" for yellow tang, and a limit on kole over 4"long. To project how many fish are likely to be taken, the FEIS relies completely on the historical catch records of these ten fishers for the forty "White List" species. See Tables 5-2 and 5-11. The FEIS concludes that 160,832 fish would be taken annually, based on the maximum number taken by the ten permittees in any year, during the 2000-2017 period. See §5.4.1.5. The assumption that historical catch records adequately predict the future take has a number of shortcomings.*

   As BLNR noted above, the FEIS concluded that a total of 160,832 fish would be taken annually by the 10 collectors, based on their prior (reported) efforts. Given that the RDEIS set total allowable catch limits for 8 species that amount to an annual total of 246,560 fish, *by 7 collectors*, representing an increase over the prior version of 53.3% in total take, and more than double by each collector, BLNRs concern over the shortcomings surrounding the Applicant's assumption that historical catch records adequately predict future take, were well founded, and we are left to wonder whether this increase might indeed reflect levels of prior unreported take.

8. *In order to assess the likely impact of the take, the FEIS should adequately analyze the sustainable level of take. The FEIS relies on Ochavillo and Hodgson (2006) for the proposition that 5-25% of a population is a sustainable level for annual take. The FEIS has an inadequate justification for the reliance on this publication as the best available science. The FEIS does not provide data for nor statistically analyze the sustainability of that level of take for each type of fish, given each fish species' life span, population size, reproductivity rates and age at first reproduction.*

   The need for DLNR to define "sustainable" as it pertains to the diminishment of Hawai'i's reef wildlife for the pet trade outside the state, cannot be overstated. This must not be left to the Applicant. As a former DAR administrator wrote regarding the notion of "sustainability" and the aquarium trade, "the main management questions remain unanswered. Those questions are:

what does sustainable mean, how do you measure it, what are the management goals, and how do you know if you are meeting those goals."[103]

One method used by fisheries managers bases sustainable levels of catch on the unique life history characteristics of each species, such as described by BLNR above and used by Ochavillo and Hodgson (2006). Another example is an ecosystem-based approach such as was used in a study cited in the RDEIS. That study determined that implementing a minimum size limit and reducing take to no more than 10% of natural biomass of a heavily targeted Caribbean herbivore added enough resilience to coral reefs in that area that they may persist into the future.[104] Absent from each of those methods, however, is a cost and benefit analysis, such as the one referenced earlier for the Hawaiʻi aquarium trade, that equally factors all stakeholders and not just the fishers.

In any case, the RDEIS did not address this point and continued to use the life history characteristics for species not covered under the RDEIS and not occurring in Hawaiʻi (i.e. the Ochavillo and Hodgson manual) to justify so-called "sustainable" collection levels for the White List species, despite the facts that doing so is baseless, unprecedented, and unnecessary, given the decades of aquarium catch and species abundance data at relevant scales, that is available to the Applicant from DLNR. In addition to the detailed input we provided in our consultation letter to the Applicant on this issue, and the extensive comments we provided in the first DEIS on this issue, we note the following here regarding the Ochavillo and Hodgson (2006) manual (emphasis added in all cases):

- "This manual has been developed as a guide for scientists to be able to **analyze ornamental fisheries with limited historical data** and to set total allowable catch limits for targeted ornamental populations" (see Manual, pg. 7)
    - This does not apply to Hawai'i which has detailed historical data on aquarium collecting including reported catch, by zone, and the impacts of that catch, by zone, as compared to natural, unfished abundance.
- "Table 3: Proportion of populations of ornamentals suggested as sustainable collection levels **based on estimated natural mortality rates**." (see Manual, pg. 13)
    - Just 2 of the 33 species included in the table occur in Hawai'i, one of which, the bird wrasse, is on the White list. The Hawaiʻi data is far more relevant.
    - The RDEIS did not calculate natural mortality rates for any of the 8 White List species.

10. *The FEIS has an inadequate discussion of the role of herbivores. Many of the "White List" species are herbivores.*

[103] Miyasaka (2015).
[104] Bozec et al. (2016).

The RDEIS added a section discussing the role of herbivores, but failed to disclose and describe the impact of the Preferred Alternative on herbivore populations.

Abundant populations of herbivorous fishes are critically important to coral reefs. They keep algae from overgrowing corals or preventing new corals from starting. Reductions in herbivore biomass drive an increase of algae abundance. Important families of herbivorous fishes in Hawaiʻi include surgeonfishes, damselfishes and parrotfishes.

Historically 98% of the fishes taken by the aquarium trade in West Hawaiʻi are herbivores, the vast majority of which are surgeonfishes. In the RDEIS, 7 of the 8 species under the Preferred Alternative are herbivores, and they represent >99% of the total allowable take proposed.

Fishing and aquarium collecting are significantly impacting herbivore biomass in West Hawaiʻi: herbivore biomass in MPAs is 70% greater than Open and FRAs.[105] Importantly, the lowest levels are typically found in the Open Areas, which experience extraction pressure from both food fishing and aquarium collection. (See Figure 9).[106]

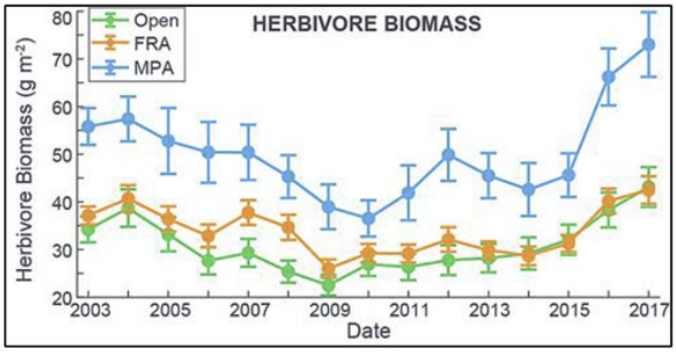
The RDEIS avoided discussing this negative finding through its focus on before-after comparisons using arbitrary dates, and which hid the impacts, as we have discussed in these Comments, at length. Case in point: rather than describing the impacts of decades of aquarium collecting, as we have done in our comments, the RDEIS focused on a DAR statement "that herbivore biomass has not changed since 2003 in the Open Areas or FRAs and has increased by 30.8% in the MPAs," and concluded that it "**indicat[ed] that historic aquarium collection is sustainable,"**[107] a conclusion that was not reached in the DAR document cited.

Moreover, the RDEIS omitted the fact that herbivore biomass is still far below that which is needed to increase resilience and the chances for Hawaiʻi's coral reefs to persist with the climate catastrophe barreling down upon us. The aquarium trade's portion of reef fish biomass removal each year is substantial, and nearly 100% of it is herbivore biomass. Under prior collection rates it averaged 27% of the total reef fish biomass taken annually, and under the Preferred Alternative would represent 21% of the biomass.

Though the RDEIS cited Gove and DLNR 2015, 2019 repeatedly, it excluded the information that unlike the MPAs, herbivore biomass in both FRAs and Open Areas exhibited significant declining long-term trends, and that increases in fish abundance in recent years were likely due to the 2014 fish recruitment anomaly.[108, 109]

Figure 9. Herbivore Biomass in West Hawaiʻi, per DAR WHAP data.[110]

[105] DLNR (2019).
[106] Gove et al. (2019).
[107] RDEIS at 137.
[108] DLNR (2015).
[109] Gove et al. (2019).
[110] Gove et al. (2019).



Additionally, the RDEIS claimed the Preferred Alternative would lessen the impact of aquarium fishing on herbivores by reducing the number of species that can be collected and establishing individual catch quotas for the 8 species on the Revised White List."[111] However, because that statement is inaccurate, and because the direct, indirect, and cumulative/long-term impacts of the proposed level of take are not described in the RDEIS, for the following reasons, it failed to meet HEPA requirements:

- The RDEIS did not quantify the impact of aquarium collecting on herbivores.
- The RDEIS did not quantify the reduced impacts the Applicant claims would occur under the Preferred Alternative.
- Collection of herbivores in any given zone could *increase* under the Preferred Alternative.
- The total allowable catch would be less than reported regularly since 2003, but more than was reported during the prior 27 years.
- The total allowable catch would allow aquarium collectors to take more reef fish from West Hawaiʻi reefs than all food fishers, *combined* (see Table 4).
- Under the Preferred Alternative, aquarium collection would amount to 55.9% of the total number of reef fish and 20.6% of the total biomass taken from West Hawaiʻi reefs, 99.9% of which would be herbivore biomass.

Table 4. Comparison of the number and pounds of reef fish caught by food fishers 2008 - 2011 relative to aquarium collecting under the Preferred Alternative (adapted from DLNR 2019 report to the legislature).[112]

West Hawai`i Reef Fish Catch Numbers

[111] RDEIS at 178
[112] DLNR (2019) at 66.

Recreational	Commercial	Total Food	AQ Preferred Alternative	AQ % of Total
146,176	48,498	194,674	246,560	**55.9%**
Reef Fish Catch Biomass (lbs.)				
153,193	55,468	208,661	54,243	**20.6%**

Further, the RDEIS claimed that collection rates under the Preferred Alternative would be lower than what occurred in the Tissot and Hallacher (2003) study which found no increases in the abundance of macroalgae where the abundance of herbivores was reduced by aquarium collecting.[113] As explained below, that statement is both inaccurate and irrelevant.

During the Tissot survey years of 1997 to 1999, reported aquarium catch averaged about 250,000 fishes each year—not much more than the 246,560 proposed under the Preferred Alternative.[114] The impacts on the reefs were the result of that direct collection pressure combined with the indirect and cumulative impacts of collection pressure over the prior two decades, which occurred during periods of reported catch that was substantially lower, averaging approximately 181,600 fishes annually in the decade prior to Tissot's first survey year and 33,000 fishes annually in the decade before that (see Figure 11).

Therefore, under the Preferred Alternative, collection pressure would be at least as much as, if not far greater than the collection pressure that caused the significant aquarium collecting impacts documented in the Tissot 2003 and 2004 studies.

Further, the RDEIS omitted Tissot and Hallacher's conclusion that their study may not be a good test of that hypothesis for several reasons, including that herbivores taken by aquarium collectors primarily consume filamentous algae (i.e. turf), not macroalgae, and that further investigation is warranted.[115] Additionally, most algal cover in West Hawai'i is from turf algae. Macroalgae accounts for <2% of algal cover in West Hawai'i which renders the referenced study fairly irrelevant regarding algae, although it remains highly relevant regarding reduced fish abundance stemming from aquarium collecting.[116]

Additionally, not only did the RDEIS omit the most important finding in Tissot et al. (2003), while including an irrelevant point regarding macroalgae, it also omitted research documenting that, for over a decade, the Open Areas had the lowest levels of hard coral cover and the highest levels of total algal cover, which is predominantly turf algae (see Figure 8).[117] Total algal cover in the protected areas began significantly increasing following the crash in coral cover that resulted from the 2015 ocean heat wave and coral bleaching event.

[113] RDEIS at 178.
[114] DLNR (2019).
[115] Tissot and Hallacher (2003).
[116] Gove et al. (2019).
[117] Gove et al. (2019).

The RDEIS failed to discuss the relationship between the Open Area high levels of total algal cover, the extent to which the historical removal of hundreds of thousands of herbivores, representing upwards of 74,000 lbs. of herbivore biomass contributed to that algal cover, and how it relates to herbivores and algal cover under the Preferred Alternative.

Further, the RDEIS downplayed the importance of herbivores taken by aquarium collectors, as follows:

- Claimed that the smaller fish, which are the primary targets of the trade, are "the least effective sizes for cropping algae."[118]
- Ignored the fact that juvenile yellow tangs are 56% less abundant in the Open Areas.[119]
- Ignored the research documenting the importance of smaller bodied fish in reef algal consumption.[120], [121], [122]

In doing so, the RDEIS failed to discuss the extent to which aquarium collecting contributes to the total algal cover in the WHRFMA, particularly in the Open Areas.

The RDEIS attempted to downplay the impact of aquarium collecting on surgeonfish abundance with a misstatement from Foo et al. (2020) that, "Surgeonfish biomass declines linked most strongly to changes in reef rugosity."[123] What Foo et al. (2020) actually reported was that grazer (i.e. surgeonfish) biomass *increased* with increasing rugosity and that it "showed the strongest positive relationship with rugosity. However similar relationships with rugosity were seen for all fish functional groups."[124]

Importantly, the RDEIS omitted negative findings that while surgeonfish biomass is significantly decreasing, Foo et al. (2020) documented that grazer biomass was the *greatest* in the areas where aquarium collection was banned.[125, 126] These findings contradict the Applicant's claim that differences in herbivore biomass are not due to aquarium collection, but are due to food fishing.[127]

In 1987, the year when reported aquarium catch exceeded 100,000 for the first time ever, yellow tangs were considered the dominant herbivore in West Hawaiʻi (see Figure 11).[128] The extent to which the reduction in yellow tang abundance on the majority of West Hawaiʻi reefs has impacted the key ecosystem function provided by yellow tangs—under past and future

[118] RDEIS at iii
[119] Gove et al. (2019).
[120] Smith et al. (2001)
[121] Kelly et al. (2017)
[122] Bozec et al. (2016).
[123] RDEIS at 135.
[124] Foo et al. (2020).
[125] DLNR (2019).
[126] Foo et al. (2020) at Appendix S1.
[127] RDEIS at 136.
[128] Eble et al. (2011).

proposed aquarium collection that is 2-3 times higher than it was in 1987—was not discussed in the RDEIS.

Additionally, the RDEIS failed to disclose the beneficial impact of the No Action alternative on the White List herbivores which is occurring as a result of the cessation of legal aquarium collection in the fourth quarter of 2017. The Applicant was asked to include information on the increasing species but did not do so and claimed that information was not available to their knowledge.[129] This, despite the fact that the RDEIS included evidence of those increases for the top 2 most collected species, the yellow tang and *kole*.[130]

If the RDEIS is to be believed, the aquarium trade has not contributed to any of the reduced herbivore abundance and biomass that is so well documented by science. Magically, the 74,000 lbs. of herbivore biomass annually taken by aquarium collectors, which historically amounted to 26% of the total reef fish catch biomass (i.e. including all food fishers) in West Hawai'i, had no effect, whatsoever, and will continue to do so under their Preferred Alternative. Such wishful thinking has no place in an EIS, which requires complete and factual analyses under HEPA.

11. *The FEIS does not adequately discuss relevant negative findings, for example, the reduced numbers of aquarium fish at collection sites found by Tissot and Hallacher (2003). The FEIS need not agree or disprove the negative findings, but it should discuss them.*

The RDEIS did not address this reason for nonacceptance, citing the Environmental Council's determination that it was "arbitrary and capricious," and refused to consider this item because it was under judicial review.

Importantly, the Hawai'i State Environmental Court has since **vacated the Environmental Council's determination** and remanded this specific issue back to the Council for further proceedings. The Applicant's continual failure to address this issue may ultimately be reversed, which would prompt further environmental review.

As Commenters advised in our consultation letter, "the disclosure and discussion of findings contrary to what is claimed by the Applicant (i.e. negative findings), which in many cases are contained within the RDEIS but neither disclosed, nor described, is key to a legal, adequate EIS." Numerous examples are found within the comments we've submitted beginning with the DEA and culminating with our testimony to the BLNR on the FEIS. In addition, comments from others describing other negative findings, and new research that has been published, should also be included. Additional details and examples are provided below.

<u>Examples of Negative findings: Tissot and Hallacher (2003); Tissot et al. (2004); U.S. Coral Reef Task Force; Clark and Gulko (1999); WHAP data 1999 - 2018; Gove et al. (2019):</u>

[129] RDEIS at Appendix B
[130] RDEIS at 118 and 120.

Tissot and Hallacher (2003) sought to quantitively estimate the effects of aquarium collecting on fishes on the Kona coast through a comparison of differences in fish abundance between sites open to collection and control sites where collection is prohibited.[131] They concluded that "aquarium collectors have significant effects on the abundance of targeted fishes on the Kona coast of Hawai'i."

In 2004, building on their earlier work, Tissot et al. reported on surveys from numerous additional sites and concluded that aquarium targeted fishes were significantly less abundant in the Open Areas compared to the MPAs, with differences ranging between 14-97%.[132] They further noted that with two exceptions, the results were "remarkably similar" to their results reported in 2003.[133] In 2005, the U.S. Coral Reef Task Force described those results as follows: "Severe overfishing for aquarium trade occurs even in the United States: Aquarium fishes outside of reserves [in West Hawai'i] experience significant declines – from 14% to 97%."[134] Similarly, per a DLNR report on the state of Hawai'i's reefs, on Hawai'i Island, aquarium collecting was have a major impact and was one of the main causes of coral reef degradation.[135]

The aquarium collecting effects they documented are presented below (see Table 5 and Figure 10). Table 5 presents the effects alongside the WHAP data from 2017/2018 for the same species, two of which are among those proposed for the new White List in the RDEIS. As shown in the table, aquarium collecting continues to have a significant effect on targeted species, even after the 2014 anomalous surge in fish abundance and the cessation of legal collection as of the fourth quarter of 2017.

Table 5. Effects of aquarium collecting on seven heavily collected current White List aquarium species. The negative percent indicates reduced abundance at collection vs. control sites.[136]

	DLNR WHAP Open/MPA Difference **2017/2018**	Tissot et al. (2004) Open/MPA Difference **1999**	Tissot & Hallacher (2003) Open/MPA Difference **1997/1998**
Achilles Tang	64%	-56%	-58%
Potter's Angelfish	+3%	-42%	-46%
Multiband Butterflyfish	+3%	-4%	-38%
Fourspot Butterflyfish	-30%	-97%	-42%
Kole	-34%	-14%	-15%
Longnose Butterflyfish/Forcepsfish	-53%	-55%	-54%
Yellow Tang	-49%	-43%	-47%

[131] Tissot & Hallacher (2003).
[132] Tissot et al. (2004).
[133] Ibid.
[134] U.S. Coral Reef Task Force, Trade Subgroup Report (2005).
[135] Clark and Gulko (1999).
[136] DLNR (2019) and Tissot et al. (2004).

Figure 10. Effects of aquarium collecting on nine heavily collected aquarium species. Significant declines, ranging from 14% - 97%, were seen in 7 of 9 species.[137]

Taxa	This Study	Tissot and Hallacher (2003)
Acanthurus achilles	−56*	−58*
Centropyge potteri	−42*	−46*
Chaetodon multicinctus	−4	−38*
Chaetodon ornatissimus	−7	−39*
Chaetodon quadrimaculatus	−97*	−42*
Ctenochaetus strigosus	−14*	−15
Forcipiger spp.	−55*	−54*
Zanclus cornutus	−49*	−46*
Zebrasoma flavescens	−43*	−47*
Overall	−26*	

Note: Statistical differences in density between reference and FRA sites were tested using a two-sample *t*-test (* = significant at $P < 0.05$). Mean estimates are compared with the study of Tissot and Hallacher (2003), which estimated the effects of aquarium collectors on these species in a previous study in West Hawai'i.

Importantly, the collection impacts reported by Tissot in both papers resulted, at least in part, from collection rates that were substantially *lower* than the 246,560 total allowable take proposed under the Preferred Alternative, which is contrary to the assertion made in the RDEIS that collection was *higher* under Tissot.[138]

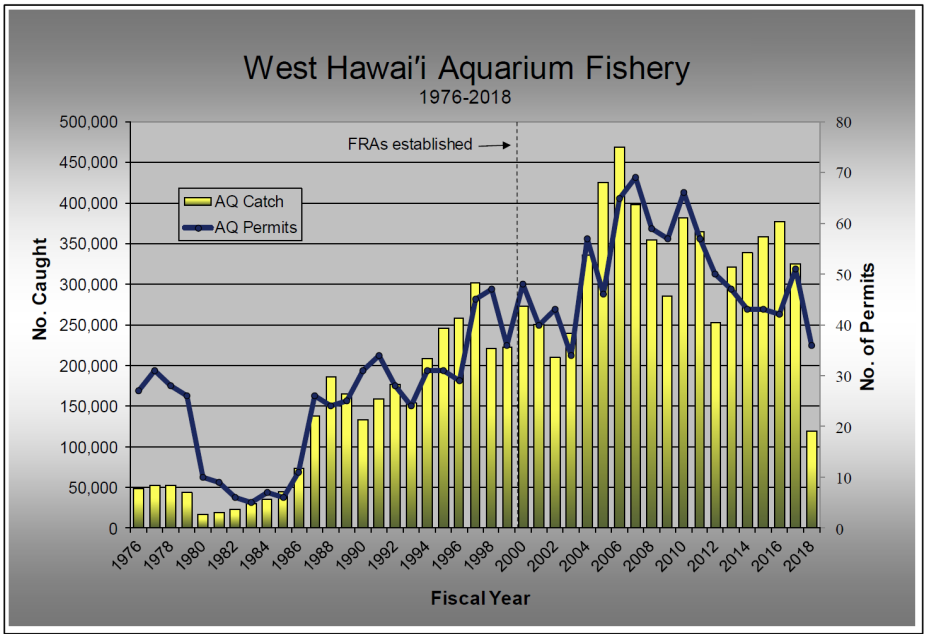
During the Tissot survey years of 1997 to 1999, reported aquarium catch averaged about 250,000 fishes each year—not much more than the 246,560 proposed under the Preferred Alternative.[139] The impacts on the reefs were the result of that direct collection pressure combined with the indirect and cumulative impacts of collection pressure over the prior two decades, which occurred during periods of reported catch that was substantially lower, averaging approximately 181,600 fishes annually in the decade prior to Tissot's first survey year and 33,000 fishes annually in the decade before that (see Figure 11). Therefore, under the Preferred Alternative, collection pressure would be at least as much as, if not far greater than the collection pressure that caused the significant aquarium collecting impacts documented in the Tissot 2003 and 2004 studies.

Additionally, as early as the mid 1980's, when reported catch had yet to exceed 100,000, aquarium collecting impacts were already noticeable to dive tour operators, who in 1987 negotiated a voluntary agreement with the trade to refrain from collecting in certain areas.[140]

[137] Tissot et al. (2004).
[138] RDEIS at 178 and 179.
[139] DLNR (2010).
[140] DLNR (2010) at 3.

Therefore, the Applicant's claim that "commercial aquarium collection under the Preferred Alternative is anticipated to have minimal impacts on populations in general" is unsupported by both scientific and anecdotal findings summarized in this section which unequivocally show that aquarium collecting at rates similar to or less than proposed in the RDEIS, significantly impacts targeted populations in West Hawai'i.[141]

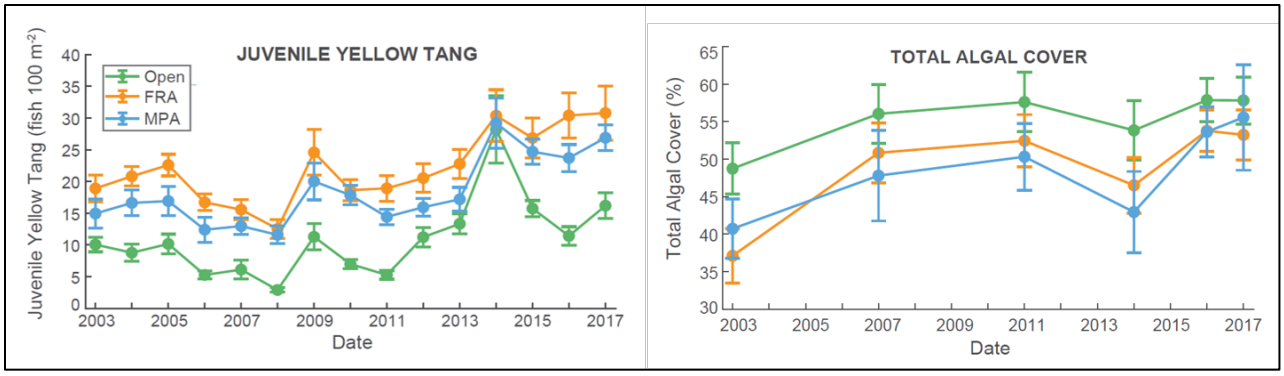
Figure 11. Number of aquarium animals collected and number of commercial aquarium permits in West Hawai'i for Fiscal years 1976-2018.[142]



The RDEIS cited Gove et al. (2019) numerous times, but omitted highly relevant, although negative, findings, such as the significant impacts of aquarium collection on the most heavily targeted fish, the juvenile yellow tang. Gove reported that juvenile yellow tangs in the MPAs and FRAs are 66% and 90% more abundant than in the Open Areas (i.e. 56% less abundant in the Open Areas), a difference that increased from 2003 to 2017.[143] The RDEIS also failed to discuss the extent to which the significantly reduced abundance of juvenile yellow tangs in the Open Areas has contributed to the significantly increased total algal cover in those same areas (see Figure 12).

Figure 12. Juvenile yellow tang abundance and total algal cover in West Hawai'i, per DAR WHAP data.[144]

[141] RDEIS at iii and 178
[142] DLNR (2019).
[143] Gove et al. (2019).
[144] Gove et al. (2019).



Ignoring the negative findings, the RDEIS instead provided the statistic that juvenile yellow tangs significantly increased by 60.8% in the Open Areas between 2003 and 2017, and although that before-after comparison uses arbitrary dates that do not represent a time before aquarium collecting (a problem throughout the RDEIS).[145] This is another example of the RDEIS omitting negative findings which are based upon the same data and found in the very reports and studies it uses to make claims and inferences that aquarium collecting does not impact targeted fish species.

Further examples of negative findings occur throughout these Comments and include data and conclusions found in these studies and reports: Bozec (2016); DLNR (2004, 2010, 2015, 2019); DLNR Species of Concern; DLNR/South Kohala Reefs in Dire Straits; Schaar and Cox (2021); Williams and Walsh (2007).

12. *The extreme threat of climate change on our reefs warrants extreme caution in reviewing activities that may affect them. The FEIS should further discuss potential effects of present and future levels of climate change including ocean warming, ocean acidification, coral bleaching, extreme storms, and resulting reef destruction and algae growth, and the potential for mitigating harm (i.e. further regulation) if the proposed fishery has unanticipated or greater negative effects with climate change.*

The RDEIS failed to adequately evaluate the extreme threat to targeted fish species and coral reefs from the combination of aquarium collection and climate change. The RDEIS recognized that climate change poses serious threats to Hawai‘i’s coral reefs and the species targeted by the Applicant, claimed that “the Preferred Alternative was specifically designed to help buffer climate change by creating individual catch quotas,” yet failed to quantify and evaluate the impacts of the Preferred Alternative which includes the annual removal of 246,216 herbivores—representing 20% of the total reef fish biomass taken annually from West Hawai‘i reefs—from reefs located in areas ranging in size from 1 to 8 AQ zones.[146]

Further, the RDEIS completely ignored a key aspect of this nonacceptance item: a discussion or proposal for mitigation in the event of unanticipated or greater than anticipated negative

[145] RDEIS at 159.
[146] RDEIS at 184 and 197.

impacts from aquarium collecting stemming from climate change. For example, under the Preferred Alternative, should climate change result in habitat destruction (e.g. from storms, ocean heat waves, or acidification) or reduce the abundance of any of the White List species, during any permit period, nothing prevents the 7 aquarium collectors from focusing all of their effort in a single zone, or from removing all of any given species (in a "get it while you can" mentality).[147] As we explain elsewhere, this is not mere speculation, as it has already happened on O'ahu. The RDEIS did not address this, although further analysis of impacts and exacerbation of impacts due to climate change is required, as is mitigation.

One such mitigation measure might be, for example, a proposal for minimum thresholds for coral cover, total algal cover, species abundance, and herbivore biomass, which when crossed, as indicated by WHAP monitoring, would automatically trigger the closure of the impacted zone(s) and/or set the total allowable catch to zero for the impacted species until the population is restored.

13. *The FEIS failed to sufficiently consider cultural impacts. The FEIS improperly concluded that the impacts to cultural resources under any of the proposed alternatives would be less than significant based on the flawed premise that cultural impacts would only occur if the proposed action would cause a significant decline in the population of a White List Species considered to be a cultural resource. A number of testimonies expressed misgivings from a cultural standpoint with the proposed activity itself, regardless of impact on resources, and this was not adequately considered in concluding no significant impact.*

    See pages 28, 31; and, Section VII. Flawed Analysis of Cultural Impacts and Lack of Proposed Mitigation Measures

VI. <u>Further Impacts Inadequately Analyzed</u>

Environmental impacts from aquarium trade activities have been documented for over forty years. Under the Preferred Alternative, which lacks take limits tied to specific sites, major impacts, with potential catastrophic effects to the 8 White List species could still occur within any of the 8 AQ zones and countless smaller bays and reefs that make up the WHRFMA.

As has been long recognized,

> The impact of commercial aquarium fish collecting is a complicated issue. The fish community members are highly dependent on one another. There is a constant interaction between predators and competitors, as well as other members of the food web. There is a lot of variability in the system, even when it is not disturbed by man. Reefs seem to undergo natural cycles. At times they may be very abundant. There is also natural variation in the fish community at different locations.[148]

[147] Friedlander et al. (2008); Stevenson et al. (2011).
[148] Noland (1978).

The RDEIS failed to assess the high aesthetic value of this beautiful marine life as well as impacts to the complex relationships inherent in coral reef ecosystems and impacts to overall coral reef health. "Animal communities" are included in the rule definition for "environment," however the RDEIS excluded any mention of the impact to fish and invertebrate communities, or the impact to the animals themselves.

A. Damage to Reef Habitat

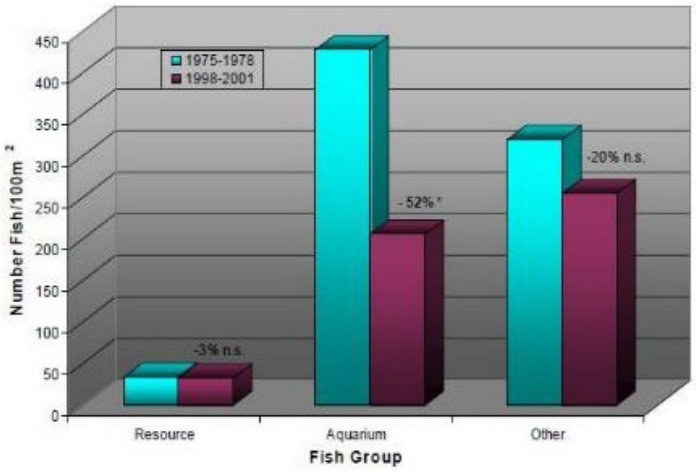
In nearly every encounter with commercial aquarium collectors on West Hawaiʻi reefs, snorkelers, and divers have witnessed and documented destructive practices that harm corals, with the most damage coming from vessel anchors and chains. Additionally, nets, weighted with lead, are placed in the corals, materials mimicking sand is laid on top of corals, sticks are hit against corals to chase the target fishes into the nets, buckets, underwater propulsion devices (scooters) are laid in the corals and the fins, knees and legs of collectors often come in contact with the reef—in fact, they are typically described as "crawling across" or "standing" on the corals. Furthermore, for two of the White List species, the Chevron Tang and Potter's Angelfish, capture frequently involves the use of sticks which are thrust into fragile finger coral habitat in order to flush out the hiding fish.[149] The results of these actions include abrasion and coral breakage. The RDEIS referred to a study that determined there was no evidence to indicate the presence of destructive fishing practices (e.g. breaking apart corals to capture hiding fishes) from just two sites.[150] However, there is an abundance of photographic evidence documenting coral breakage from vessel anchoring and fish capture activities that means these impacts cannot be dismissed and must be evaluated in the RDEIS. Photographs of these practices and their effects can be found at Appendix 2.

B. Examples of Impacts in Various Hawaiʻi Island Regions

Baseline fish population data from the 1970's at Honaunau in West Hawaiʻi were compared to data gathered in surveys conducted 1998 – 2001. The results indicated that nearly all small bodied surgeonfish, butterflyfish and angelfish (i.e. species targeted by the aquarium trade) declined in abundance. Commercial aquarium collecting was implicated in the decline (see Figure 13).[151] Similar results were found at Keʻei where the site had been intermittently surveyed since 1979.[152]

Figure 13. Comparison of various fish functional groups at Honaunau over two survey periods. [153]

[149] Stevenson et al. (2011)
[150] RDEIS at 178.
[151] Williams & Walsh (2007).
[152] Williams & Walsh (2007).
[153] Williams & Walsh (2007).



"Of the 20 most collected aquarium species, 18 declined in abundance with the species facing the heaviest fishing pressure typically showing the greatest declines."[154]

In addition to documenting the impact of aquarium collecting in these areas, these studies also document baselines for abundance levels of aquarium targeted and other impacted species. Examinations of reported catch, as documented by DLNR, serve to further highlight the impacts of the trade. [155] The documentation shows that the initial surveys were conducted during a time when the aquarium trade reported taking fewer than 33,000 fish annually from West Hawai'i reefs. In subsequent years, from 1987 to the final surveys in 2001, reported aquarium fish catch in West Hawai'i had skyrocketed to an annual catch of more than 218,000 individuals, on average. Since then the annual West Hawai'i aquarium fish catch has ranged between 250,00 and 550,000 fish.

Under the Preferred Alternative, 246,560 fish could be taken, making this especially relevant. Additionally, with the closure of approximately 32% of the reefs in West Hawai'i with the implementation of the FRAs in 2000, this increased fishing pressure was focused in smaller areas with likely intensified results. The RDEIS failed to acknowledge this example of significant aquarium collecting impact in these areas.

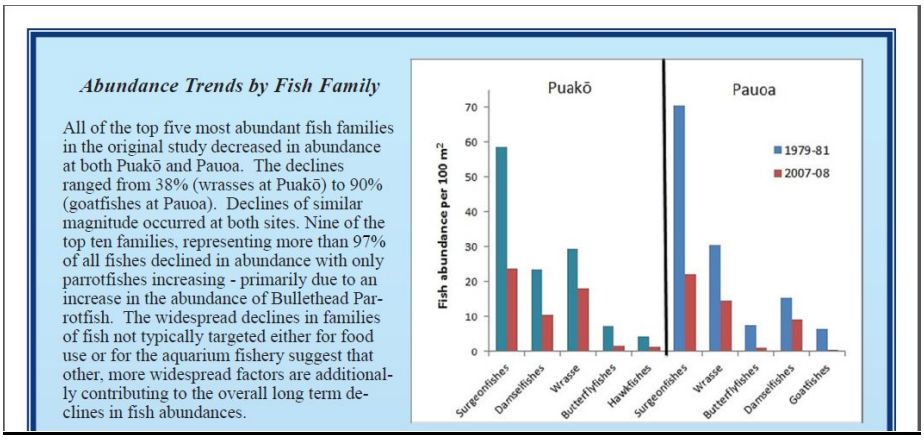
Another long-term study looked at reefs in South Kohala and determined that reef fish abundance was in "drastic decline" and reefs were in "dire straits".[156] Populations of all of the top five most abundant fish families had declined since the original surveys conducted in 1979-1981 (see Figure 14). Thirty-one of the thirty-five most abundant fish species had declined, including 19 species targeted by the aquarium trade. Most of the aquarium targeted species had declined by more than 50% and many were down by more than 80%.[157] The extent to which the massive increase in reported take contributed to this decline was not studied in the RDEIS. Nor was this reduced fish

[154] Williams & Walsh (2007).
[155] DLNR (2019).
[156] Walsh (2013).
[157] Walsh, unpublished data used as background in South Kohala Reefs in Walsh (2013).

abundance factored into the Preferred Alternative with zone and site-specific take limits to address these situations.

As the Applicant noted in the FEISs' responses to this comment, DLNR reported that "given the length of protection at these sites and the overall decline in habitat quality and fish populations in South Kohala it seems unlikely that the declines are due *primarily* to aquarium collecting." [158][emphasis added] Rather than rebutting the argument that further analysis is needed, this statement only served to highlight why the RDEIS needed to *also* evaluate the potential of cumulative impacts of other factors (e.g. pollution, and sedimentation) on targeted fish species, such as decline of coral coverage, which have been demonstrated to influence reef fish species diversity and abundance.[159] Here, too, the flawed analyses failed to accurately identify impacts.

Figure 14. Drastic declines of the most abundant fish families at two South Kohala Reefs.[160]



The areas south of these reefs are subject to some of the most intense aquarium collecting pressure in the state. Aquarium take between Keahole Point and these reefs in South Kohala, in one year alone, exceeds the aquarium take from the entire Great Barrier Reef in Australia, which has a reef area that is 300 times larger than Hawai'i's. For example, in 2014 aquarium collectors reported taking 191,083 fish from the two zones that make up this area. [161] By comparison, 2014 reported aquarium take from the Great Barrier Reef was 112,000.[162] Under the preferred alternative, all 246,560 could be taken from just one of these zones, with disastrous consequences.

The Dire Straits study also documented a 90% decline in herbivorous surgeonfish and damselfish populations, while parrotfish populations had actually increased over time.[163] That 90% decline in herbivores contributed to a 35% reduction in coral cover, a 64% reduction in coral building coralline algae, a 38% increase in algae at one site and a staggering 322% increase in algae at another. Claims by the Applicant that parrotfishes are more important herbivores than

[158] FEIS at pdf 1748
[159] Jones et al. (2004); Friedlander et al. (2018).
[160] Walsh (2013).
[161] DLNR Aquarium Catch Reports.
[162] Queensland Summary Fishery Reports.
[163] Walsh (2013).

surgeonfishes when it comes to keeping algae in check on coral reefs are challenged by this study given the parrotfish increases. On these South Kohala reefs, the increased parrotfish populations were not enough to offset the loss of surgeonfishes and damselfishes, and the algae still outcompeted the corals. The notion that surgeonfishes taken by the aquarium trade are not an important component to coral reef health is challenged by this study.

Further, a more recent assessment of ecosystem trends in West Hawaiʻi includes, among other data, the differences in herbivore biomass and coral cover between reefs on the northern portion of the West Hawaiʻi coast (which encompasses the South Kohala area described above and extends from Keahole Point, northward) and reefs on the southern portion (from Keahole Point, southward).[164] The data shows that herbivore biomass in the north is significantly lower than that found on the south.[165] Additionally, while the northern reefs are now dominated by algae, and coral cover has declined by ~30%, the same not true for the southern reefs.[166] Notably, though the northern area is ~33% smaller than the area to the south, catch reports do not indicate a corresponding reduction in take. In fact, in 2014 take was higher in the north than in the south.[167] The extent to which heavy collection pressure in the north has contributed to this shift was not addressed in the RDEIS. Neither does it propose any mitigation or plan to prevent it from worsening.

C. Examples of Impacts to White List Species

The selection criteria used to determine the species for inclusion on the revised white list is highly problematic because it ignores the impacts to species that have occurred from decades of aquarium collecting that occurred without HEPA review. Here again, the RDEIS relied upon a before-after comparison using an irrelevant 'before' date that reflected the start of the WHRFMA, rather than the start of aquarium collection impacts on those species.

Additionally, it included species that did not meet all of the criteria. For example, Black Surgeonfish only meet the criteria related to Open Area population density using the data from 2017/2018 which incorporated years when they were not facing collection pressure. Using years when they faced heavy collection pressure such as 1999/2000 and 2012/2013, their Open Area population density was 0.17 and 0.25/100m^2, well below the 0.5 fish/100m^2 threshold in the criteria.

The RDEIS stated that "populations of the eight species on the proposed Revised White List are not anticipated to substantially decline under the Preferred Alternative," which is a misleading statement that omitted the fundamental facts that they are currently in significant decline as a result of aquarium collection (see Table 1). [168]

Aquarium collectors in West Hawaiʻi historically took 1.8X more reef fish than recreational and other commercial fishing combined, most of which were yellow tangs and the results of that heavy collection pressure are described throughout these comments.[169] Under the Preferred Alternative,

[164] Gove et al. (2016).
[165] Gove et al. (2016).
[166] Gove et al. (2016).
[167] DLNR Catch Reports
[168] RDEIS at iii.
[169] DLNR (2019).

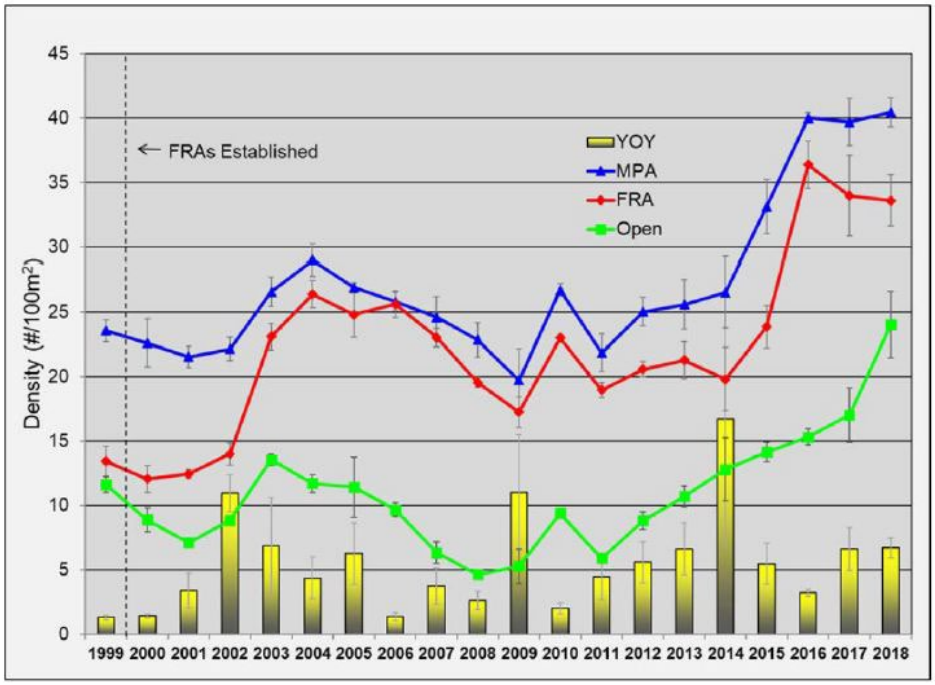
200,000 yellow tangs would be taken annually, and although the Applicant claimed it would not cause a substantial decline in their abundance, in part because it's lower than prior collection pressure, it's important to note that in 2002, the last time approximately 200,000 yellow tangs were taken, their abundance in the Open Areas was 9/100m^2, which is below the 2018 levels of 24/100m^2, and even farther below their natural abundance of 40/100m^2 as of 2018 (see Figure 15).[170]

The majority of West Hawai'i reefs are open to the aquarium trade and subject to diminishment by the trade. For example, the reduction in yellow tang abundance is apparent below in the large gap between the green line (Open Areas) and blue line (MPAs which serve as a proxy for natural abundance) and which represents millions of missing yellow tangs on West Hawai'i reefs. (see Table 1 and Figure 15).[171]

Further countering the Applicant's claim of no substantial decline is, the increase in FRA yellow tang abundance that began in 2003, three years after establishment of these replenishment areas, and the increase in Open Area abundance that began in 2017 after the cessation of aquarium collecting throughout West Hawai'i. These clear examples help to reveal the impacts of the trade on natural populations: when collection pressure was removed, populations significantly increased. As noted earlier, those increases are separate from the overall increase in yellow tang abundance that have occurred since 2014 is due to the anomalous recruitment pulse that coincided with warming waters in 2014.[172] Typical recruitment pulses, such as those that occurred in 2002 and 2009, have resulted in short-lived increases in fish populations that were followed by prolonged or short and steep population declines (see Figure 15).

Figure 15. Overall changes in yellow tang abundance 1999-2018. [173]

[170] DLNR catch reports.
[171] Tissot & Hallacher (2003); Tissot et al. (2004); DLNR (2019).
[172] Gove et al. (2016).
[173] RDEIS at 118.



D. Failure to Assess Impacts to Aesthetic Value

In addition to the impacts to biodiversity, ecosystem function, and other fisheries, aesthetic and other social values are also heavily impacted.[174] Species experiencing the heaviest collection pressure, with a corresponding reduction in natural abundance, are Hawai'i's most beautiful, charismatic and iconic fishes. The diminished aesthetic value from the cumulative and substantial reductions in species such as yellow tangs, butterflyfishes and Moorish Idols, which are dominated by vibrant yellows and oranges and striking white and black patterns, cannot be overestimated (see Figure 16).

Figure 16. Reefs lacking yellow and orange fishes are greatly diminished in beauty.

[174] Walsh, Background on Proposed Hawai'i Administrative Rule 13-60.4 (2013).

These colors are more than aesthetically pleasing, as our eyes are physiologically attuned to them. The frequencies and wavelengths of yellows, oranges and reds allow them to strike our eyes much faster than the other colors.[175]

By removing the species with prominent yellow, orange, red or white coloration and markings, the palette and very essence of what makes a coral reef beautiful to the human eye is diminished and degraded. It is impossible to decrease populations of a coral reef's beautiful wildlife without greatly decreasing the natural beauty of the place. Divers who have frequented these coral reefs, such as some of the Commenters, have noticed decreased abundance of colorful fish in recent years. The RDEIS failed to address these cumulative losses and propose proper mitigation measures.

E. Failure to Assess Impacts to Recreational Value

The RDEIS failed to acknowledge and address the effects of the trade on the recreational value of this marine life and their coral reef homes and propose proper mitigation measures. The annual estimated expenditures related to marine life viewing (i.e. snorkeling and scuba) in Hawai'i is $551 million. Reef-adjacent marine tourism expenditures (including hotel rooms) within 30 km of the coastline are an annual $680 million.[176]

These amounts exclude the lost value from declining fish abundance which is captured in willingness to pay surveys and summarized below:

- Healthier reefs lead to substantial economic gains.
    - Recreational users are willing to pay higher rates for a healthier marine environment.[177]
    - Snorkel/dive businesses benefit when there are more fish for their clients to see.[178] One recent study showed divers were willing to pay $93 to $110 more to dive with abundant fish life. [179]

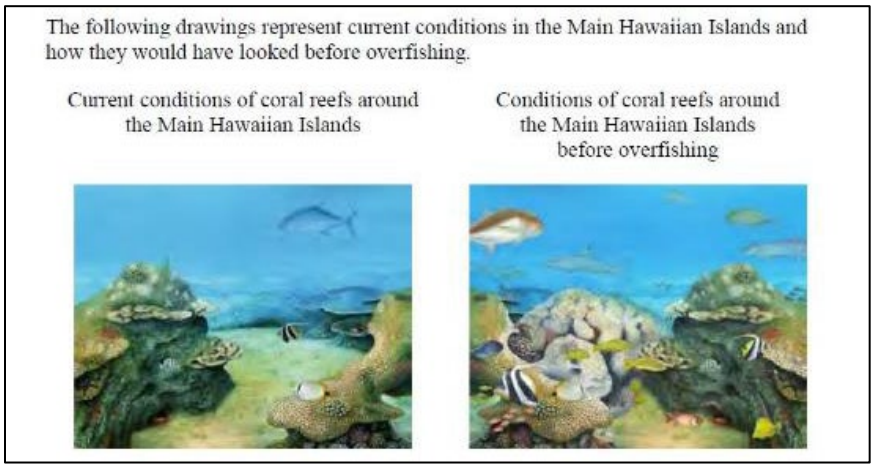
[175] Slembrouck (2011).
[176] Spalding (2017).
[177] Davidson et al. (eds.) (2003); FORCE Management Brief #4 for Caribbean Reef Management (P7/2007-2013).
[178] Davidson et al. (eds.) (2003).
[179] FORCE Management Brief #4 for Caribbean Reef Management (P7/2007-2013).

- Without new regulations the potential for increasing losses is real.
    - Inability to stem declining reef fish numbers could cause significant losses to dive tourism industry (i.e. reductions in willingness to pay).[180]
    - These consumer surplus losses could range from $1.2 million to $12.2 million annually.[181]
    - Areas with degraded reefs and low fish populations could also see significant losses from a decrease in their share of the global dive market.[182]
    - Anecdotal reports from long-time residents and visitors point to revenue loss already occurring from reduced abundance of beautiful fishes on Hawai'i reefs.

F. Failure to Assess Impacts to Passive Use Value

The RDEIS failed to acknowledge and analyze the effects of the trade on the substantial non-use values of this marine life and their coral reef homes and propose proper mitigation measures. Intrinsic and social values associated with coral reefs are diminished by reduced fish populations. Concern for the marine environment has increased in recent years and people now place tremendous value on coral reef ecosystems. Many people value beautiful and healthy coral reef ecosystems as part of their legacy and responsibility to ensure future generations are able to experience them. A 2011 NOAA report estimated the passive use annual value of Hawai'i's coral reef ecosystems through a willingness to pay survey of U.S. households. The survey included a visual representation of an overfished and an abundant coral reef (see Figure 17).

Figure 17. Visual representation of an overfished vs. an abundant coral reef.[183]



The project determined that increased protections and restoration of degraded coral reefs in Hawai'i is worth about $288 to the average U.S. household which aggregated over all U.S. households amounts to a $34 billion annual passive use value for Hawai'i's coral reefs.[184] This and

[180] FORCE Management Brief #4 for Caribbean Reef Management (P7/2007-2013).
[181] FORCE Management Brief #4 for Caribbean Reef Management (P7/2007-2013).
[182] FORCE Management Brief #4 for Caribbean Reef Management (P7/2007-2013).
[183] Bishop et al. (2011).
[184] Bishop et al. (2011).

other socio-economic values described here provide meaningful insights into the public's concerns and should be addressed in a comprehensive RDEIS.

G. Failure to Assess Impacts to Aquatic Life Post Capture

A major factor that drives the rates of collection is premature mortality rates in captivity. According to a long-time industry insider, most yellow tangs die within the first month in a hobbyist tank and fewer than 1% of those captured survive one year in captivity, although in the wild their lifespan is upwards of 41 years.[185, 186]

One of the core requirements of the aquarium collection statute is that aquatic life taken under the permit is maintained alive and in reasonable health.[187] The RDEIS included a discussion on the post-collection mortality as an indirect effect. The RDEIS claimed that no post-collection data are available for fish collected in Hawai'i.[188] However, as described below, that statement is incorrect:

- A 2012 study of the aquarium trade included a consumer survey and an aquarium trade supply chain analysis. Hawai'i's yellow tang ranks among the top ten fish sold in the marine aquarium trade and was included in both aspects of the study.[189, 190] In addition to 72 species that do not occur in Hawai'i, the analysis included Hawai'i's yellow tang and 12 additional species taken by Hawai'i aquarium collectors which also occur elsewhere in the Indo-Pacific. The analysis determined that mistreatment in capture, handling, transport, and holding plays a larger factor in these premature deaths rather than hobbyist inexperience.[191]
- A 2002 study documented mortality rates self-reported by Hawai'i aquarium collectors and dealers:
    - 0.5 – 2% during collection; 0 - 1% from collection to wholesaler; <1% - 2% in wholesaler tanks; .75% - 2% during shipping.[192]
    - Aquarium catch reports differences between numbers caught and sold indicate that an average of 3% of captured fishes die at this stage of the chain of custody.[193]
- Wholesalers receiving fish from Hawai'i have reported a similar average "dead on arrival" rate of 0 - 3%, and note that the industry standard is to allow up to 5% to arrive dead with no charge-back to the shipper for losses.

Per Commenter's original consultation letter, we continue to assert the Applicant must provide the average and maximum annual mortality rates for the 8 White List species fish taken by each of the 7 collectors in order for DLNR to fulfill its statutory duties to exercise discretion in granting permits. Without this information the state has no way of assessing whether these permittees are

[185] Fenner, FAQs About Yellow Tangs 4; Fenner. Marine Life Use in the Aquarium Hobby.
[186] Claisse et al. (2009).
[187] HRS § 188-31
[188] RDEIS at 153.
[189] DLNR Aquarium Catch Reports; Rhyne et al. (2015).
[190] Cartwright et al. (2012) at 119, 123, 125, 131, 136, 137.
[191] Cartwright et al. (2012).
[192] Dierking (2002).
[193] DLNR Aquarium Catch Reports

responsible aquarium collectors that deserve these exclusive privileges. Furthermore, the public needs this information, as well, which is one of many reasons why withholding the identities of the 7 collectors until publication of the FEIS is unacceptable.

A number of practices frequently utilized as cost saving measures by the aquarium trade in Hawaiʻi are inhumane and significantly contribute to the stressors that accumulate and ultimately lead to premature deaths of captive marine life. One such practice is the rapid surfacing of fish from the reef depths to the surface which causes an injury known as barotrauma that may impact the internal organs, eyes and brains of fishes. The fish captured by Hawaiʻi collectors typically are "partially decompressed with the *residual trauma* relieved by purging air from the fish's swim bladder using a hypodermic needle." (emphasis added)[194] The purging of residual air from fish swim bladders is a technique known as "fizzing" among trade members. Per a marine aquarium trade best practices manual, "the use of a sharp instrument to deflate the swim bladder, a procedure known as "fizzing," or "needling" is not advisable."[195] Instead, the best practice calls for the following: "When collecting fishes deeper than 30 feet (10m), raise holding containers at a rate no faster than 3 feet every 10 minutes."[196]

In addition to being ill-advised, and traumatic to the animal, by knowingly and recklessly causing substantial bodily injury, it is also illegal according to Hawaiʻi's misdemeanor animal cruelty statute, which provides protections for all non-human animals.[197] Further, the fact that collectors use practices that *cause* barotrauma counters the assertion made in the RDEIS that collectors use methods that *avoid* barotrauma.

Other harmful practices include starving fish for 2 – 10 days prior to transport, and spine cutting, both of which are prohibited under the animal cruelty statute. Alternatives to these practices include withholding food for no more than 48 hours and transporting fish in larger volumes of water to dilute any waste produced by fishes during transport, and transport in hard plastic containers that cannot be punctured by fish spines.

Every fish who dies early results in additional pressure then put on natural resources though the take of their replacements. There is a general consensus in many countries that it is not ethical to trade in live animals, unless their health and welfare are ensured. These unnecessary and early deaths have given the trade a poor image. A $20 million, multi-stakeholder reform effort, referred to as the Marine Aquarium Council, failed, in part, because of the trade's reluctance to address, and take steps to reduce, mortality rates.

Among the 8 White List species in the Preferred Alternative, two, the endemic Potter's Angelfish and the Black Surgeonfish (aka Chevron Tang), are sold through online retail outlets without the minimal and standard "arrive alive" guarantee that is provided to most species (see Appendix 3).

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[194] Stevenson et al. (2011).
[195] Cohen et al. (2010).
[196] Cohen et al. (2010).
[197] HRS § 711-1109

They are considered by many trade members as species unsuitable for the hobby due to their especially high mortality rates during their first month in captivity. For example:

- Potter's Angelfish was described by one industry expert as "doomed despite anything you might be able to provide or do."[198]
- Potter's Angelfish is said to suffer from Post Traumatic Shipping Disorder (PTSD, aka Delayed Mortality Syndrome) which "affects a large number of seemingly well-adjusted fish who die suddenly, days or weeks after transport."[199] The cause may be inadequate nourishment during a period of significant (stress-induced) metabolic demand.[200]
- "Unfortunately, the Potter's is very prone to loss [without] much notice. Most die 'mysteriously' during the night. . . 'Looking perfectly fine' the day before. Following up on the issue of PTSD, the species is simply given to a low tolerance to stress."[201]
- "Historically the Potter's angel has a lousy survival record in captivity. Likely less than five percent are alive within one month of capture. . . Most of this attrition can be traced to damage in collection (getting thrashed by nets, their gill/opercular spine getting caught in netting), holding (totally unnatural "cubicle" settings or mixed in with fishes with no cover to hide in), shipping in too small bags . . . Along with dealers' and hobbyists practiced ignorance in keeping the species in inappropriate settings."[202]

Further, the conditions described above (e.g. injury during collection, holding in unnatural "cubicle" settings, shipping in too small bags), and more, apply to all wild marine life captured for the aquarium pet trade. This helps explain why the remaining 6 White List species are sold without guarantees to stay alive beyond arrival or purchase for amounts of time ranging from 0 to 14 days. For example, saltwater fish at Petco stores are sold with zero guarantee to stay alive and purchases are nonrefundable, while freshwater fish are sold with a 30-day guarantee to stay alive, and Petco will "gladly refund your money" if they die within that time frame.[203]

Aquarium collectors and dealers need only to get these animals on a plane and out of Hawaiʻi in order to profit. The next level of profits flow to PIJAC members throughout the rest of the country (e.g. marine life wholesalers) who need only to sell these animals to the retailers, who, in turn, need only sell them to the hobbyist. At each of these steps, the risk of premature death to these animals is passed on to the buyer, and in any case, research shows that each step in the supply chain significantly profits from customer purchases to replace fish that die prematurely, and that profits from replacement fish sales are so high, sellers have no incentive to take action to reduce deaths.[204]

The inherent harm, disrespect, and waste of Hawaiʻi's precious reef wildlife, that goes hand-in-hand with their capture and sale for profit in the pet trade, creates ethical and cultural conflicts that have

[198] Fenner, Potter's Angel
[199] Lidster (1999).
[200] Lidster (1999).
[201] Fenner, Potter's Angel
[202] Fenner, Potter's Angel
[203] Petco, Returning Items Purchased at Petco; Returning Live Aquatics
[204] Cartwright et al. (2012).

has long been a point of contention between Hawaiʻi residents and the Applicant. For example, as noted by Tissot (2005) regarding conflicts with native Hawaiian culture:

> "*Malama aina* involves asking permission prior to fishing, taking only what you need, sharing your catch with your extended ʻ*ohana* or community and having respect for the sacredness of the process. Clearly, harvesting live fish for economic gain and shipping them in a bag for a long, convoluted odyssey, potentially resulting in mortality and waste, violates the very core of these traditional values."[205]

The RDEIS failed to accurately describe the impacts to the White List species during and post-capture, and failed to provide mitigation measures to meaningfully reduce those impacts. Further, the RDEIS failed to describe why the Applicant's desire to profit from 4,376 Potter's angelfish, 3,152 black surgeonfish, 5,872 orangespine unicornfish, 30,000 *kole*, 344 bird wrasse, 2,016 Thompson's surgeonfish, 800 brown surgeonfish, and 200,000 yellow tang—nearly all of whom will die prematurely from the stress of captivity—is more important than their value to the reef and their value to Hawaiʻi residents.

VII. <u>Flawed Analysis of Cultural Impacts and Lack of Proposed Mitigation Measures</u>

As set forth in HAR §§ 11-200-10, 16-18, a complete analysis and discussion of impacts to cultural resources is required. The RDEIS failed to accurately analyze the direct, indirect, and cumulative impacts on cultural resources, because it (1) fundamentally failed to accurately assess the reductions in fish abundance, and (2) artificially narrowed the scope of cultural impacts disclosed. The loss and harm caused by the irrevocable commitment of natural resources equally applies to impacts to cultural resources, as well. The RDEIS also failed to acknowledge and address the effects of the trade on native Hawaiian's traditional reliance on species targeted by the trade for subsistence, and most importantly, propose proper mitigation measures.

Decades of the Applicant's actions have directly impacted more than 200 species and indirectly impacted an unknown number of additional vertebrate and invertebrate species found in Hawaiʻi's coral reefs, one of the most complex ecosystems on Earth, where the fate of each species is determined by the existence, abundance and diverse actions of a multitude of other species that inhabit or otherwise rely upon these unique places.

While the CIA provided an extensive history of native Hawaiians and their symbiotic relationship with the ocean and its animal inhabitants, it completely dismissed the overwhelming oral testimonies in opposition to[206] both past and current trade practices and impacts.

More than 90 percent of those interviewed noted how the trade both directly and indirectly impacts their cultural resources, beliefs, practices and values, yet none of these concerns were addressed and no mitigation measures were proposed.

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[205] Tissot (2005).
[206] CIA at 104.

The CIA also failed to propose any substantive mitigation measures to address the biological and various socio-economic impacts to cultural resources and the ethical concerns and harm done to the animals, themselves.

The CIA initially acknowledged "*As stated in the OEQC Guidelines for Assessing Cultural Impacts, the goal of the oral interview process is to identify information 'relating to the practices and beliefs of a particular cultural or ethnic group or groups' (State of Hawai'i, Office of Environmental Quality Control 2012:11). It is our contention that, in addition to assessing the significance of any identified traditional cultural properties, oral interviews should also be used to augment the process of identifying traditional cultural properties*."

Thus, it is the researcher's responsibility to utilize the gathered cultural-historical background information, as well as the information collected through the consultation process, to identify and describe potential cultural impacts to resources, practices, and beliefs, **and to propose appropriate mitigative measures for those impacts as necessary.**

The RDEIS further stated: "*As discussed in Section 4.2, detailed in the CIA, and mentioned by commenters during the comment periods of the previous EA and FEIS, many of the 40 White List Species* ***have a cultural significance*** *in Hawai'i, and* ***there are distinct differences between the traditional Native Hawaiian approach to fish harvest and management and the western model approach***" (emphasis added).[207]

However, the above statements and subsequent lack of proposed mitigation measures, do not reflect these findings. Fifty-five individuals were consulted for the CIA, 50 of whom voiced strong concern with the trade.

The false equivalency declared in the CIA and parroted by the Applicant in its RDEIS is that "…if the issuance of commercial aquarium permits leads to a significant depletion of the populations of the above-mentioned species (either directly or indirectly through habitat disruption), then the result would be a cultural impact. Conversely, if the biological assessments (conducted by others) indicate that the issuance of the fourteen commercial aquarium permits will have no significant effect on either the fishes or their habitat, then the issuance of the permits would not result in a cultural impact."(emphasis added)[208]

Cultural impacts cannot be assessed only by counting fish.

As well as unreasonably constraining the range of metrics by which cultural impacts may be evaluated, the biological assessments used to arrive at those metrics and analyze the impacts of the trade are extremely flawed, thus, the conclusion that the issuance of 14 permits will have no significant impact, is equally flawed, and barely begins to paint a picture of the trade's impacts to cultural resources.

[207] RDEIS at 108.
[208] CIA at 135.

We continue to agree with a number of concerns earlier raised by DLNR, and respectively, the Office of Hawaiian Affairs (OHA):[209]

"*Cultural impacts of aquarium fishing need significantly more analysis than provided in the FEA. The OEQC guidelines should be followed for assessing cultural impacts, including consulting with traditional cultural practitioners and other knowledgeable informants and sources about cultural resources, cultural practices, and the proposed action's potential impacts. Traditional Hawaiian practices and subsistence uses, local place-based and life-cycle knowledge, and traditional Hawaiian cultural significance of each type of aquarium fish taken should be reviewed.* ***The indirect impact of modem technologies for highly efficient catch methods on traditional harvest capabilities should be included in the analysis."*** (emphasis added)

The RDEIS failed to respond to our questions regarding what type of gear/nets that are currently being used to collect animals (outside of fine mesh nets). The CIA failed to include a discussion on gear types or recommend any regulations or prohibitions on the use of aquarium collection gear, that allows for the take of hundreds more animals per day, than if using traditional subsistence fishing methods. Further, there is no discussion about additional species take-prohibitions, bag limits (less reducing the daily bag limit of Achilles Tang from 10 to 5), "pono" fishing practices, the foundation of which is taking only what is needed, or a discussion on "resting" (closing) certain areas from commercial extraction.

OHA also states it "*anticipates that the RDEIS will include a broader scope of analysis and* ***include a consideration of all consequences on the environment, including both direct and indirect effects,*** *in accordance with Hawai'i Administrative Rules § 13-200-17(i)…*" yet the scope of the discussion of impacts is limited to 14 collectors who made up nearly 80 percent of the total catch even in years when not all 14 collectors were reporting take. The CIA also failed to include any legally required proposed mitigation measures, to address cumulative (past, present, and reasonably foreseeable future) impacts to cultural resources.[210]

In yet another gross contradiction, the CIA states that: "*According to those guidelines: In scoping the cultural portion of an environmental assessment, the geographical extent of the inquiry should, in most instances, be greater than the area over which the proposed action will take place. This is to ensure that cultural practices which may not occur within the boundaries of the project area, but which may nonetheless be affected, are included in the assessment. (State of Hawai'i, Office of Environmental Quality Control 2012:11) For this reason, for assessing the potential cultural impacts of the issuance of fourteen commercial aquarium permits within the WHRFMA, the entire fishery management area along the* ***western coast of Hawai'i Island*** *is considered, not just those areas within which commercial aquarium fishing will be permitted. To Hawai'i's host culture, the ocean is viewed as an integrated whole, flowing unrestrained by politically imposed boundaries…*" but failed to consider the impacts to the entire island of Hawai'i, including the East side of the island which is seeing increased take rates from those seen in the past, with no disclosure or discussion of current

[209] CIA at 4; 2019 DEIS at 359.
[210] 2019 DEIS at 359.

gear-take methods, or the impacts of reducing species in one area impacting their health and abundance in other areas.[211]

The CIA concludes with the following inadequate and/or unmeasurable recommendations, that in no way could be considered substantive mitigation measures, especially based on the numerous oral interviews and testimonies proposing a full closure of the trade or significant remedies to past and continuing conflict:

"*It is clear that the nearshore waters of West Hawai'i Island, along with all of its contributing tangible and intangible elements and associations, could be considered a traditional cultural property significant under Criteria a, b, and e. Having a comprehension of the traditional cultural significance of nearshore waters of West Hawai'i Island by all of its user constituencies, is a first step in ensuring that the activities of any one user group does not in any significant way conflict with the activities of another user group. As part of any future permitting processes associated with the WHRFMA**, it is recommended that DLNR-DAR provide to potential permit issuees a document that provides a synopsis of the traditional cultural significance of the fishery***" (emphasis added).[212]

It is woefully inadequate to attempt to simplify this complex issue by only providing collectors with "a" document. There is no way to ensure that collectors even read the document let alone take any actions not to impact cultural resources, beliefs and practices.

The CIA then states: *"… the authors recommend that PIJAC, and any commercial aquarium fishers who intend to conduct their operations within the WHRFMA,* ***consider developing or partnering with governmental and/or local organizations to help improve the management and sustainability of the nearshore fishery as a means to not only sustain, but actually improve reef-fish populations in the take areas . . .*****"** (emphasis added).[213]

The CIA notes that aquarium collectors should "*consider developing or partnering with governmental and/or local organizations to help improve management and sustainability of the nearshore fishery . . .*" yet failed to provide even the most basic information, timeline, or explanation as to how any partnership would proceed. The CIA further states the hope of improving reef-fish populations in the take areas, yet goes on to support the status quo, "*it is recommended that the existing bag limits and no-take areas within the WHRFMA remain in-place . . .*".[214]

The CIA adds *"Furthermore, it is recommended that the applicant (PIJAC) continue to work with the approving agency (DLNR), and the various other user groups within the WHRFMA, to* ***help improve the transparency of the accounting methods for fish takes, and the enforcement of the existing rules and regulations that govern those takes****. With respect to limiting the potential for cultural impacts, DLNR-DAR plays a significant role in managing and enforcing the rules and regulations that are intended to support the sustainability, viability, and fecundity of the WHRFMA . . ."* yet provides no information or guidance on actually improving the transparency of catch/accounting records and

[211] CIA at 4.
[212] CIA at 135.
[213] CIA at 135.
[214] CIA at 135.

enforcement. This approach removes any all responsibility and accountability from the collectors and offers no solutions to the issues of enforcement, compliance and oversight.[215]

The CIA continues, "*As voiced by many of the consulted parties, the lack of support and funding have hampered DNLR DAR's ability to fulfill its fiduciary responsibility, namely to enhance, protect, conserve, and manage Hawai'i's unique and limited resources, which are supposed to be held in public trust for the current and future generations of the people of Hawai'i nei, and visitors alike. While achieving this goal is not an easy task, and it certainly cannot be achieved by any single means,* ***DLNR-DAR should be proactive in seeking additional funding sources, and work with the various user groups who are most familiar with the WHRFMA, including the commercial aquarium fishers, to improve its enforcement capacity.***" (emphasis added) [216]

Again, this empty statement provides no information on mitigation measures, including proposed regulations, or funding sources, that could encourage better compliance or enforcement.

Finally, the CIA notes "*As expressed by multiple community members, the lack of enforcement by DLNR-DAR has resulted in community members feeling the need to police their respective areas themselves, which ultimately diverts time and energy from their desire to educate the next generation of Hawai'i and to perpetuate their own cultural practices. As part of improving enforcement, as expressed by some of the consulted parties, the* ***DLNR-DAR should consider incorporating more traditional Hawaiian fishery resource management practices (as detailed above) into the management of the WHRFMA, and representatives from the aquarium fishing industry should continue to work with the other user constituencies*** *(i.e., native Hawaiian organizations) that maintain an interest in the WHRFMA*" yet failed to include any discussion on what, if any, traditional Hawaiian fishery resource management practices should be considered, when they might be considered or how.[217]

In summary, the CIA remains extremely flawed and inadequate, with its inherent purpose—to identify the full range of potential cultural impacts and propose mitigations measures to limit such impacts—not being met.

VIII. <u>Additional Deficiencies</u>

A. <u>Lack of Meaningful Alternatives Analyses</u>

The RDEIS failed to describe the potential effects on the environment or provide meaningful and accurate analyses for any of the alternatives, both proposed and dismissed, because it used an incorrect and irrelevant baseline, hypothetical scenarios, expanded spatial scales, and omissions of essential data in its analyses.

The Revised White List and Limited Permit Issuance Preferred Alternative is not reasonable, as is required by HEPA.[218] The Preferred Alternative ignores the vast majority of the input and

[215] CIA at 135.
[216] CIA at 135.
[217] CIA at 136.
[218] HAR § 11-200-10(7).

comments submitted throughout this process by the Commenters and Consulted Parties, as well as the many public comments naming locations where the impacts of collecting pressure are of concern. Contrary to what is claimed in the RDEIS, this alternative does not ensure the Applicant's Actions do not lead to degradation of fish populations and the habitats in which they occur, and does not specifically addresses concerns related to declining populations and sustainable collection.[219]

A reasonable alternative would require the Applicant to first determine:

1) the life history, spawning grounds and offspring/recruitment patterns for each species to be collected for aquarium purposes;
2) natural abundance (i.e. unfished) levels and complete stock assessments, for each AQ zone, for those same species (see DLNR map of aquarium trip zones at Appendix 4);[220]
3) a definition for "sustainable" as it relates to the natural abundance of coral reef species taken in Hawaiʻi for aquarium purposes; and
4) annual total allowable catch, by species, designed to restore and then sustain natural abundance levels, with negligible impacts as defined in the Queensland Ecological Risk Assessment of the Marine Aquarium Fish Fishery, for each species to be taken for aquarium purposes, in each zone.[221]

After making these necessary threshold determinations, the Agency would issue up to 7 Aquarium Permits, by zone and by species with corresponding total allowable catch limits, per the above parameters.

Another example of a reasonable alternative would be a moratorium on the take of herbivores, which was considered but dismissed in the RDEIS, based on an erroneous and outrageous claim that aquarium collection is not causing a decline in herbivores.[222] As described above, aquarium collection certainly is contributing to the reduced herbivore biomass in the Open Areas as shown by the herbivore biomass in the MPAs which is far greater.

Furthermore, the costs to administer the aquarium trade was omitted from analyses of the alternatives, including the No Action Alternative, which would incur costs associated with enforcement, as indicated by the 3 cases and 8 individuals in 2020 alone who were involved with large scale poaching in West Hawaiʻi. DLNR has estimated that the costs to administer the aquarium trade, including resource monitoring, but excluding enforcement, ranges from $300,000 to $500,000 annually, statewide.[223] Additionally, DLNR has estimated that commercial fisheries cost the state $1,000,000 annually, above and beyond license fees, which amounts to approximately $333 per commercial marine license.[224] All of those administrative costs and their funding sources, together with enforcement costs and funding sources, should be described for each alternative.

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[219] RDEIS at 30.
[220] DLNR Aquarium Fish Trip Report.
[221] *See* Roelofs (2008) for a useful guide for describing the range of impacts to populations of target species in marine aquarium fisheries.
[222] RDEIS at 32.
[223] Schaar and Cox (2021).
[224] DLNR Submittal to BLNR (2020).

Moreover, the No Action Alternative was not analyzed or described properly. Obvious beneficial impacts to populations of targeted species have occurred since the cessation of aquarium collection in 2017. Data presented in the RDEIS included some of those benefits, but it was not described as such or analyzed.

Additionally, that information was requested of the Applicant in the consultation letter, and the Applicant responded in the RDEIS that the information is not available to their knowledge.[225] Commenters are left to assume that the Applicant did not actually attempt to obtain the information, because we requested, and received, a subset of that data for 2019 from DAR. Since then, DAR has conducted WHAP surveys for 2020, as well. Describing the beneficial impacts of the No Action Alternative, rather than pretending that they don't exist, is required under HEPA.

B. Lack of Mitigation Measures

HEPA also requires an EIS to consider mitigation measures, however, such a discussion is plainly absent from the RDEIS.[226] Decades of Applicant actions have directly impacted the 8 White List species in addition to the more than 200 other fish species previously collected; and, indirectly impacted an unknown number of additional vertebrate and invertebrate species found in West Hawai'i's coral reefs, one of the most complex ecosystems on Earth, where the fate of each species is determined by the existence, abundance, and diverse actions of a multitude of other species that inhabit or otherwise rely upon these unique places.

Further, collection rates under the Preferred Alternative are higher than those that occurred in the 1970's when a decline in yellow tang and other reef species was reported by the Division of Fish and Game (now DLNR); and, higher than those that occurred in the 1980's when conflicts arose between marine tour operators and aquarium collectors as the trade expanded and conservation concerns increased; and, higher than those that occurred through much of the 1990's, just prior to the Tissot studies that found aquarium collecting was significantly impacting populations of targeted species.

Yet, the RDEIS claimed the Preferred Alternative is not anticipated to cause population declines and, therefore, proposed no mitigation measures.[227] Such an outrageous claim is made possible only through the deeply flawed impact analyses presented throughout the RDEIS that rendered invisible the significant impacts that are evident and have been so for decades.

The flawed impact analyses also led the RDEIS to omit any proposals to mitigate the biological and related impacts to the various socio-economic values, to cultural resources, and to address the ethical concerns, violations of Hawai'i's animal cruelty statute and harm done to the animals, themselves, described herein.

C. Inadequate Consultation

[225] RDEIS at pdf. Pg. 372
[226] HAR § 11-200-10(7).
[227] RDEIS at 152 and 177.

The Applicant failed to conduct the required early consultations prior to submitting its Draft and Final Environmental Assessments, despite the HEPA requirement that the Applicant must "at the earliest practicable time, . . . consult with . . . those citizen groups and individuals which the approving agency reasonably believes to be affected."[228] In this case, it is clear from the long history of litigation that Commenters, at the very least, should have been consulted. The Applicant should also have consulted native Hawaiian groups (outside of those contacted as part of CIA).

To this end, we expected the Applicant to comply with the requirement "to develop a fully acceptable draft EIS prior to the time the draft EIS is filed with the office, through a full and complete consultation process, and shall not rely solely upon the review process to expose environmental concerns."[229]

Further, we expected our substantive comments on the first DEIS to be incorporated and our January 2021 consultation to be responded to in writing and incorporated into the RDEIS by the Applicant prior to the filing of the RDEIS with DLNR and Office of Environmental Quality Control. We also expected that the responses would not be merely self-serving recitations of benefits and/or rationalizations of the proposed actions. However, these expectations were not met. See Appendix 1 for a detailed description of how the Applicant's responses to the questions we raised during consultation process were inadequate.

IX. Enforcement and Compliance

The Certificate of Origin proposed in the RDEIS to allow for better tracking and enforcement amounts to a small step in the right direction but is rife with issues that must be addressed to ensure compliance. In its current form the Certificate of Origin is little more than a duplication of the existing permit system which is easily manipulated. For example:

- Collectors must already report their catch; and name the dealer sold to.
- Dealers must already report purchases from collectors.
- Hawaiʻi Department of Agriculture must already inspect and approve shipments (inter-island).

Gaping holes in process and resources facilitate the intra and interstate movement of unreported, uninspected, unidentified coral reef wildlife in the aquarium trade. For example, DLNR lacks the resources and capacity to enforce these existing requirements via real time comparisons of catch records and dealer reports. Additionally, the Hawaiʻi Department of Agriculture (HDoA) inspectors have been video recorded giving collectors the green inspection tags without even leaving their offices to look at the boxes. In another recorded incident, a green tag was simply taped to the outside the door for a collector to pick up, without any direct contact between the inspector and the collector.

Moreover, collectors and dealers can easily conspire to ensure that sales records match purchase records, given they share the same interest in protecting profits. There is nothing that would

[228] HAR § 11-200-9(b)(1).
[229] HAR §11-200-15.

prevent collectors and dealers from continuing to conspire through underreporting, or nonreporting, to ensure any quota is not met, so that collection and profits can continue.

Adequate enforcement to ensure compliance is best handled by DLNR and DOCARE, not HDoA. Given the loopholes in the Applicant's plan, and the decades-long compliance issues, we propose the following inspections by DOCARE officers and DAR staff to ensure compliance:

- Upon return to harbors or ramp facilities (date/time confirmed in advance): DOCARE verification of required licenses and permits; zone where collection occurred (per vessel GPS); species and numbers collected; fish mortalities; and, next immediate destination (i.e., warehouse, holding facility).
- At warehouses/holding facilities (unannounced): DOCARE inspections to ensure terms and conditions of the aquarium permit which requires the animals to be held in good conditions, to verify equipment (tanks, oxygen levels) are functioning and maintained, that record keeping, and reporting requirements are being met, including catch and sales reports, and verify mortality.
- At air cargo carriers (date/time confirmed in advance): DOCARE inspections of containers to be transported off-island and packing lists (or similar document) to verify number and species, and destination/receiver information. Forward federal Lacey Act documentation, labeling and other potential violations to USFWS.
- Administrative (monthly): DAR inspections and comparisons of collector catch reports, dealer reports and packing lists/invoices to ensure accurate accounting; and coordination with DOCARE to ensure catch quotas are not exceeded.
- State and Federal Taxes: additional permit term and condition requiring tax clearance certificates for state and federal taxes prior to issuance of permit.

Permittees would bear the full burden of expenses associated with needed staff through fees to the state. Costs related to the Certificate of Origin and enforcement measures described above should be calculated and obtained from DLNR. Additionally, DLNR has estimated the current costs to administer the aquarium trade (statewide), including resource monitoring in West Hawaiʻi at $300,000 to $500,000 annually, statewide.[230] Permit fees should be collected that meet those costs, in addition to the commercial fisheries shortfall related to the permittees under the Applicant's proposal, and all resources needed to ensure compliance with species, catch numbers, catch locations, and all other terms and conditions, as outlined above.

X. <u>Conclusion</u>

For the reasons explained above, the RDEIS was patently insufficient in its analysis of the impacts of commercial aquarium collection permits. Therefore, as the impacts remain unevaluated, so too, are the alternatives and the mitigation measures necessary to eliminate, reduce, and rectify those impacts.

The legislature has decreed it the "policy of the State" that DNLR and other agencies must "[c]onserve natural resources . . . by preserving or augmenting natural resources, and by

[230] Schaar and Cox (2021).

safeguarding the State's unique natural environmental characteristics . . . ."[231] The Agency must also "[e]ncourage management practices which conserve . . . all natural resources," and encourage all individuals "to fulfill the responsibility as trustees of the environment for the present and succeeding generations."[232] In enacting HEPA, the State legislature found "that the quality of humanity's environment is critical to humanity's well-being, [and] that humanity's activities have broad and profound effects upon the interrelations of all components of the environment . . . ."[233] The Agency simply cannot meet these mandates by allowing any aquarium collection resulting from this flawed evaluation, in light of the serious environmental consequences of those permits that have yet to be accurately described by the Applicant.

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[231] Haw. Rev. Stat. § 344-3(1).
[232] Haw. Rev. Stat. § 344-4(2)(A), (10)(A).
[233] Haw. Rev. Stat. § 343-1.

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Appendix 1.

Outstanding Questions from Consultation

Despite our objections to this flawed process, we submitted the below comments and questions to Stantec in an effort to inform and improve the RDEIS and ensure that they were thoroughly evaluating the environmental impacts of this proposed action pursuant to HEPA. Stantec responded to some of our concerns and questions, however, a number remain unanswered.

Therefore, below are our **outstanding questions** and in red, those questions that were inadequate in their response, or were not answered. Stantec's responses are italicized:

1. What are the **environmental benefits** of the No Action Alternative? Specifically, as of December 2020, which White List species experienced population increases in the Open Areas, relative to the FRAs and MPAs, compared to their January 2018 abundance levels and what was the extent of those increases? What is the estimated increase in biomass for the herbivorous species among that group?

Inadequate response.

Response: "To the Applicant's knowledge, this information is not available.".

We assume that the Applicant did not actually attempt to obtain the information, because we requested, and received, a subset of that data for 2019 from DAR. Since then, DAR has conducted WHAP surveys for 2020, as well. The Applicant failed to describe the environmental benefits of the No Action Alternative.

2. Have any of the individuals been charged with any offense related to the aquarium trade or occurring during the course of aquarium trade activities, or county or state natural resource related offenses? If so, include date, offense and outcome of each offense. Five aquarium collectors have been cited and convicted with poaching related activities. Are or were any of these collectors current or prior Applicants?

No response.

3. How will the 14 applicants 1) specifically comply with the following recommended actions, and, given the extremely limited enforcement resources and capabilities of DLNR, 2) how do they propose to show compliance with these recommended actions?

    - Reduce or stop taking herbivorous fishes such as surgeonfish which are needed to keep algae growth under control so as not to smother and kill corals stressed from bleaching
    - Avoid touching, standing in corals
    - Keep vessel anchors and chains off corals

Inadequate response.

Response: "As stated in the RDEIS, damage of coral will continue to remain unlawful. The new Preferred Alternative limits collection of aquarium fish to just 8 species, and the RDEIS includes an

expanded discussion on the role of herbivores and specifies which of the 40 White List Species are herbivorous."

The Applicant failed to provide any information on *how* the 7 collectors would comply or show compliance with DLNR's recommended actions.

4. DLNR, specifically the Division of Aquatic Resources and their enforcement arm, the Division of Conservation and Resource Enforcement (DOCARE) has severely restricted resources, such as inadequate staff and funding for enforcement, and there are current statutory restrictions on searches of certain containers carrying marine life and certain vessels.

   How do the individuals/applicants propose that enforcement will be achieved on any proposed limits to their activities, including verifiable compliance with current administrative rules, and state and federal laws, including those listed below. How are the individuals/applicants currently complying?

   - Federal Lacey Act requirements USC Title 16
   - Hawai'i Misdemeanor Cruelty to Animals statute HRS 711-1109

Inadequate response.

Response: The Applicant proposed a Certificate of Origin, which as we describe above, is a step in the right direction, but still has a number of shortcomings that need to be addressed if meaningful compliance and enforcement is to be achieved. However, the Applicant failed to describe how the individuals would comply with Hawai'i's Misdemeanor Cruelty to Animals statute HRS 711-1109, which prohibits, among other things, causing substantial injury to animals or starving them. Animals are defined in HRS 711-1100 as "any non-human animal."

5. Though we requested it, the FEIS failed to include data and records which are not readily accessible to the public and other interested parties. Please provide the necessary data and response to the following to address our outstanding concerns with enforceability of the above-referenced laws specifically as it relates to animal health, welfare and mortality rates:

   a) For each individual, please provide the following regarding the fishes they captured for aquarium purposes each month from October 2017 to the present:

   - The number of fishes sold to marine dealers on Hawai'i Island, and their identities
   - The number of fishes sold and shipped intrastate to a marine dealer(s) on another island, and their identities
   - The number of fishes shipped interstate or internationally and the identities of the purchaser(s)
   - The mortality rates for each shipment (a) upon arrival and (b) at 14 days post-shipment

No response.

   b) For each of the applicants please note whether they are also a marine dealer, and if so, provide the names and CMLs of those they have purchased fish from since 2000. For individuals who are not marine dealers, provide the names of the entities they sell their catch to, inside and outside the state;

No response.

c) For each of the applicants, please note which collectors engage in the following practices:

- Withholding of food (starvation) and for what period of time;
- Fizzing or puncturing of the swim bladder;
- Cutting of spines or dorsal fins;
- Body compression (squeezing animal to forcibly eject fecal matter).

No response.

6. Aside from reducing the bag limit of Achilles Tang, Stantec failed to respond to any of the above questions. Further, they premise their Preferred Alternative on rules, regulations or legislative changes that the Applicants are not in a legal or policy position to change. Only DLNR, with public input, could make the changes necessary to amend or create a new permitting process to limit statewide issued aquarium collection permits (issued under HRS 188-31) to a specific geographic area and change the West Hawai'i aquarium permit process to limit issuance to only 14 individuals. No other case is known where a proposed alternative subject to HEPA is contingent upon a state action(s) that has yet to be undertaken. A proposed action or alternative must be described in its entirety and cannot be broken up into component parts, as suggested in the preferred alternative that has yet to be initiated if at all. Per HEPA this could be considered a phased project (involving a later phase that cannot be fully described) or "segmenting", which is generally forbidden under HEPA.

   This proposal further exemplifies the flawed process as the Applicants are proposing policy and legal changes that have yet to be implemented and are subject to the public input process and other approvals (BLNR, DLNR, state legislature). On pages 17-18 of the RDEIS Stantec *states "The Applicant has no legislative or regulatory authority and cannot create, eliminate, or alter conservation areas (e.g., MPAs, FRAs, MLCDs); create, eliminate, or alter current regulations (e.g., bag and size limits, season length, permit term); or change reporting requirements. Despite this, during the public comment period on the Draft EA Draft Environmental Impact Statement Alternatives 18 that was published on April 8, 2018,* ***in response to DLNR concerns and in coordination with the DLNR, the Applicant developed an alternative that required regulation creation by DLNR*** *(i.e., implementation of bag limits)."*

   Please clarify if DLNR-DAR coordinated with and made any commitments to the Applicants about undertaking such regulatory/statutory changes, without notifying the public about such proposed actions, that must be disclosed immediately.

Inadequate/no response.

Appendix 2

All photos courtesy of Paul Cox.

Aquarium Collecting Vessel Anchored off Black Rock Caves, North Kohala 2011

Aquarium Collecting Vessel Anchored off Papa Bay, Milolii, February 2014: prior coral damage apparent in trench adjacent to current anchor location; newly broken coral indicated by bright white pieces.

Aquarium Collecting Vessel Anchored off Papa Bay, Milolii, March 2014 (same vessel as in images for Feb. 2014).

Aquarium Collecting Vessel Anchored off Papa Bay, Milolii, September 2014: (different vessel from Feb/March photos).

Aquarium collectors crawling through coral wearing knee pads. Note: none of these divers are wearing buoyancy control devices—used to maintain neutral buoyancy above the coral—which are standard equipment for recreational scuba divers. Instead they use a backpack designed to contribute to negative buoyancy, along with weight belts.

Fins, sticks, nets, buckets in the coral

Appendix 3

Arrive Alive/Stay Alive Guarantee Restrictions on Two White List species:

Potter's Angelfish: No guarantee to arrive alive

https://www.freshmarine.com/potter-angel.html

Fresh Marine
www.freshmarine.com

Fast FREE Premium Shipping on order over $500

Live Stats: 681 Live Stock and 6268 Dry Goods

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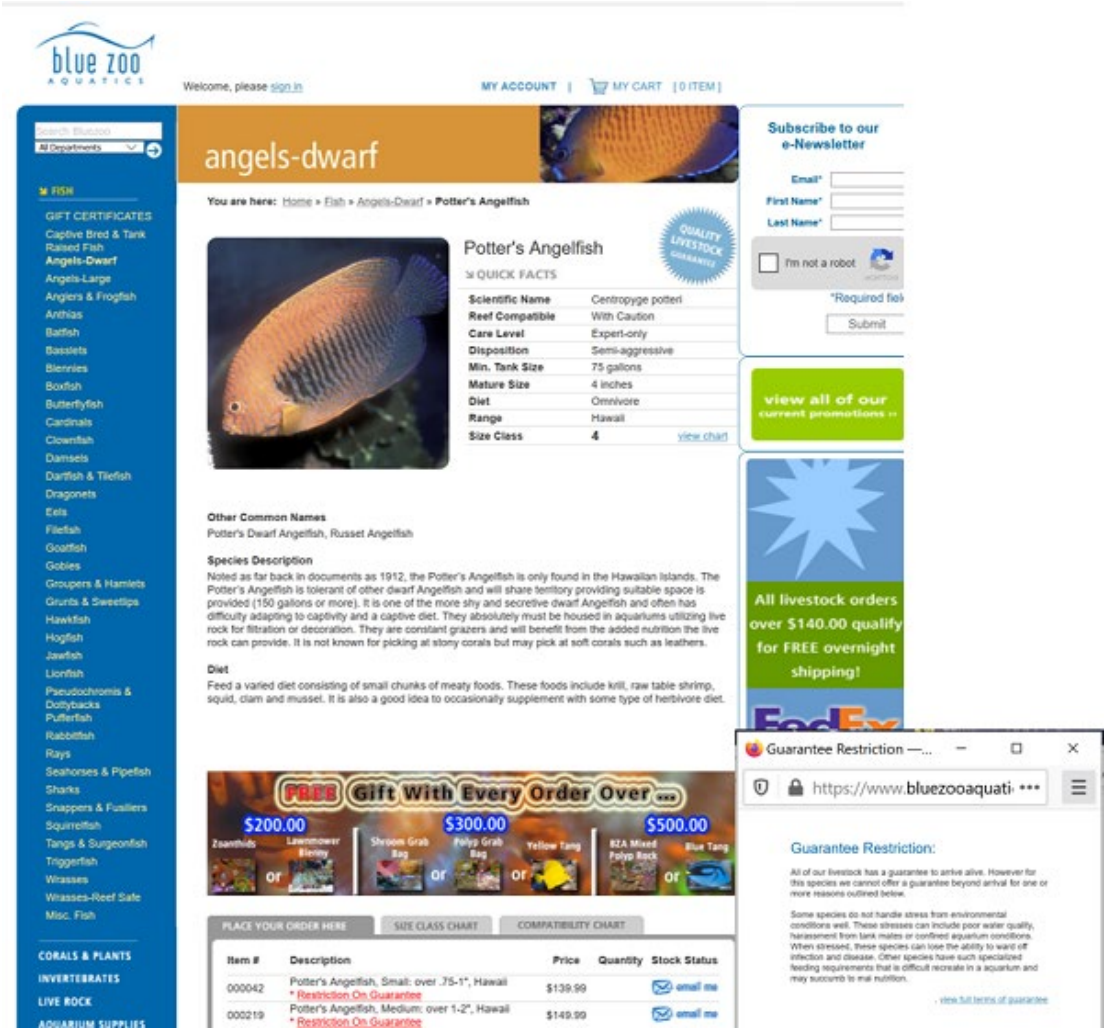
Home > Popular Category > Salt Water Fish A-G > Angelfish, Dwarf > Potter's Angelfish - Centropyge potteri - Potter's Angel Fish

Potter's Angelfish - Centropyge potteri - Potter's Angel Fish

Aquarium suitability:	
Care level:	Expert Only!!! Not Cover Under Arrive Guaranteed
Behavior:	Semi-aggressive
Minimum tank size:	20 Gallon
Maximum size:	5.1 inches
Reef compatibility:	Yes, with Caution
Diet:	Omnivore, Greens, Pellet, Flake
Origin:	Hawaiian Islands, Johnston Atoll
Family:	Pomacanthidae
Manufacturer Name:	FreshMarine
Regular Price:	~~$129.98~~
Purchase size:	Dwarf Angel Size From 2" - 4"
Our Price:	$109.98

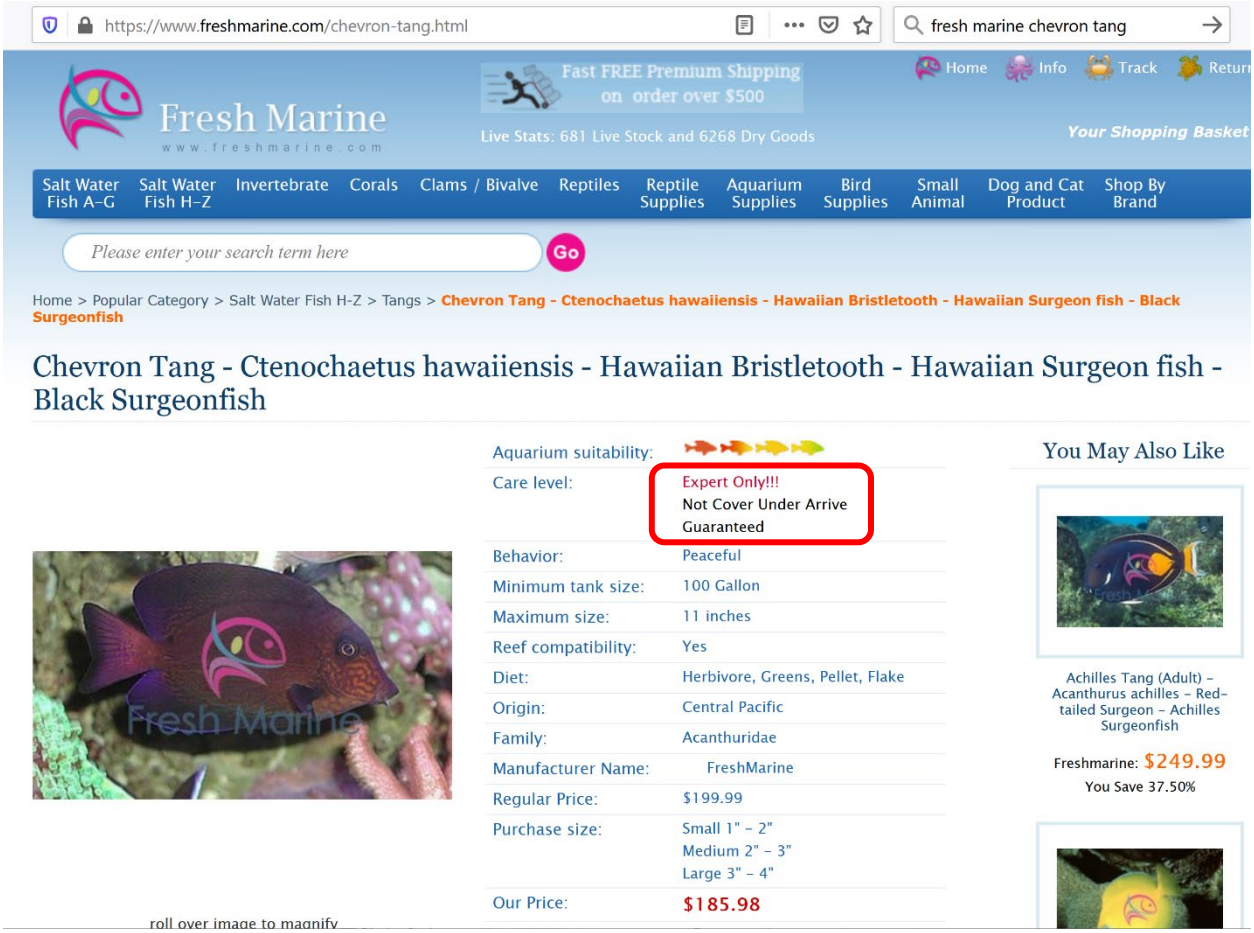
See: https://www.freshmarine.com/potter-angel.html

Potter's Angelfish: no guarantee to survive beyond arrival



See: https://www.bluezooaquatics.com/productDetail.asp?did=1&pid=182&cid=9

Chevron Tang/Black Surgeonfish: no guarantee to arrive alive



See: https://www.freshmarine.com/chevron-tang.html

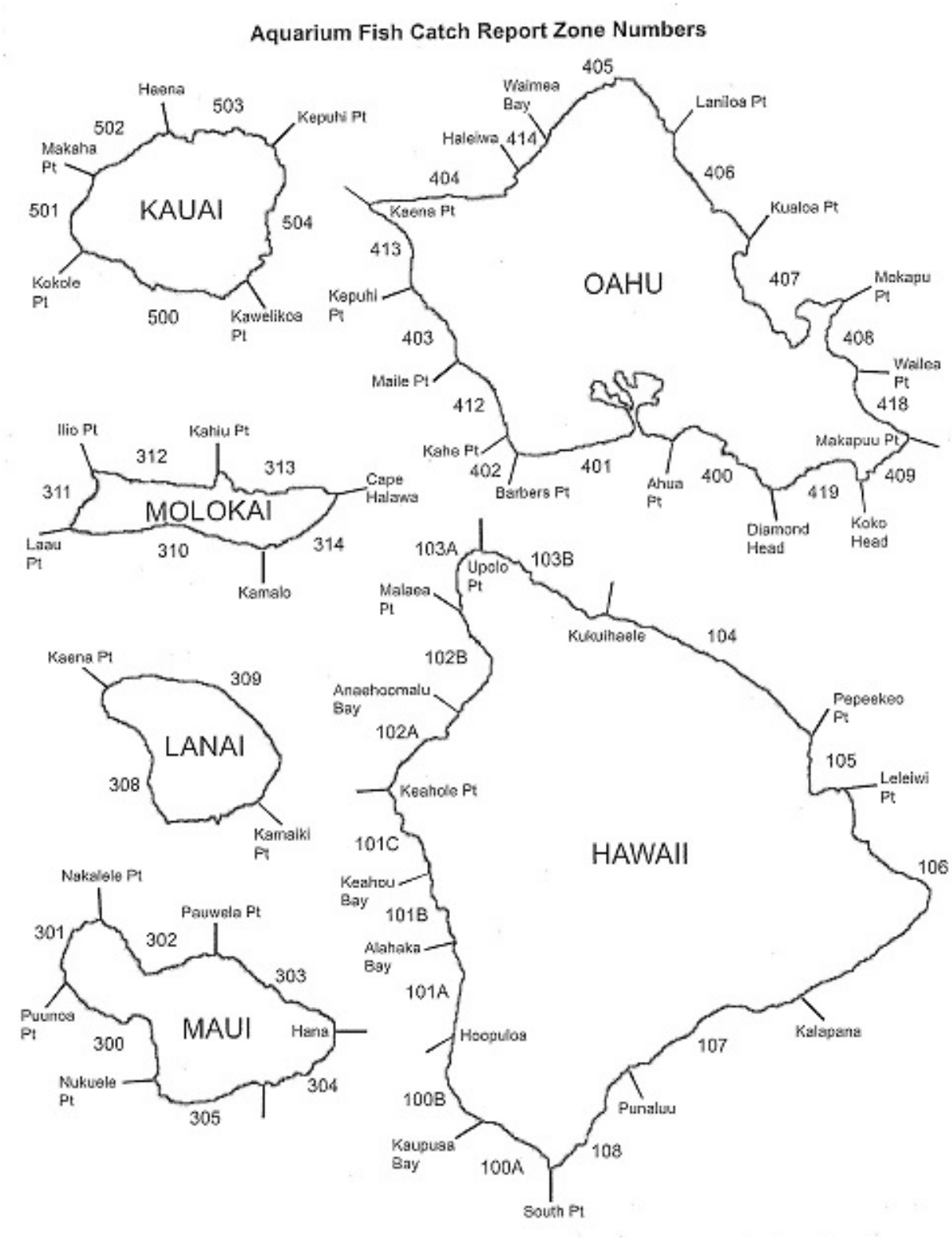
Chevron Tang/Black Surgeonfish: no guarantee to survive beyond arrival

Available at: https://www.bluezooaquatics.com/productDetail.asp?did=1&pid=867&cid=287#

Guarantee Restriction: https://www.bluezooaquatics.com/guarantee_restriction.htm

Appendix 4

DLNR Aquarium Fish Catch Report Zones (available in DLNR Aquarium Fish Trip Report Booklet)



Effects of Aquarium Collectors on Coral Reef Fishes in Kona, Hawaii

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Effects of Aquarium Collectors on Coral Reef Fishes in Kona, Hawaii

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Abstract: *No previous studies have conclusively documented the magnitude of the effect of aquarium collecting on natural populations. In Hawaii concern over the effects on reef fish populations of collecting for the aquarium trade began in the early 1970s, primarily in response to multiple-use conflicts between aquarium-fish collectors and recreational dive-tour operators. In 1997–1998 we used a paired control-impact design to estimate the effect of aquarium collectors. We compared differences in fish abundance along visual belt transects between collection sites, where collecting was known to occur, and control sites, where collecting was prohibited. To test the assumptions of our observational design, we surveyed a combination of species captured by aquarium collectors and those not captured. The extent of bleaching, broken coral, and coral cover was also surveyed. Seven of the 10 aquarium species surveyed were significantly reduced by collecting. The abundance of aquarium fish at collection sites ranged from 38% lower (*Chaetodon multicinctus*) to 75% lower (*C. quadrimaculatus*) than that at control sites. In contrast, only two of the nonaquarium species displayed a significant collection effect. There were no significant differences in damaged coral between control and collection sites to indicate the presence of destructive fishing practices. In addition, there were no increases in the abundance of macroalgae where the abundance of herbivores was reduced by aquarium collecting. Although our results suggest that aquarium collectors have a significant effect on the abundance of targeted aquarium fishes, better knowledge of the intensity and location of collecting activities is required to make a rigorous assessment of the effects of collecting on nearshore fish populations. Several lines of evidence suggest that the current system of catch reporting underestimates actual removals.*

Efectos de Colectores de Acuario sobre los Peces de Arrecifes de Coral en Kona, Hawai

Resumen: *La magnitud del efecto de la recolección para acuarios sobre poblaciones naturales no ha sido documentada concluyentemente en ningún estudio previo. La preocupación por los efectos de la recolección para el comercio de acuarios sobre las poblaciones de peces de arrecifes comenzó a principios de los años 70 en Hawai principalmente en respuesta a los conflictos de uso-múltiple entre colectores de peces para acuarios y operadores de viajes de buceo recreativo. En 1997–1998 utilizamos un diseño apareado de control de impacto para estimar el efecto de colectores de acuario. Comparamos diferencias en la abundancia de peces a lo largo de transectos visuales en sitios de recolección, donde se sabía que ocurría recolección, en relación con sitios control en los que la recolección estaba prohibida. Para probar los sopuestos de nuestro diseño observativo examinamos una combinación de especies capturadas por los colectores de acuario y otra de especies no capturadas. Se examinó también la extensión de blanqueo, coral roto y cobertura de coral. Siete de las 10 especies de acuario examinadas estaban reducidas significativamente por la recolección. Las abundancias de peces de acuario en sitios de recolección variaron de 38% menos (*Chaetodon multicinctus*) a 75% menos (*C. quadrimaculatus*) individuos que en los sitios control. En contraste, sólo dos de las especies no recolectadas para acuario mostraron un efecto significativo de recolección. No hubo diferencias significativas en el coral dañado entre los sitios control y de recolección que indiquen la presencia de prácticas pesqueras destructivas. Además, no hubo incrementos en la abundancia de microalgas donde la abundancia de herbívoros se redujo*

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por la recolección para acuarios. Aunque nuestros resultados sugieren que los colectores de acuarios tienen un efecto significativo sobre la abundancia de los peces de su interés, hace falta un mayor conocimiento de la intensidad y localización de las actividades de recolección para evaluar rigurosamente los efectos de la recolección sobre las poblaciones de peces costeros. Varias líneas de evidencia sugieren que el sistema actual de registros de captura subestima las remociones reales.

Introduction

Global trade in ornamental fishes is a major industry involving approximately 350 million fish annually with a value of $963 million (Young 1997). Although marine fishes account for only 10–20% of the total ornamental catch, rapid increases in the collection of marine species occurred in the 1980s (Andrews 1990). Moreover, whereas freshwater fishes are largely derived from cultivated stocks, <1% of marine fishes are cultivated, and the majority are taken from wild populations (Wood 2001). Almost all marine ornamental fish are of tropical origin, and many are removed from coral reefs. Because aquarium-fish collectors are highly selective and often capture large quantities of individuals of high value, the potential for overexploitation is high (Wood 1985, 2001).

Although numerous authors have discussed the potential effect of the aquarium trade on marine fishes in Australia (Whitehead et al. 1986), Djibouti (Barratt & Medley 1990), Hawaii (Taylor 1978; Walsh 1978; Randall 1987), Indonesia (Wood 1985), the Philippines (Albaladejo & Corpuz 1981), Puerto Rico (Sadovy 1992), and Sri Lanka (Edwards & Shepherd 1992), few studies have estimated the effects of collecting on natural populations. The most common approach has been to examine the rate of international trade (Lubbock & Polunin 1975; Wood 1985; Andrews 1990; Edwards & Shepherd 1992; Young 1997). Other approaches include qualitative or quantitative observations of fish densities in collected areas (Albaladejo & Corpuz 1981; Barratt & Medley 1990) or comparisons of collection rates to crude estimates of sustainable yield based on field estimates of density (Edwards & Shepherd 1992). Although Nolan (1978) concluded that aquarium collectors did not have a significant effect on natural populations in Hawaii, the results are suspect because of problems with suitable controls in the observational design. Thus, no study has conclusively documented the magnitude of aquarium collecting on natural populations, despite repeated calls for such studies to help develop sustainability in the aquarium trade (Walsh 1978; Wood 1985; Young 1997).

Many of the marine ornamentals originating from the United States are captured in Hawaii, which is known for its high-quality fishes and rare endemic species of high value (Wood 1985). Concern over the effects of aquarium collecting on reef fish populations arose in the early 1970s, principally for the Kona coast of the island of Hawaii (Taylor 1978; Walsh 1978). Controversy has centered on multiple-use conflict between aquarium-fish collectors and recreational dive-tour operators over apparent declines in nearshore reef fishes (Taylor 1978; Grigg 1997; Young 1997; Clark & Gulko 1999). These concerns prompted the Hawaii Division of Aquatic Resources (DAR) to instigate monthly collection reports from all permit holders in 1973 (Katekaru 1978), and these reports have been the primary basis for management of the aquarium industry in Hawaii (Miyasaka 1994, 1997).

Based on collection reports, about 90,000 fish, with a reported total value of $50,000, were harvested in 1973 under 75 commercial permits (Katekaru 1978). In 1995 the annual harvest had risen to 422,823 fish (total value of $844,843) under 160 commercial permits (Miyasaka 1997). Although aquarium collecting was primarily centered on the island of Oahu in the 1970s and 1980s, the Kona and Milolii areas of the island of Hawaii became the predominant collecting areas in the late 1980s and early 1990s. Between 1993 and 1995, the harvest from Kona increased 67% and accounted for 59% of the state harvest with 47 commercial permits (Miyasaka 1997).

Although 103 fish species were collected statewide in 1995, over 90% of the harvest was focused on 11 species: the Achilles tang (*Acanthurus achilles*), Potter's angelfish (*Centropyge potteri*), raccoon butterflyfish (*Chaetodon lunula*), multiband butterflyfish (*Chaetodon multicinctus*), ornate butterflyfish (*Chaetodon ornatissimus*), four-spot butterflyfish (*Chaetodon quadrimaculatus*), goldring surgeonfish (*Ctenochaetus strigosus*), longnose butterflyfish (*Forcipiger flavissimus*), clown tang (*Naso lituratus*), moorish idol (*Zanclus cornutus*), and yellow tang (*Zebrasoma flavescens*), with *Z. flavescens* accounting for 52% of the total collection (Miyasaka 1997; DAR, unpublished data). Thus, given the increasing rate of removal focused on a small number of species, the potential for overexploitation of these reef fishes is high.

In addition to the direct effects of collecting fish for the aquarium trade, there has been considerable concern about destructive practices associated with fish capture. These practices include the use of poisons and explosives to capture fish and damage to coral during collecting (Lubbock & Polunin 1975; Wood 1985, 2001; Randall 1987; Johannes & Riepen 1995; Young 1997). An additional concern is the effect on the coral reef community of large reductions in the number of herbivorous fishes, such as the yellow tang. Because herbivorous fishes may

control the abundance of algae on coral reef ecosystems, their removal may cause shifts in community structure (reviewed by Hixon 1997).

Our goal was to obtain quantitative estimates of the effects of aquarium collectors on fishes on the Kona coast of Hawaii. Moreover, in response to reports of broken and bleached coral associated with destructive fishing practices, we also investigated changes in the associated coral reef habitat at each study site.

Methods

Observational Design

We used a paired control-impact design to estimate the effect of aquarium collectors on reef-fish abundance. The magnitude of the effect was estimated by comparing fish abundance at collection sites where aquarium-fish collecting was known to occur with geographically adjacent control sites where collecting was prohibited. Because the study was initiated after collection had begun, we assumed there were no differences between control and collection sites in the abundance of aquarium fishes prior to the onset of aquarium harvesting (i.e., their natural abundances were similar) (Osenberg & Schmitt 1996). We also assumed that all differences between the control and collection sites were due to aquarium-fish collecting and not other factors, such as fishing. As part of our study design, we gathered data to test these assumptions.

We established four study sites that served as two replicate control-collection pairs (Fig. 1). One pair of study sites was located at Honokohau (lat 19°40.26′N, long 156°01.82′W) and Papawai (lat 19°38.83′N, long 156°01.38′W). Papawai, a fishery management area (FMA) where collection of aquarium fishes has been prohibited since 1991 (Department of Land and Natural Resources 1996), served as our control site. Honokohau was frequented by aquarium collectors and served as a collection site. This pair of sites is hereafter referred to as the Honokohau study area. The second pair of sites was located at Red Hill North (lat 19°32.90′N, long 155°57.74′W) and Red Hill South (lat 19°30.32′N, long 155°57.17′W). Red Hill South is an FMA where the collection of aquarium fishes has been prohibited since 1991 (Department of Land and Natural Resources 1996), and it served as our control site. Red Hill North was frequented by aquarium collectors and served as a collection site. This pair of sites is hereafter referred to as the Red Hill study area.

At each study site, four permanent 50-m transect lines were established at 10- to 15-m depths by installing stainless steel eyebolts at the beginning and end points of each line. Transects served as reference lines for both the fish and coral surveys. We used a visual strip-transect search method to estimate fish abundances (Sale & Douglas 1981). A pair of divers swam side by side down either side of the transect line and counted all fishes seen within a corridor 3 m wide and extending to the surface.

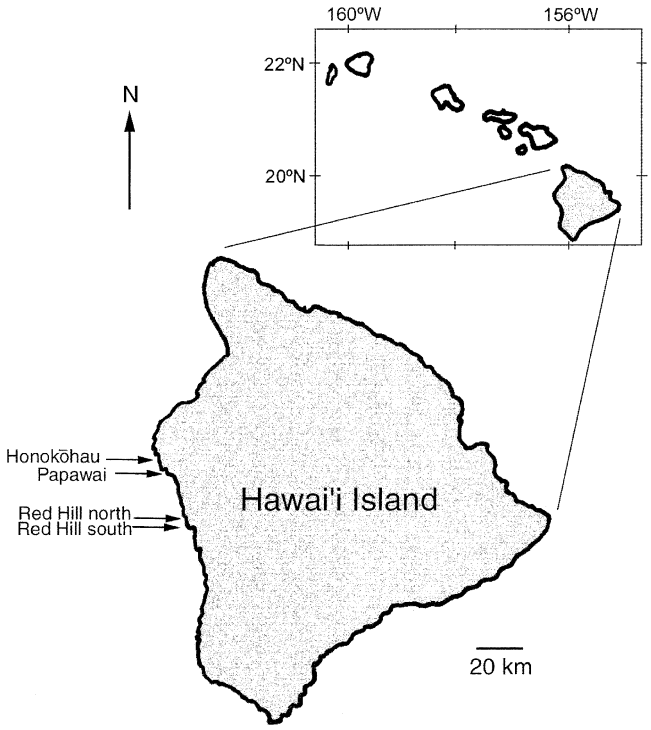

Figure 1. Map of study sites located off the island of Hawaii.

Surveys began at Honokohau in March 1997 and at Red Hill in September 1997 and ended at both areas in December 1998. All sites were sampled at 2- to 5-month intervals, for a total of eight surveys at Honokohau and five at Red Hill. During each survey we estimated the abundance of 21 fish species. These species included 11 aquarium fishes selected on the basis of high levels of capture, accounting for over 92% of the fish collected in Hawaii (DAR, unpublished data). Due to uncertainty in species identification, we pooled longnose butterflyfish as *Forcipiger* spp., which may include both *F. longirostris* and *F. flavissimus*, although most of the fish counted were probably the latter (personal observations). The remaining 10 fish species we surveyed were not targeted by aquarium collectors but were in guilds similar to those of collected species. These species were selected to provide tests of the assumptions of the observational design. Although the assumption of no difference between the control and collection sites prior to the study could not be tested directly, one prediction of this assumption was that uncollected species should not differ between control and collection sites. Accordingly, *Acanthurus nigrofuscus, A. nigroris, A. triostegus, Chaetodon lunulatus, C. unimaculatus, Paracirrhites arcatus, P. forsteri, Plectroglyphidodon johnstonianus, Stegastes fasciolatus*, and *Thalassoma duperrey* were also surveyed. The overall

structure of the fish communities at control and collection sites should also be similar if the sites are ecologically similar. Thus, to test this prediction, during the next-to-last survey at each site all reef fishes seen were counted and identified to species.

Of the 21 species surveyed, 2 species (*C. lunula* and *C. unimaculatus*) were too rare for analysis, with one individual of each species observed during the entire study. These species were excluded from further analysis.

Divers were undergraduate students who had completed a rigorous coral reef monitoring course and were trained in species identification and standardized survey methodology (Hallacher & Tissot 1999). To minimize observer bias, the same diver pairs were used at each control-collection study site during each survey. Divers did, however, vary among surveys. To minimize temporal variation, all surveys were conducted during midday (generally from 0900 to 1500 hours), and both control and collection sites were surveyed either on the same day or on consecutive days.

To provide an additional test of similarities between control and collection sites and to test for destructive harvesting methods associated with aquarium collecting, we also conducted surveys on corals, macroalgae, and the general substratum of each transect. Divers took photographs of the substratum with a Nikonos V camera with a 15-mm lens attached to a PVC quadrat covering an area of approximately 0.50 m^2 (0.8 × 0.6 m). Along each 50-m transect line, 18 photographs were taken at randomly selected coordinates at all study sites at both the beginning and end of the study. Percent cover estimates were made of all living and nonliving substrata in each photograph by projecting the slide over a series of 50 random coordinates and recording the observed substratum under each point. In addition, the percent cover of bleached and broken coral was estimated for each slide. We identified broken coral as recently damaged coral fragments with no algal overgrowths. We identified bleached coral as unusually pale portions of the coral colony located at the tips or edges of coral colonies. To minimize observer bias, a single observer analyzed all the photographic data.

Data Analysis

We analyzed fish data with two-way repeated-measure analysis of variance (ANOVA). Fixed factors included control and collection study sites ("effect"), replicate study areas (Honokohau and Red Hill or "area"), and the interaction between effect and area. Although each survey provided an estimate of the level of collection through control-collection differences, because the same individual fish may have been counted between surveys, surveys were treated as a random, repeated measure in the analysis (Zar 1996). A significant "collection" effect indicates a similar difference between control and collection sites at both study areas. A significant "collection-area" effect indicates a difference between control and collection sites that varies between study areas. A significant "area" effect indicates spatial differences in abundance among study areas. Because our goal was to obtain estimates of the magnitude of collection effects, only factors associated with a significant collection effect were interpreted (e.g., only collection or collection-area interactions, not temporal variation).

We calculated the percent difference in abundance as the difference between control and collection sites using the formula

$$\text{percent difference} = \frac{D_{\text{collection}} - D_{\text{control}} \times 100}{D_{\text{control}}},$$

where D is density expressed as number of individuals per 100 m^2. Thus, a negative percent difference associated with a significant collection effect indicates the presence of significantly fewer fish at collection sites than at control sites, whereas a positive value indicates the opposite.

We analyzed coral cover, bleaching, and breakage data with a three-way ANOVA, with effect, area, and time (beginning of study vs. end of study) as fixed factors. Data from photoquadrats along transects were treated as a random nested factor.

Prior to all analyses, we examined data for homogeneity of sample variances. We used transformed data in cases where the original data demonstrated heteroscedasticity. We did not examine normality because samples were small ($n = 4$) and normality is not an important assumption for ANOVA (Box 1953). Following ANOVA, we used the procedure described by Underwood (1997) to pool nonsignificant factors.

We used species richness (S), evenness (J), and the Shannon-Wiener composite diversity index (H') to examine overall fish and coral-algal-substratum community structure. We compared community structures by using the percent similarity index (Krebs 1986). These indices tested the prediction that the overall structure of the fish and coral-algal-substratum communities at control and collection sites would be similar.

Results

There was a significant difference in the abundance of aquarium fishes between control and collection sites but no differences in the abundance of nonaquarium species between these sites (Table 1, Fig. 2). Seven of the 10 aquarium species displayed a significant collection effect in the two-way repeated-measure ANOVA. In contrast, only two of the nine nonaquarium species, *P. arcatus* and *S. fasciolatus,* displayed a significant collection effect (Table 1, Figs. 3 & 4).

Of the 10 aquarium species, three exhibited a significant collection-only effect (Fig. 3). All of these species

Table 1. Mean (SE) percent change in fish abundance between sites with aquarium-fish collection and without aquarium-fish collection for each study area.

		Percent change[a]								
		overall		*Honokohau*		*Red Hill*		*p*[b]		
Species	*df*	*mean*	*SE*	*mean*	*SE*	*mean*	*SE*	*effect (E)*	*area (A)*	*E ∗ A*
Aquarium species										
Chaetodontidae										
Chaetodon multicinctus	1,88	−38.2	6.57	−42.0	9.05	−32.3	9.63	0.02	–	–
Chaetodon ornatissimus	1,88	−39.5	20.2	−37.0	25.8	−43.4	36.4	–	<0.01	–
Chaetodon quadrimaculatus	1,87	–	–	−94.4	4.81	21.8	94.7	0.01	<0.01	–
Forcipiger spp.	1,86	–	–	−60.9	6.20	−43.6	19.5	0.01	<0.01	0.01
Pomacanthidae										
Centropyge potteri	1,87	–	–	−29.2	15.8	−73.1	12.3	0.03	<0.01	–
Acanthuridae										
Acanthurus achilles	1,88	−57.1	10.2	−64.0	13.3	−46.0	16.3	<0.01	–	–
Ctenochaetus strigosus	1,88	−14.7	8.20	−33.6	4.96	15.4	9.65	–	–	–
Naso lituratus	1,88	31.2	34.2	66.5	50.8	−25.2	25.1	–	–	–
Zebrasoma flavescens	1,87	–	–	−49.8	6.89	−43.2	6.47	<0.01	<0.01	–
Zanclidae										
Zanclus cornutus	1,88	−46.5	11.9	−45.9	16.1	−47.5	19.2	<0.01	–	–
Nonaquarium species										
Cirrhitidae										
Paracirrhites arcatus	1,86	–	–	−12.1	14.1	−75.3	3.16	<0.01	<0.01	<0.01
Paracirrhites forsteri	1,88	58.4	59.3	168.3	85.7	−73.6	14.5	–	–	–
Chaetodontidae										
Chaetodon lunulatus	1,88	−70.0	10.4	−70.0	10.4	–	–	–	–	–
Pomacentridae										
Plectroglyphidodon johnstonianus	1,88	−31.3	12.6	−12.1	15.2	−61.9	14.2	–	–	–
Stegastes fasciolatus	1,87	–	–	488	281	50.0	22.4	0.04	<0.01	
Labridae										
Thallasoma duperrey	1,88	17.4	12.4	31.6	17.0	−5.3	13.2	–	–	–
Acanthuridae										
Acanthurus nigrofuscus	1,87	27.3	22.8	15.2	26.7	46.7	43.5	–	<0.01	–
Acanthurus nigroris	1,88	67.2	63.6	−18.0	36.7	186.5	140.0	–	–	–
Acanthurus triostegus	1,88	−4.26	20.8	−5.68	32.4	<0.10	<0.10	–	–	–

[a] *A negative mean percent change indicates fewer individuals at effect relative to control sites.*
[b] *The* p *values and degrees of freedom (df) are reported for a two-way repeated-measure ANOVA on density.*

displayed a similar significant difference between control and collection sites at both study areas in which individuals were significantly more abundant at the control sites. These species, and the magnitude of their overall percent difference at collection sites, were as follows: *A. achilles,* −57%; *C. multicinctus,* −38%; and *Z. cornutus,* −47% (Table 1). (The negative percent indicates fewer individuals at collection than at control sites.)

Four species exhibited a significant collection and area effect (Table 1; Fig. 4). These species displayed significant differences between control and collection sites, but their overall abundance varied between study areas. Both *C. potteri* and *S. fasciolatus* were more abundant at Honokohau than at Red Hill, whereas *C. quadrimaculatus* and *Z. flavescens* were more abundant at Red Hill than at Honokohau (Fig. 4). The magnitude of their overall percent difference (in parentheses) at collection sites were as follows: aquarium species: *C. potteri,* −56%; *C. quadrimaculatus,* −75%; *Z. flavescens,* −46%; nonaquarium species: *S. fasciolatus,* +64% (Table 1).

Two species exhibited a significant collection-area interaction effect, where differences between control and collection sites varied between study areas (Table 1; Fig. 4). In the aquarium species *Forcipiger* spp., percent difference was greater at Honokohau (−61%) than at Red Hill (−44%). In contrast, the nonaquarium species *P. arcatus* displayed a lower percent difference at Honokohau (−18%) than at Red Hill (−75%) (Table 1; Fig. 4).

The overall fish community structure of the paired control and collection sites was remarkably similar. The H' diversity index at control and collection sites, respectively, was 1.18 and 1.16 at Honokohau and 1.16 and 1.17 at Red Hill. Similarly, the evenness index at control and collection sites, respectively, was 0.72 and 0.69 at Honokohau and 0.69 and 0.69 at Red Hill. At Honokohau, 44 species were seen at the control site, whereas 48 species were seen at the collection site. Forty-nine species were observed at both control and collection sites at Red Hill. Overall fish densities were 27% higher at Red Hill (mean density = 146 fish/100 m^2) than at Honokohau

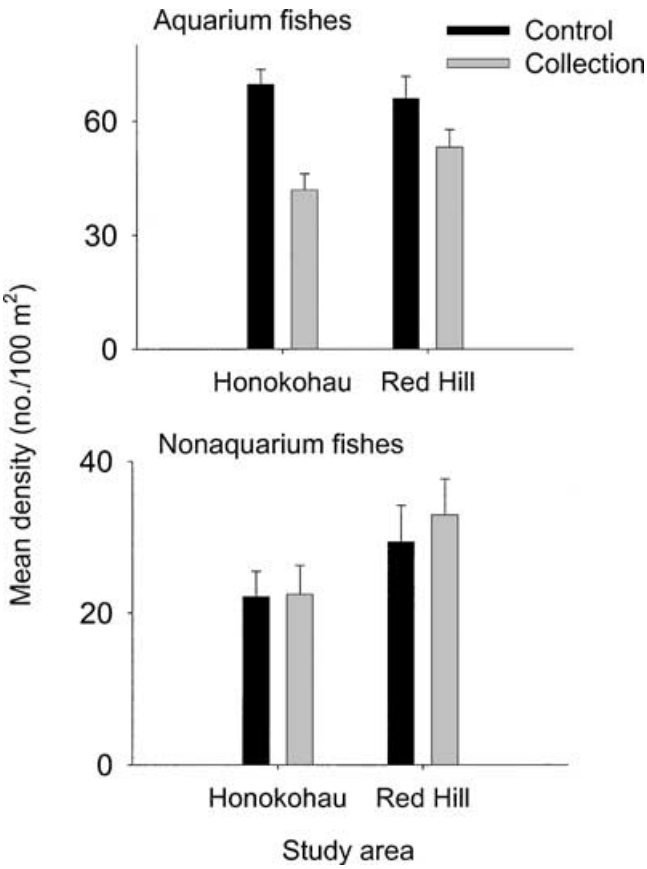

Figure 2. Mean fish density (±1 SE) for pooled aquarium and nonaquarium species at control and collection sites in both study areas.

(107 fish/100 m^2). Accordingly, control-collection pairs exhibited higher percent similarity (0.85–0.88) than that among study areas (0.75).

Live coral cover was significantly different between control and collection sites and between initial and final surveys, and there was a significant collection-survey interaction (all $p < 0.05$; df = 1,566; Fig. 5). Coral cover at all sites increased an average of 2.8% per year and was similar at both Honokohau sites but higher at the collection than at the control site at Red Hill. At Red Hill, coral cover increased 4.6% at the collection site and 2.3% at the control site (Fig. 5).

The amount of bleached coral was significantly different among areas ($p < 0.01$; df = 1,561): mean cover of bleached coral was 2.8% at Honokohau and 4.6% at Red Hill (Fig. 5). No other factors or interactions were significant. The percent cover of broken coral exhibited a significant difference among surveys ($p = 0.01$, df = 1,559): the mean cover of broken coral was 12% at the beginning of the study and 17% at the end (Fig. 5). No other factors or interactions were significant.

The abundance of macroalgae was low at all sites. No macroalgae was seen in the photoquadrats at Honokohau, and cover was <0.01% at the Red Hill sites. In contrast, coralline algae was fairly common at all sites.

The overall coral-substratum community structure of paired control and collection sites was similar. Species diversity, evenness, and richness were similar at all sites, and control-collection pairs exhibited higher percent similarity in community structure (79–82%) than that among study areas (63%).

Discussion

Seven of the 10 fishes targeted by the aquarium trade were significantly lower in abundance in areas subjected to collecting than in areas where collecting was prohibited. The magnitude of these differences ranged from −38% for *C. multicinctus* to −75% in *C. quadrimaculatus*. In contrast, only two of the nine nontarget species were significantly less abundant in collecting than in control areas, bolstering the conclusion that aquarium collectors have significant effects on the abundance of targeted fishes on the Kona coast of Hawaii.

Evaluation of Assumptions

The most critical assumption made when estimating the effects of differences between control and collection sites is that the parameter of interest is similar at both sites prior to the effect (Osenberg & Schmitt 1996). Otherwise, spatial variation in initial abundance can confound control-effect differences. For example, Nolan's (1978) study on aquarium collectors compared a collection site from the Kona area to a control, or "seldom-collected" site about 30 km away in north Kohala. His conclusion that collectors have no significant effect on abundance was based on finding a greater number of aquarium fishes at the collection site than at the control site. However, given the large distance between control and collection sites and the fact that aquarium collectors operated at both sites, this conclusion is unwarranted because of the high potential for confounding spatial variation with potential human effects.

Pairs of geographically adjacent sites minimize spatial variation, but this potential problem remains for all control-effect designs if there are no data prior to the onset of the effect (Osenberg & Schmitt 1996). Although the assumption of no prior differences cannot be tested explicitly, it can be inferred from several lines of evidence, including examination of spatial variation in fishes that are ecologically similar but not subjected to collecting and comparisons among the habitat of both sites. To evaluate this assumption, we used a combination of nontarget species that were ecologically similar to target species, species that were indicators of particular habitats, and examination of the coral habitat.

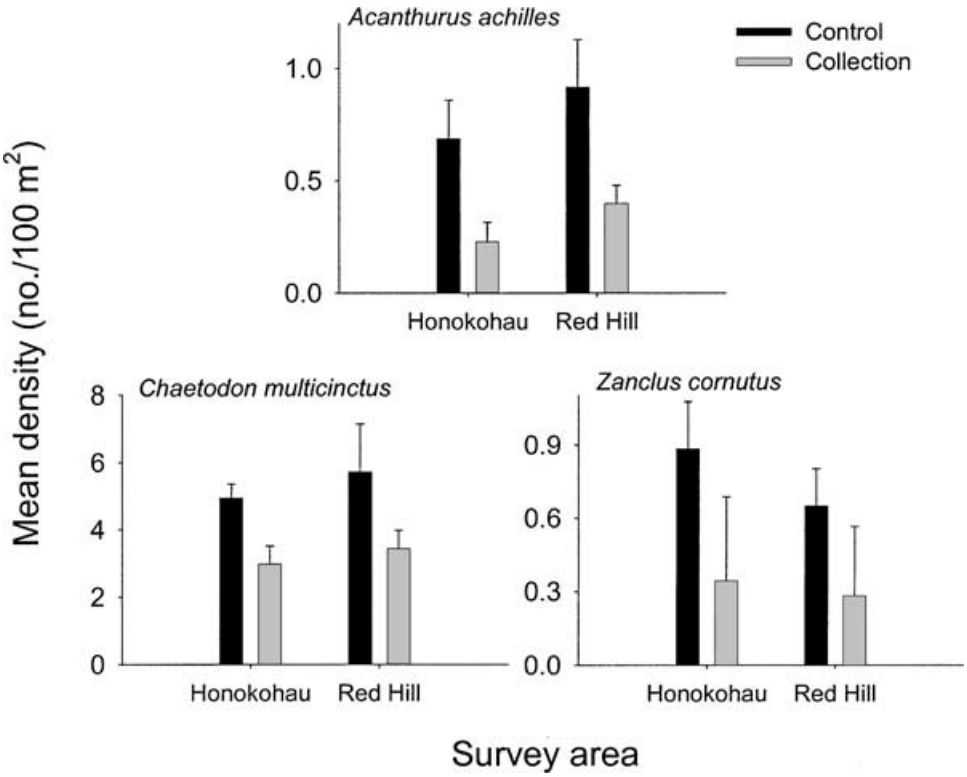

Figure 3. Mean fish density (±1 SE) for aquarium species that displayed significant collection-only effects. These three species are targeted by collectors of aquarium fish.

For example, the nontarget brown surgeonfish (*A. nigrofuscus*) and the targeted yellow tang (*Z. flavescens*) are both generalized herbivores that feed on filamentous algae, occupy the same depth ranges and habitats, and exhibit similar patterns of spawning and larval recruitment (Randall 1985; Walsh 1987; Lobel 1989). Yellow tangs were 47% less abundant at collection than at control sites, whereas brown surgeonfish did not differ significantly between the sites. Similarly, no differences were observed between control and effect sites among species that feed or live in close association with coral (*C. lunulatus, P. johnstonianus*), whereas their targeted counterparts (*C. multicinctus, C. ornatissimus, C. quadrimaculatus)* exhibited significantly lower abundances at effect sites. Moreover, nontarget species with generalized diets and distributions across the reef (*A. nigroris*, *A. triostegus*, *P. forsteri, S. fasciolatus, T. duperrey*) also did not vary, whereas ecologically similar aquarium species (*A. achilles*, *C. potteri*, *Z. cornutus*) were significantly different.

An additional line of evidence supporting the assumptions of our observational design is that the overall fish community structure of control and collection sites was remarkably similar in species diversity, richness, and evenness, with the percent similarity index ranging from 85% to 88%. At the habitat level, control and effect sites were also similar with respect to the diversity of coral, algae, and nonliving substratum composition, with percent similarity ranging from 79 to 82%. Thus, at several levels there was considerable support for the assumption that the reef communities were similar at both control and effect sites.

Another important assumption is that differences in abundance between control and effect sites were due to aquarium-fish collecting and not other processes that selectively affect these species, such as fishing. We addressed this assumption by selecting collection sites largely inaccessible from shore, thereby minimizing the effects of shore-based fishing. Moreover, both the aquarium fish *C. strigosis* and the nontarget species *A. triostegus* are commercially and recreationally fished in Hawaii. However, *A. triostegus* did not vary significantly between control and effect sites, indicating that fishing impacts were not significantly different in these areas.

Illegal collecting at control sites would also confound control-effect differences. Although some illegal collecting may be occurring in Kona, it is probably uncommon and unlikely to have a significant effect on fish abundances in existing protected areas (W. Walsh, personal communication). Thus, the only clear difference between the control and effect sites in this study was aquarium-fish collecting, as evidenced by the significantly lower abundance of aquarium species at the collection sites.

Indirect Effects of Aquarium Collecting

Destructive practices associated with the collection of fish are common and include breaking coral to capture

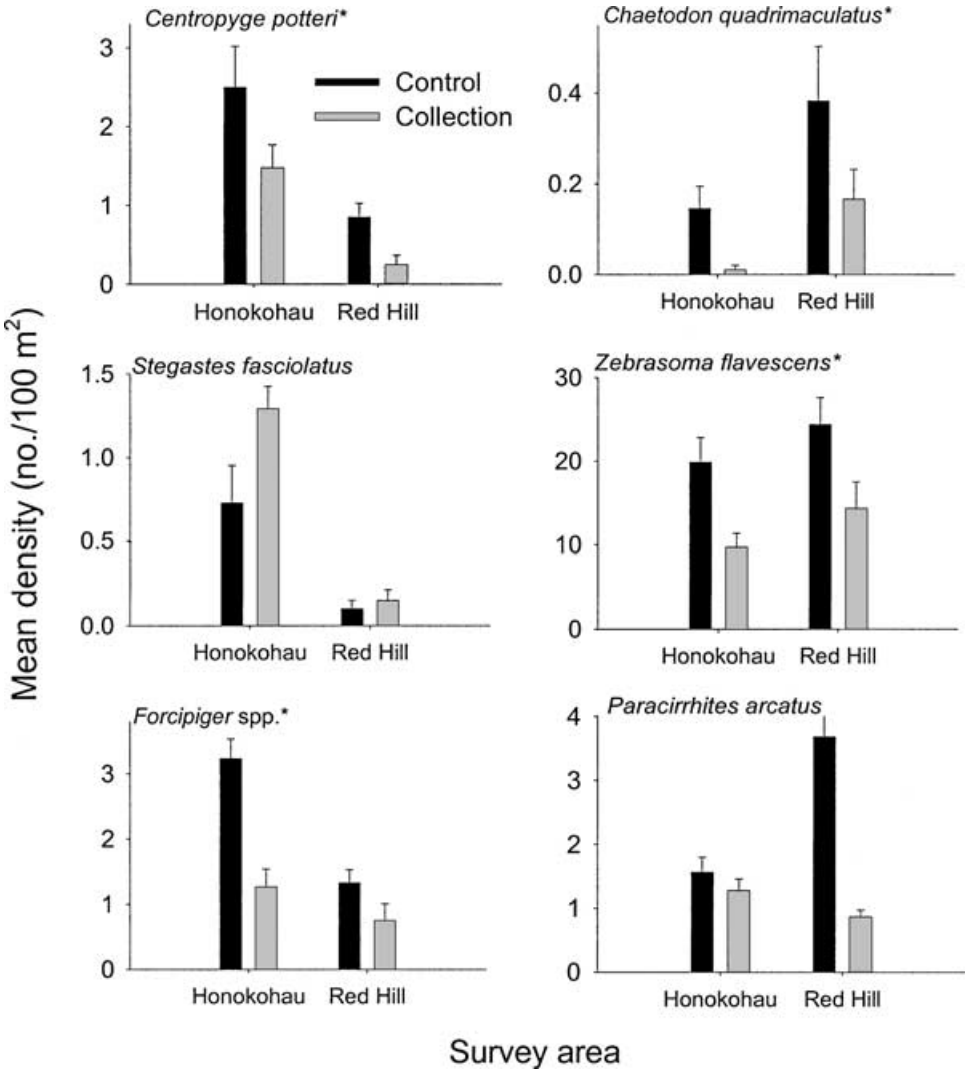

Figure 4. Mean fish density (±1 SE) for aquarium and nonaquarium species that displayed significant collection, area, or collection-area interaction effects. Species targeted by aquarium collectors are indicated with an asterisk (*).

live animals, snagging nets on coral, and using bleach and cyanide to stun target species (Randall 1987; Johannes & Riepen 1995; Wood 2001). Both the breaking of coral and the use of bleach to collect aquarium fish have been observed in Hawaii, although they are prohibited by law (W. Walsh, personal communication). We examined differences in coral cover and the incidence of broken and bleached coral as indicators of these effects. Although some differences were noted in the extent of bleaching and coral cover among study areas, there were neither consistent nor significant differences between control and effect sites that would indicate the presence of destructive fishing practices.

An issue of more general interest is the extent to which large-scale removal of herbivorous fishes can alter reef community structure. Four of the aquarium fishes (*A. achilles, C. potteri, N. lituratus, Z. flavescens*) accounted for 61% of the herbivorous fishes at the Honokohau and Red Hill control sites. These species were reduced in overall mean abundance by 32% at the effect sites relative to the control sites. Given that herbivorous grazers control algal populations that can overgrow corals (review by Hixon 1997), it is of interest to examine the community structure in areas where herbivory is reduced. Macroalgae were rare at all study sites, suggesting that reductions in herbivory associated with aquarium-fish collecting did not have a significant effect on this group of algae. However, our study may not be a good test of this hypothesis for several reasons. First, based on the model of Littler and Littler (1984), algae may be limited more by nutrients than herbivores. Second, with the exception of *N. lituratus*, the herbivorous aquarium fishes fed primarily on filamentous algae, not macroalgae. Filamentous algae are not easily surveyed by our photographic methods, so we collected no data on their abundance. Lastly, other reef herbivores, such as sea urchins, may control macroalgal populations, so reductions due to aquarium collecting may not be functionally significant. Given the global scope of aquarium harvesting on coral reefs, this question warrants further investigation.

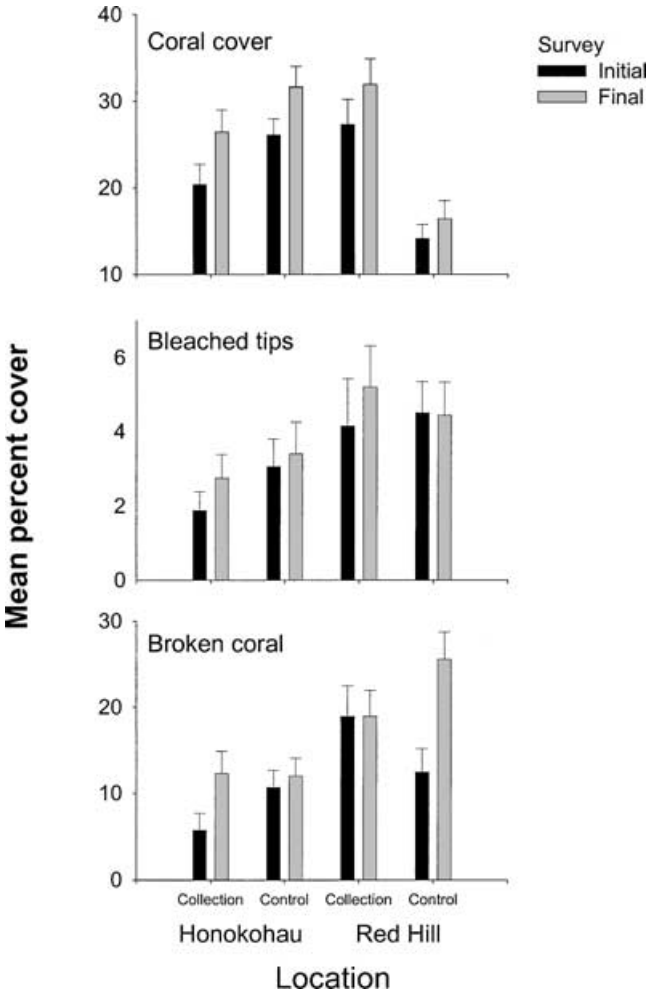

Figure 5. Changes in the mean percent (±1 SE) coral cover, bleached coral, and percent broken coral at control and collection sites in each study area at the beginning and end of the study.

Implications for Fishery Management

Aquarium collectors had significant effects on 7 of the 10 species of reef fish we examined. To determine whether these abundance patterns were clearly due to aquarium fish collecting will require better knowledge of the intensity and location of collecting activities. Although there are currently about 50 permits issued to collectors in western Hawaii, the number of active collectors is likely to be lower (W. Walsh, personal communication). The current system of catch reporting in Hawaii is limited to monthly collecting reports, with the 235-km coastline of western Hawaii divided into three large sections (Miyasaka 1997). Moreover, because these reports are not compared with actual catches, there is no assurance that the reports are accurate. Analysis of the current catch reports indicates that a significant portion of the monthly reports are not filed, although collectors are required to file a report even if no fish are collected (W. Walsh, personal communication). More specific information about location, catch, and effort are essential to support the results of this study. Moreover, random monitoring of collectors' catch reports would provide some level of quality assurance for these data.

We focused on major targeted species and did not collect data on rare species. Of the 103 species collected statewide, many are considered uncommon or rare and could also be threatened by overexploitation. For example, based on 1994–1995 collection reports, 204 Tinker's butterflyfish (*Chaetodon tinkeri*), a rare, deep-water species, were collected in western Hawaii and may possibly be overcollected. Other rare aquarium species, such as the Hawaiian turkeyfish (*Pterois sphex*) and the flame angelfish (*Centropyge loricula*), are also of concern and should be considered in future monitoring and management plans.

The magnitude and extent of the effects we documented and their relationship to the sustainability of aquarium collecting are problematic but warrant further investigation. In response to continued public outcry over the collection of aquarium fish, the Hawaii state legislature passed a bill in 1998 that focused on improving management of reef resources by establishing the West Hawaii Regional Fishery Management Area. A major component of the bill is to improve management of the aquarium industry by declaring a minimum of 30% of the western Hawaii coastline as fish replenishment areas (FRAs), protected areas where aquarium-fish collecting is prohibited. Based largely on input from the West Hawaii Fisheries Council, a community-based group of individuals, a network of nine FRAs was established in January 2000 as part of a plan to manage the aquarium industry. Current efforts are focused on monitoring these areas to evaluate the effectiveness of the reserve network as a fishery management tool.

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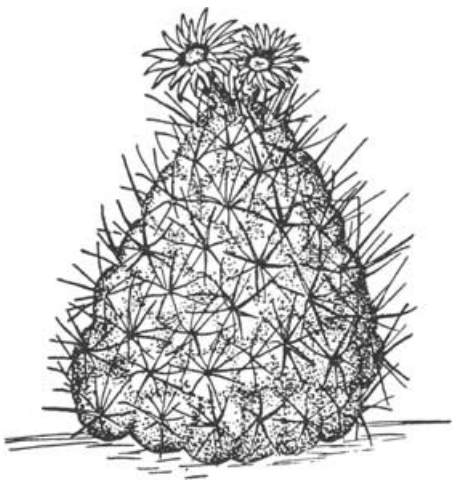

Evaluating Effectiveness of a Marine Protected Area Network in West Hawai'i to Increase Productivity of an Aquarium Fishery[1]

Brian N. Tissot,[2] *William J. Walsh,*[3] *and Leon E. Hallacher*[4]

Abstract: A network of nine Fish Replenishment Areas (FRAs) was established in West Hawai'i in 2000 in response to declines of reef fishes taken by aquarium collectors. In 1999, we established 23 study sites in FRAs, areas open to collectors, and reference areas (existing protected areas) to collect data both before and after the closure of the FRA network in 2000. To date we have conducted 23 bimonthly fish surveys as well as surveys of the benthic habitats of all sites. Baseline surveys, done before FRA closure, document significant effects of aquarium collector harvesting on selected fishes. On average, aquarium fishes were 26% less abundant in newly established FRAs (formerly open) than in adjacent reference areas. Analysis of postclosure surveys in 2000–2002 using a Before-After-Control-Impact procedure provided evidence of a significant increase in two of the 10 species examined, including the yellow tang (*Zebrasoma flavescens*), the most collected aquarium fish in Hawai'i. The recovery of yellow tangs to preexploitation levels in the FRAs was probably due to the high number of newly recruited fishes observed in 2001–2002. Large recruitment events are rare in West Hawai'i but are likely to be an important factor determining the effectiveness of Marine Protected Areas to help replenish depleted fish populations.

CORAL REEFS ARE diverse and productive biological communities that provide important natural resources in tropical areas. However, reefs in many parts of the world currently are being threatened with a wide variety of anthropogenic disturbances (Richmond 1993). On the island of Hawai'i, excessive harvesting by the aquarium trade is a major source of overfishing that warrants improved resource management (Grigg 1997, Clark and Gulko 1999, Tissot and Hallacher 2003). This project addresses the implementation and evaluation of a fishery management plan on the island of Hawai'i (Act 306 of 1998) focused on aquarium fish collecting using a network of Marine Protected Areas (MPAs).

MPAs are currently of wide national and international interest (Allison et al. 1998, Bohnsack 1998, Murray et al. 1999). However, very few studies of MPAs are replicated (e.g., have more than one protected area) or have statistically rigorous monitoring programs with data collected both before and after closure (Murray et al. 1999). This project represents a unique opportunity both to investigate the effectiveness of MPAs in fishery management and to provide an assessment of aquarium fish collecting effects on the island of Hawai'i that builds on earlier work (Tissot and Hallacher 2003).

The aquarium collecting industry in Hawai'i has had a long, contentious history. As early as 1973, public concern over collecting activities was first addressed by the Hawai'i Division of Aquatic Resources (DAR) by requiring monthly collection reports. However, the industry has been largely unregulated

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since then despite dramatic increases in the number of both issued collecting permits and collected fishes. Further, increases in fish collecting combined with growing public perception of dwindling fish stocks eventually developed into a severe multiple-use conflict between fish collectors and the dive tour industry.

In response to declines in reef fishes due to aquarium collectors, the Hawai'i State Legislature, through Act 306, created the West Hawai'i Regional Fishery Management Area in 1998 to improve management of fishery resources. One of the requirements of Act 306 mandates that DAR declare a minimum of 30% of the West Hawai'i coastline as Fish Replenishment Areas (FRAs), MPAs where aquarium fish collecting is prohibited. The Act also called for substantive involvement of the community in resource management decisions. In 1998, the West Hawai'i Fisheries Council, a community-based group of individuals, proposed nine FRAs along the West Hawai'i coastline that collectively prohibited aquarium fish collecting along 35% of the coast when combined with existing protected areas. The proposed management plan received 93% support at a public hearing, was subsequently approved by the Governor, and the FRAs were officially closed to aquarium collectors on 1 January 2000.

Our principal purpose in this paper is to provide a broad evaluation of the effectiveness of the nine FRAs to increase the productivity of aquarium fishery resources. Specifically, our goals in this paper are (1) to evaluate the general effectiveness of the MPA network by comparing fish abundances among reference, open, and FRA study sites before and after FRA closure; (2) to estimate the effects of aquarium fish collecting both in and outside of FRAs in West Hawai'i; and (3) to generate hypotheses on mechanisms that influence FRA effectiveness. A paper analyzing the effectiveness of individual FRAs will be published elsewhere.

MATERIALS AND METHODS

Our observational design compared FRA study sites before and after closure with sites that remained open to aquarium fish collecting (open sites) and those that were not subjected to aquarium fish collecting (reference sites). Reference sites included Marine Life Conservation Districts (MLCDs) and Fishery Management Areas (FMAs), both of which prohibit aquarium fish collecting, along with other activities. A total of 23 study sites was selected in early 1999. The sites were established in six existing reference areas, in eight open areas adjacent to FRAs, and in all nine of the FRAs (Figure 1, Table 1).

Study sites were selected within an area of suitable habitat and depth using a procedure that attempted to minimize among-site habitat variability yet selected unbiased locations within an area. A diver was towed behind a slow-moving vessel in the area of interest (open, FRA, or reference) to search for areas suitable as study sites. Criteria for acceptable sites included a substratum with abundant finger coral (*Porites compressa*) at 10- to 18-m depths. Finger coral is an important habitat for juvenile aquarium fishes, particularly the yellow tang, *Zebrasoma flavescens*, and typically dominates most areas of the West Hawai'i coast at 10- to 18-m depths except along exposed headlands and on recent lava flows (Grigg and Maragos 1974, Dollar 1982). Within an area of suitable habitat and depth a float with an attached weight was haphazardly thrown off a moving vessel and the ocean-side center transect pin was established at the coral colony nearest to the weight on the bottom. Using five additional stainless-steel bolts cemented into the bottom, we established four permanent 25-m transects in an H-shaped pattern at each of the study sites. During field surveys, study sites were located by differential global positioning system (GPS), and the transect lines were deployed between the eyebolts.

Survey Methods

We used a quantitative video sampling method to monitor benthic habitats at each study site (Aronson et al. 1994, Carleton and Done 1995). To ensure consistency with other coral reef survey methods used in the state of Hawai'i, we developed our design in

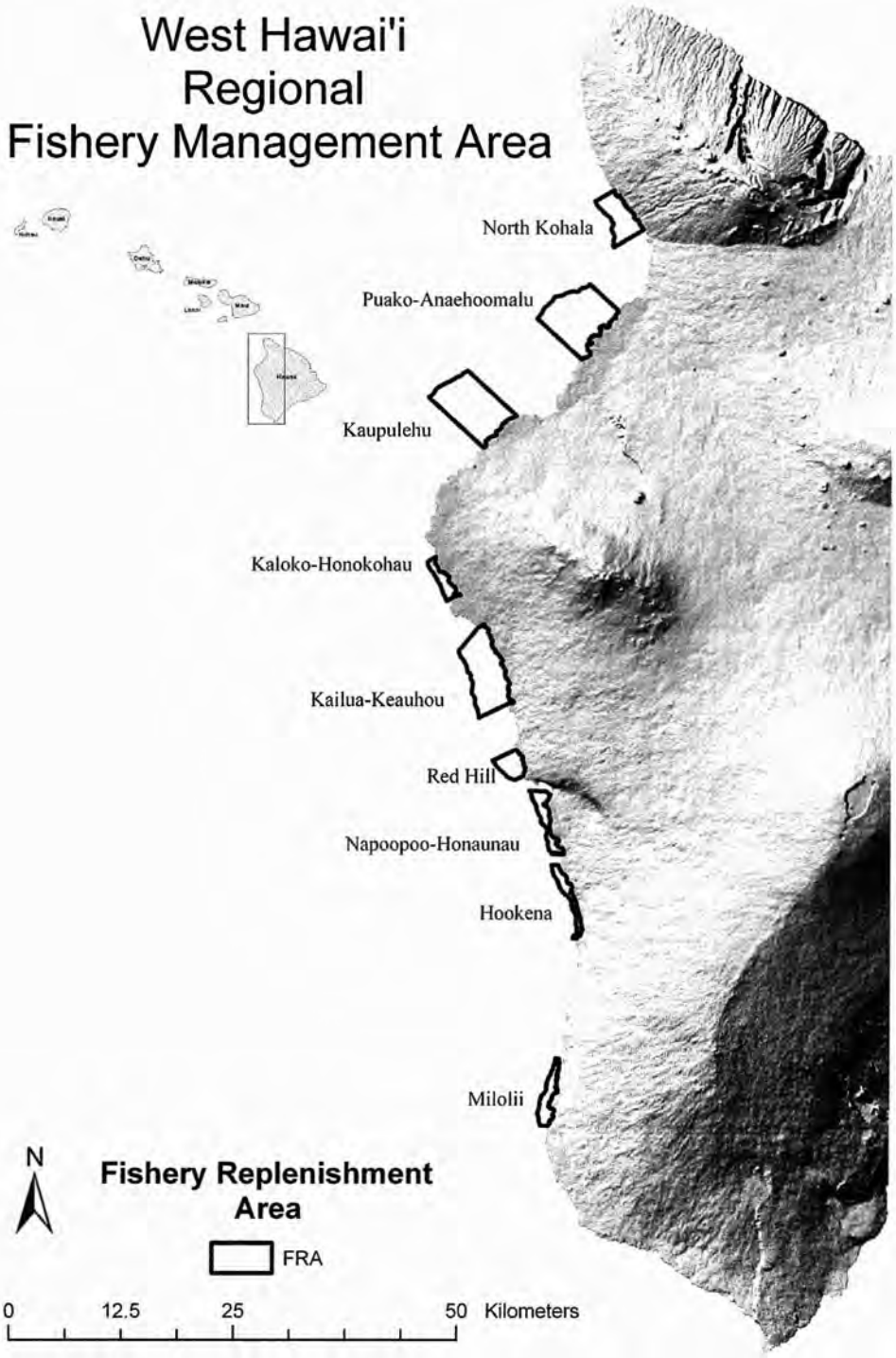

FIGURE 1. Locations of Fishery Replenishment Areas (FRAs) established in the West Hawai'i Regional Fishery Management Area.

TABLE 1

Descriptions of Study Sites Established in the West Hawai'i Regional Fishery Management Area in Relation to Observational Design Assignments

Site	Status[a]	Protected Activities at Site	Depth Range (m)
North Kohala			
1. Lapakahi	MLCD	No fishing, taking, or injuring of any type of marine life is permitted	10–15
2. Kamilo	Open	No restrictions	13–15
3. Waiaka'īlio Bay	FRA	No taking of aquatic life for aquarium purposes or to engage in fish feeding	12–14
Puakō-'Anaeho'omalu			
4. Puakō	FMA	Prohibited to possess or use any type of net except throw net	9–10
5. 'Anaeho'omalu	FRA	No taking of aquatic life for aquarium purposes or to engage in fish feeding	10–11
6. Keawaiki	Open	No restrictions	11–15
Ka'ūpūlehu			
7. Ka'ūpūlehu	FRA	No taking of aquatic life for aquarium purposes or to engage in fish feeding	13
8. Makalawena	Open	No restrictions	10–11
Kaloko-Honokōhau			
9. Wāwāloli Beach	Open	No restrictions	10
10. Wāwāloli	FMA	No taking of aquatic life for aquarium purposes or to engage in fish feeding, except for 'ōpelu fishing	12–15
11. Honokōhau	FRA	No taking of aquatic life for aquarium purposes or to engage in fish feeding	12–14
Kailua-Keauhou			
13. Papawai	FMA	No taking of aquatic life for aquarium purposes or to engage in fish feeding, except for 'ōpelu fishing	9–13
14. S. Ōneo Bay	FRA	No taking of aquatic life for aquarium purposes or to engage in fish feeding	10–14
Red Hill			
15. N. Keauhou	FRA	No taking of aquatic life for aquarium purposes or to engage in fish feeding	9–12
16. Kualanui Point	Open	No restrictions	9–13
17. Red Hill	FMA	No taking of aquatic life for aquarium purposes or to engage in fish feeding except for 'ōpelu fishing	12–15
Nāpō'opo'o-Hōnaunau			
18. Keōpuka	Open	No restrictions	9–14
19. Kealakekua Bay	MLCD	No fishing, taking or injuring of any type of marine life is permitted	6–11
20. Ke'ei	FRA	No taking of aquatic life for aquarium purposes or to engage in fish feeding	9–15
Ho'okena			
21. Ho'okena (Kalāhiki)	FRA	No taking of aquatic life for aquarium purposes or to engage in fish feeding	9–12
22. Ho'okena ('Au'au)	Open	No restrictions	11–15
Miloli'i			
23. Miloli'i (Omoka'a)	FRA	No taking of aquatic life for aquarium purposes or to engage in fish feeding	10–15
24. Miloli'i (Manukā)	Open	No restrictions	10–15

[a] Protection status: MLCD, Marine Life Conservation District; FMA, Fishery Management Area; FRA, Fishery Replenishment Area; Open, areas open to aquarium harvesting.

cooperation with the Hawai'i Coral Reef Assessment and Monitoring Program (CRAMP) to estimate the abundance, diversity, and distribution of benthic habitats (see Brown et al. [2004], this volume).

The abundance of coral, nonliving substrates, and macroalgae was estimated at each site using a digital video camera (Sony DCR-TRV900) in an underwater housing (Amphibico). In the laboratory, individual contiguous still frames from each transect were extracted from each video and archived on CD-ROM. Percentage cover estimates of substrate types were then obtained using the program PointCount '99 (P. Dustin, pers. comm.). PointCount projects a series of random dots on each image. An observer then identified the substratum type under each point. Abundance estimates of different substrate types were derived by examining the number of 50 points contacting each substrate within each video frame. Although as many as 40 frames were archived from some transects, we randomly selected 20 frames from each transect because this was a sufficient number of frames to detect a 10% change in mean coral cover between two surveys ($\alpha = \beta = 0.10$). For this paper, habitat data were analyzed to test the assumption of our observational design that habitat variation was similar among FRA, reference, and open areas.

Survey methods were developed specifically for the monitoring of fishes and benthic substrates in West Hawai'i. Fishes were surveyed using visual strip transects, which have been shown to be highly repeatable and reasonably accurate (Brock 1954, Sale 1980). Because strip transect counts are known to be biased by different observers (e.g., McCormick and Choat 1987), we created a transect design that would allow us to survey a single reference, FRA, and open area on a single day with the same set of observers. Thus, our transect design was constrained around a maximum total daily bottom time of 2.5 hr, or about 50 min per site. Other considerations that influenced our design were the variability of abundance estimates, the number of species sampled, and the statistical power to detect meaningful changes in fish abundance (Mapstone 1996).

Pilot studies on the design of optimal transect length and number were conducted at Māhukona, Hawai'i, during the final survey of the QUEST coral reef monitoring workshop in 1995, 1996, and 1997 (Hallacher and Tissot 1999). Each year, four 50-m transects were established at 7-m and 15-m depths and all fishes were counted at 10-m intervals along transects by a pair of divers. Sequential 10-m segments of each transect were then pooled to examine the effects of various transect lengths on abundance estimates.

Based on species accumulation curves the number of different fish species observed along transects increased with transect length and number (Figure 2*A*). The number of species seen increased dramatically from 10- to 20-m transects, with smaller increases among 20-, 30-, 40-, and 50-m transect lengths. Based on these results, longer transects are likely to sample more species, although there did not appear to be much difference between results from 40- and 50-m transect lengths. In contrast, mean estimates of a common (yellow tang) and uncommon (*Chaetodon quadrimaculatus*) aquarium fish did not vary strongly with transect length, nor was there marked variation in the standard error of the estimate (Figure 2*B*). Thus, accuracy and precision did not appear to vary with transect length. Based on these two results, and the previously mentioned time constraints, we used a design that maximized the number of transects we could reasonably sample with two pairs of divers at a single site in 50 min: four 25-m transects. Based on previous experience sampling coral reef fishes in Hawai'i we selected a transect width of 2 m, which has been shown to produce reasonably precise estimates of fish abundance in other areas (Sale and Sharp 1983, Cheal and Thompson 1997).

Power analysis of preliminary fish transect data indicated that our observational design would detect 10–160% changes in the abundance of the principal targeted aquarium fishes in West Hawai'i during the first year using reasonable error rates ($\alpha = \beta = 0.10$; see Mapstone 1996). Power analyses were based on the ability of a two-sample *t*-test to detect significant differences between two

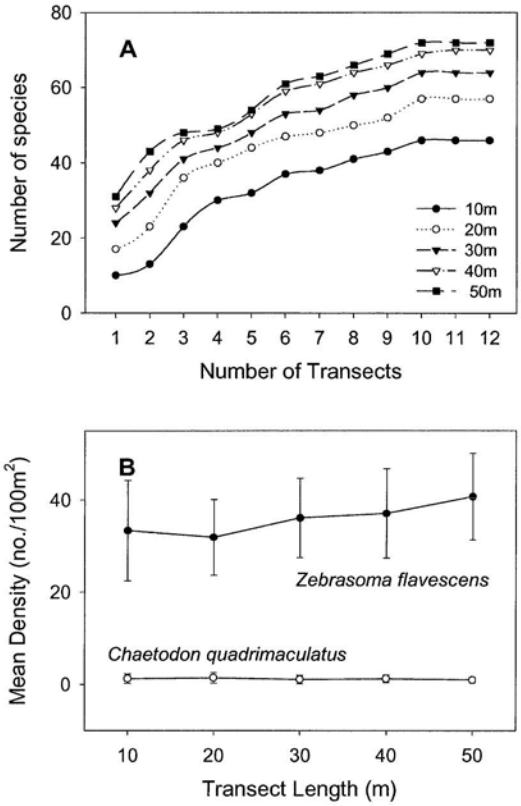

FIGURE 2. Results of pilot studies using visual strip transects that varied in transect length and number. *A*, Effects of various transect lengths and number on the total number of fish species observed. *B*, Effects of transect length on mean abundance and standard error of a common and an uncommon aquarium fish species.

samples. Our actual design is based on the BACI test (see under Data Analysis), which has even greater power to detect changes between surveys and locations (Underwood 1992).

Fish densities of all observed species were estimated by visual strip transect search along each permanent transect line. All divers either had extensive experience in conducting underwater fish surveys in Hawai'i or received training through QUEST before collecting any data. Two pairs of divers surveyed the lines, each pair searching two of the 25-m lines in a single dive. The search of each line consisted of two divers, swimming side by side on each side of the line, surveying a column 2 m wide. On the outward-bound leg, larger planktivores and wide-ranging fishes within 4 m of the bottom were recorded. On the return leg, fishes closely associated with the bottom, new recruits, and fishes hiding in cracks and crevices were recorded. All sites were surveyed bimonthly, weather permitting, for a total of six surveys per year (five in 2000). Due to problems with our research vessel, surveys were not conducted during the summer of 2002.

Data Analysis

All fishes observed were categorized as follows: (1) high rates of aquarium collecting (10 spp.), (2) any aquarium collecting (an additional 47 spp.), and (3) nonaquarium species (152 spp.). The presence and extent of collecting was based on reports in Miyasaka (1997).

We predicted that the density of protected fishes should increase in FRAs after closure, relative to reference areas, due to cessation of collecting. We tested the significance of our predictions using the Before-After-Control Impact (BACI) procedure (Osenberg and Schmitt 1996). This method tested for significant change in fish density by comparing mean FRA-reference differences before closure with mean FRA-reference differences after closure. The same comparison was also made for changes in open-reference differences to examine changes outside the FRAs.

We conducted the BACI procedure using a one-way, repeated-measure analysis of variance (ANOVA) with data from baseline surveys in 1999 (surveys 1–6) and the last six surveys in 2002 (surveys 18–23) to estimate the effectiveness of the FRAs after 3 yr of closure. Surveys were used as a random, repeated-measure factor. Data for the BACI analysis were limited to the five study areas that had reference, FRA, and open sites (Table 1). We evaluated effectiveness in two ways: (1) by calculating the percentage change in mean density from 1999 to 2002; and (2) by calculating the percentage change in the FRA-reference or open-reference difference from 1999 to 2002.

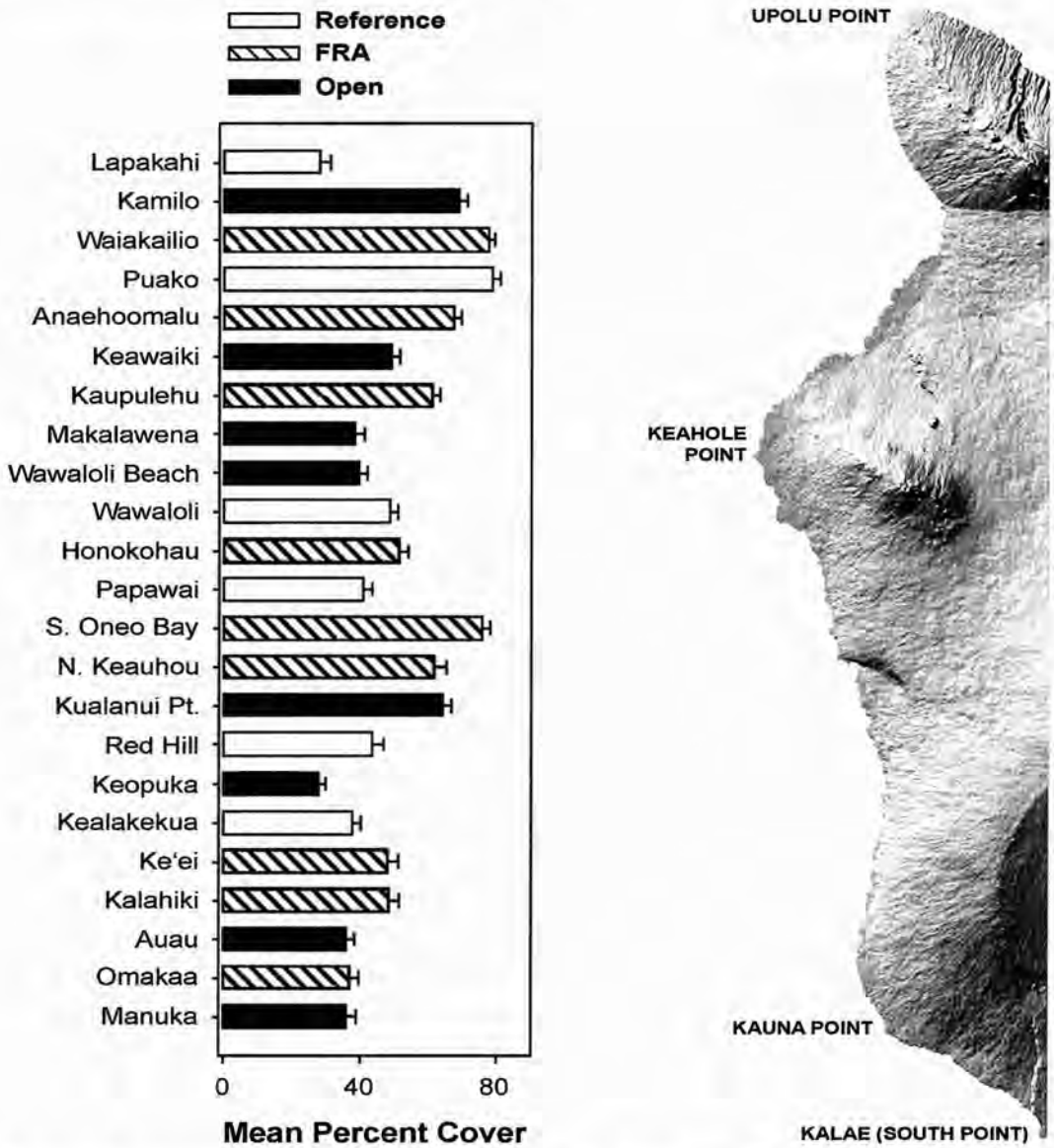

FIGURE 3. Mean percentage live coral cover at study sites in West Hawai'i (±1 SE). Site locations occur approximately opposite their geographic locations on the map (see Figure 1).

Estimates of the effects of aquarium collectors were made by comparing the mean density difference of target fishes in reference relative to FRA areas using the six baseline surveys from 1999 (see Tissot and Hallacher [2003] for a complete description of this method).

RESULTS

Benthic Habitat Analysis

Analysis of video transects revealed high variation in live coral cover in West Hawai'i (Figure 3). Overall, mean percentage coral cover ranged between 27% (Lapakahi) and

TABLE 2

Effects of Aquarium Collecting on Nine Species Estimated by Mean Percentage FRA-Reference Area Differences Using Data from Surveys before FRA Closure ($n = 6$ surveys)

Taxa	This Study	Tissot and Hallacher (2003)
Acanthurus achilles	−56*	−58*
Centropyge potteri	−42*	−46*
Chaetodon multicinctus	−4	−38*
Chaetodon ornatissimus	−7	−39*
Chaetodon quadrimaculatus	−97*	−42*
Ctenochaetus strigosus	−14*	−15
Forcipiger spp.	−55*	−54*
Zanclus cornutus	−49*	−46*
Zebrasoma flavescens	−43*	−47*
Overall	−26*	

Note: Statistical differences in density between reference and FRA sites were tested using a two-sample t-test (* = significant at $P < 0.05$). Mean estimates are compared with the study of Tissot and Hallacher (2003), which estimated the effects of aquarium collectors on these species in a previous study in West Hawai'i.

78% (Puakō). In general, coral cover was higher in sheltered areas (e.g., Puakō) and lower in areas located on more wave-exposed headlands (e.g., Keōpuka). One-way ANOVA among coral cover at reference, FRA, and open areas was not significant ($F = 2.18$; df = 2,22; $P = 0.14$).

Effects of Collectors

Overall, there were significantly less aquarium fishes in FRAs relative to reference areas in seven of the nine species analyzed during 1999 baseline surveys when collecting was still occurring (Table 2). Overall differences were significantly lower in *Acanthurus achilles* (−56%), *Centropyge potteri* (−42%), *Chaetodon quadrimaculatus* (−97%), *Ctenochaetus strigosus* (−14%), *Forcipiger* spp. (−55%), *Zanclus cornutus* (−49%), and *Zebrasoma flavescens* (−43%). There were no significant differences in *C. multicinctus* or *C. ornatissimus* (Table 2). Overall, aquarium fishes were 26% less abundant in FRAs relative to reference areas.

Effectiveness of FRAs

Overall there was a significant increase in the abundance of aquarium fishes in FRAs after 2 yr of FRA closure (Table 3A). The mean density of aquarium fishes increased 26%, and the mean density in FRAs relative to reference areas increased 50%, between pre- and postclosure surveys (Figure 4). Two of the 10 aquarium species examined had significant increases in FRAs relative to reference areas: the yellow tang, *Zebrasoma flavescens* (74%), and Potter's angelfish, *Centropyge potteri* (80%). In contrast, there were no significant changes in nonaquarium fishes in FRAs (Table 3A, Figure 4).

In areas open to collecting there were no significant overall changes among aquarium nor nonaquarium fishes before and after FRA closure (Table 3B). However, two of the 10 aquarium species had significant increases in abundance in open relative to reference areas: *Ctenochaetus strigosus* (51%) and *Forcipinger flavissimus* (61%) (Table 3B).

Recruitment

Although newly recruited individuals were present during the summers of all years, there were higher levels of recruitment of aquarium fishes after FRA closure during the summers of 2001 and 2002 relative to earlier years (Figure 5). In contrast, nonaquarium recruits were more common in 1999 before FRA closure, declining in 2000–2002. A two-way BACI ANOVA was not significant among aquarium and nonaquarium recruits, before and after closure, nor was there a significant interaction between these two factors (all $P > 0.05$).

DISCUSSION

Analysis of baseline surveys in 1999 supports earlier research documenting significant effects of aquarium collector harvesting on selected fishes in West Hawai'i. Preclosure surveys indicate that collectors continued to target seven of the nine aquarium species examined in the FRAs before closure on 1 January 2000. On average aquarium fishes were

TABLE 3

Two-way BACI Repeated-Measure ANOVA Testing for Significant Changes in before (1999) and after (2002) FRA Closure (BA)

Taxa	Mean Density (No./100 m^2) Before	After	% Change Density	% FRA-Reference Change	*P* (BA)
A. Reference-FRA differences					
Acanthurus achilles	0.22	0.28	+27	+13	0.76
Centropyge potteri	1.16	1.03	−17	+80	0.03*
Chaetodon multicinctus	4.88	3.92	−20	+76	0.26
Chaetodon ornatissimus	0.95	0.91	−4.2	−112	0.75
Chaetodon quadrimaculatus	0.01	0.02	+100	−61	0.08
Ctenochaetus strigosus	28.1	32.3	+15	+29	0.40
Forcipiger flavissimus	0.61	0.44	−28	+49	0.34
Forcipiger longirostris	0.27	0.45	+67	−47	0.32
Zanclus cornutus	0.27	0.13	−52	+27	0.57
Zebrasoma flavescens	14.2	24.6	+73	+74	<0.01*
All aquarium fishes	50.6	64.0	+26	+50	0.01*
All nonaquarium fishes	42.1	47.2	+12	−27	0.12
B. Reference-open differences					
Acanthurus achilles	0.53	0.46	−13	+131	0.15
Centropyge potteri	1.62	1.43	−12	+161	0.06
Chaetodon multicinctus	4.70	4.22	−11	−44	0.86
Chaetodon ornatissimus	0.72	0.67	−6.9	−37	0.60
Chaetodon quadrimaculatus	0.53	0.51	−3.8	−127	0.23
Ctenochaetus strigosus	22.4	30.5	+36	+51	<0.01*
Forcipiger flavissimus	0.46	0.45	−2.2	+61	0.01*
Forcipiger longirostris	0.36	0.49	+36	−72	0.32
Zanclus cornutus	0.35	0.44	+26	+167	0.06
Zebrasoma flavescens	13.7	13.8	+0.7	−21	0.16
All aquarium fishes	45.0	52.8	+17	+14	0.11
All nonaquarium fishes	60.8	74.8	+23	+0.7	0.94

Note: *P* values are reported for the most commonly targeted aquarium fishes, all aquarium species pooled ($n = 57$ species), and nonaquarium species (* = significant at $P < 0.05$).

14–97% less abundant, and overall 26% less abundant in FRAs than in adjacent reference areas. With the exception of *C. multicinctus* and *C. ornatissimus*, these estimates are remarkably similar to those reported previously by Tissot and Hallacher (2003), whose study was conducted in 1997–1998 at two of the nine areas surveyed in this study.

Three years after closure of FRAs there were significant increases in the overall abundance of fishes targeted by collectors. It is interesting that the estimated increase in abundance (26%) is the same amount as the estimated reduction due to collectors before FRA closure, suggesting that as a group these fishes may have increased to their preexploitation levels. However, only two species, the yellow tang and Potter's angelfish, showed significant (74–80%) increases in FRAs relative to previously protected reference areas. Moreover, several others species, notably *C. multicinctus* and *F. flavissimus*, showed high (>40%) but nonsignificant increases in FRAs relative to reference area (Table 3), and several other species (*C. ornatissimus*, *C. quadrimaculatus*, and *F. longirostris*) showed high but nonsignificant *decreases* in FRAs relative to reference areas. Thus, because Potter's angelfish is not abundant, it seems likely that the significant increase in aquarium fishes was largely driven by the dramatic increase in yellow tangs to preexploitation (or reference)

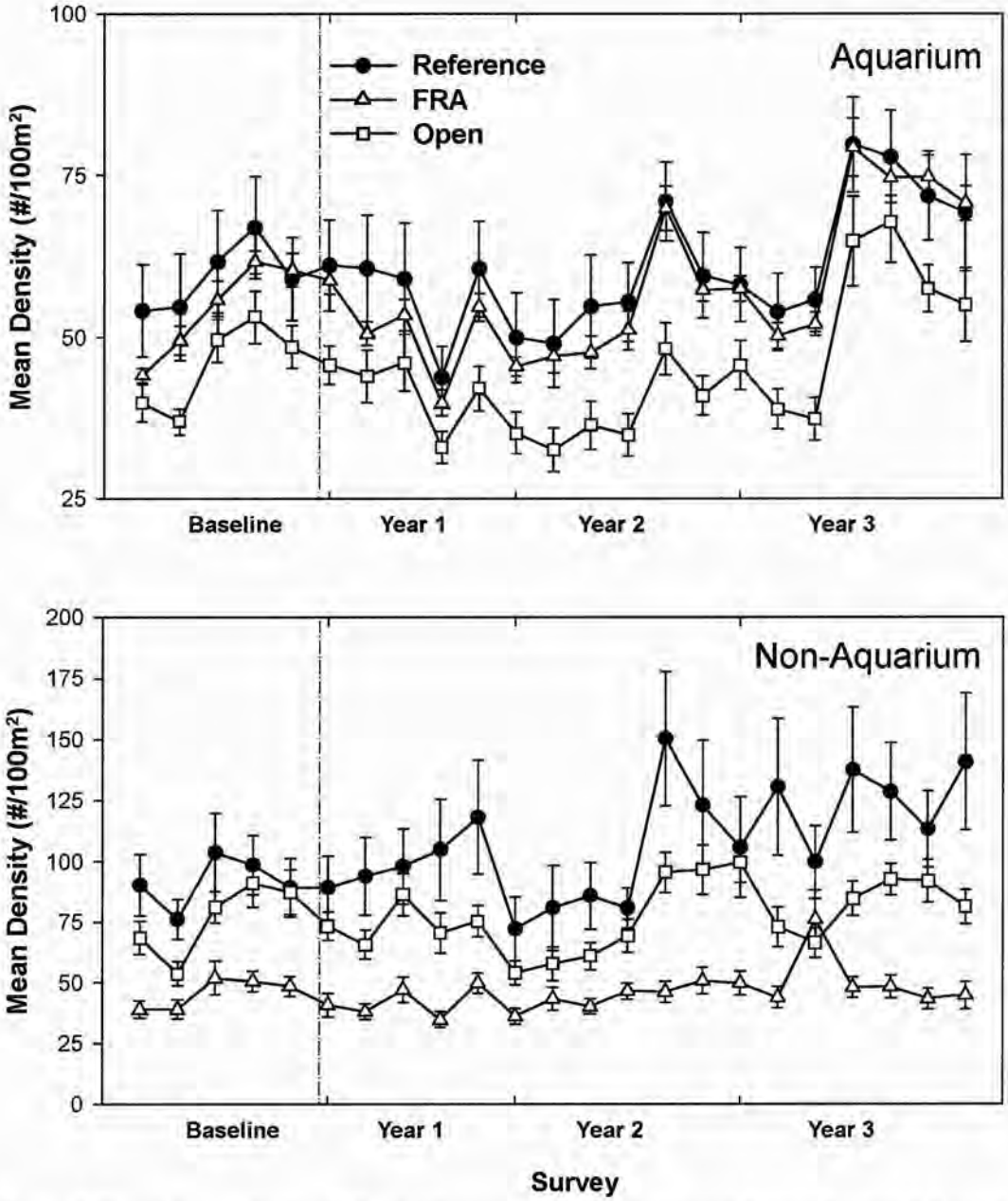

FIGURE 4. Changes in mean density of fishes in reference, open, and FRA areas pooled across all surveys before and after FRA closure (±1 SE). *Top:* aquarium fishes; *bottom:* nonaquarium fishes.

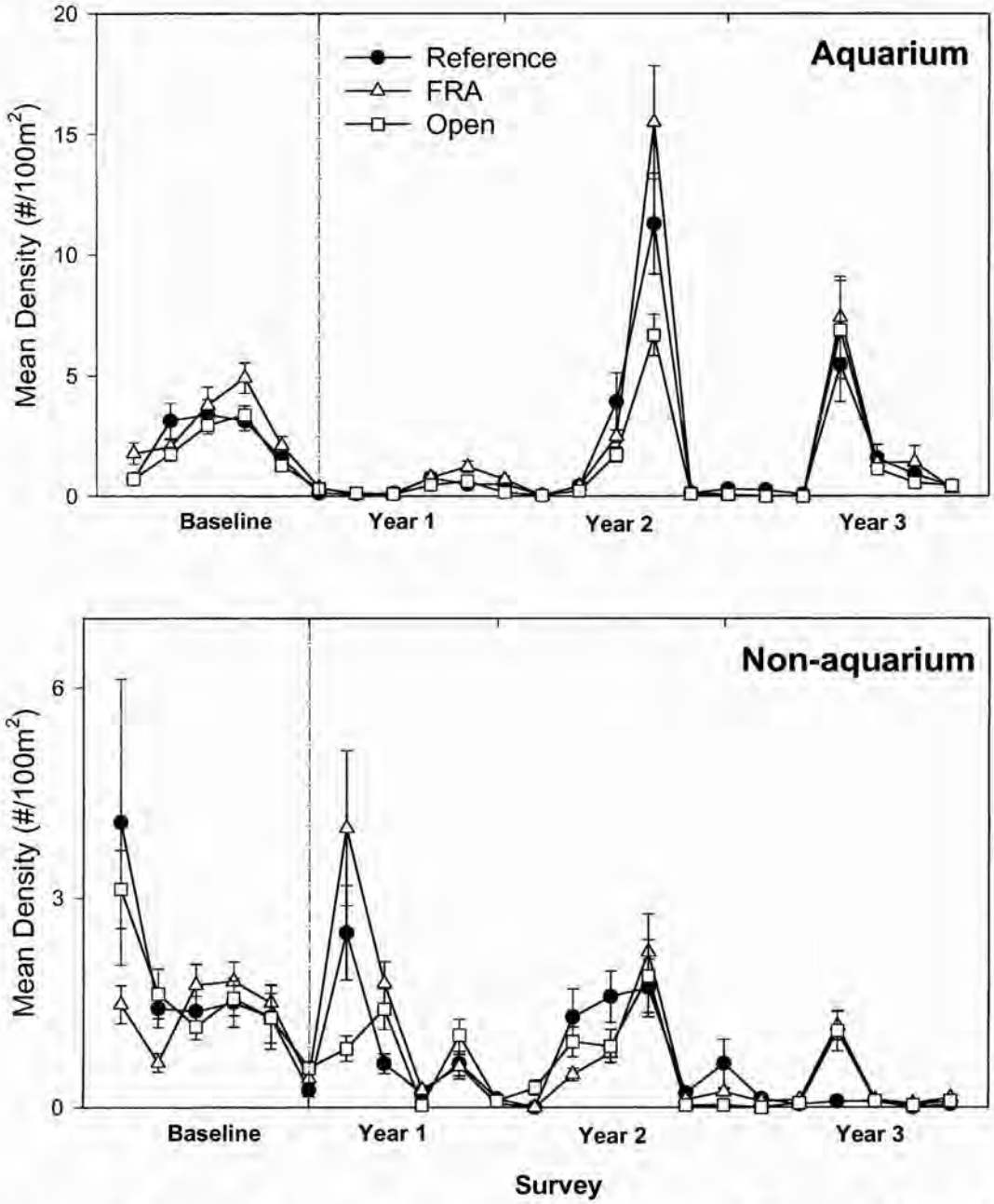

FIGURE 5. Changes in mean density of newly recruited fishes in reference, open, and FRA areas pooled across all surveys before and after FRA closure (±1 SE). *Top:* aquarium fishes; *bottom:* nonaquarium fishes.

levels. This observation is supported by the fact that the yellow tang composes about 82% of the total aquarium catch in West Hawai'i (Miyasaka 1997).

In contrast, there were no significant changes among noncollected species within FRAs or in aquarium and nonaquarium species in areas outside FRAs. Furthermore, no aquarium fishes declined in abundance in open areas as might be expected if the intensity of harvest increased outside the FRAs. In fact, two species displayed significant increases in abundance. Thus, overall the results of this study indicate that FRAs can help aquarium fish recover abundance, at least for the yellow tang and Potter's angelfish, without associated decreases in abundance outside FRAs, a common criticism of MPAs (e.g., Chapman and Kramer 1999).

There was strong interannual variation in the abundance of newly recruiting fishes in West Hawai'i. In general nonaquarium species had higher rates of recruitment before FRAs were closed in 1999, whereas aquarium species had higher recruitment in 2001 and 2002, after closure. It should be noted that the 2002 recruitment event of aquarium fishes was much larger than in 2001; the low number in the data is due to the fact that no surveys were conducted during the main summer months of 2002, only in September. Thus, it is tempting to associate the recovery of aquarium fishes in FRAs with high rates of recruitment, suggesting that the FRAs are enhancing recruitment. However, there was no significant variation between newly recruiting aquarium and nonaquarium fishes before or after FRA closure, and similar high temporal variation in reef fish recruitment in West Hawai'i was observed by Walsh (1987) over a 5-yr period. Thus, significant recovery in FRAs in some species during high levels of recruitment in 2001–2002 indicates that the frequency of recruitment is likely to be an important mechanism replenishing depleted stocks within MPAs in Hawai'i.

The results of this study demonstrate that the MPAs can effectively promote recovery of fish stocks depleted by fishing pressures in Hawai'i, at least in heavily exploited species, without significant declines outside MPAs. Within 3 yr two species, the yellow tang and Potter's angelfish, both reduced by over 40% before protection, displayed significant increases inside FRAs relative to reference areas. Yellow tangs increased in density 73% between 1999 and 2002, or about 10.4 fish per 100 m^2.

Based on these results it would be prudent to establish additional MPAs throughout Hawai'i as a precautionary measure against overfishing of marine resources. Currently, less than 1% of the main Hawaiian Islands is protected by MPAs (Clark and Gulko 1999). Furthermore, because recruitment appears to be an important mechanism influencing the replenishment of nearshore populations, we also advocate for increased monitoring of recruitment and nearshore oceanography to help better understand the dynamics of recruitment processes.

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Report to the Twenty-Fifth Legislature
Regular Session of 2010

REPORT ON THE FINDINGS AND RECOMMENDATIONS OF EFFECTIVENESS OF THE WEST HAWAI'I REGIONAL FISHERY MANAGEMENT AREA

Prepared by

Department of Land and Natural Resources
State of Hawai'i

In response to

Section 188F-5, Hawai`i Revised Statutes

January 2010

REPORT ON THE FINDINGS AND RECOMMENDATIONS OF EFFECTIVENESS OF THE WEST HAWAI'I REGIONAL FISHERY MANAGEMENT AREA

The West Hawai′i Regional Fisheries Management Area (WHRFMA) was created by Act 306, Session Laws of Hawaii (SLH) 1998, largely in response to longstanding and widespread conflict surrounding commercial aquarium collecting. The Act, now Chapter 188F, Hawaii Revised Statutes (HRS), required of the Department of Land and Natural Resources (DLNR), 1) A review of the effectiveness of the WHRFMA every five years, in cooperation with the University of Hawaii (UH), and 2) A report of its findings and recommendations prepared by DLNR to the Legislature following the review.

The overall goals of the Act are to effectively manage fishery activities, enhance nearshore resources and reduce conflict. Four management objectives were mandated: 1) Prohibit aquarium collecting in a minimum of 30% of West Hawai′i coastal waters, 2) Establish a day-use mooring buoy system, 3) Establish no-take reef fish reserves, and 4) Designate areas which prohibit gill nets.

SUMMARY OF FINDINGS

In order to accomplish the mandates of Act 306, SLH 1998, with required substantive community input, a community advisory group, the West Hawai′i Fisheries Council (WHFC) was convened by DLNR's Division of Aquatic Resources (DAR) in 1998. The first accomplishment of the WHFC was the designation of a network of nine Fish Replenishment Areas (FRAs), comprising 35.2% of the coastline. Aquarium collecting is prohibited within the FRAs. The FRAs became effective 31 December 1999.

Ten years after closure of the FRAs, the top 20 aquarium species showed a small overall increase in abundance relative to the period before the FRAs were operational. Most of the increase was attributed to the top two species Yellow Tang and Goldring Surgeonfish (kole) which comprise 91% of the West Hawai′i aquarium catch. These species increased in the FRAs by 57% and 13% respectively. Seven of the top 10 most collected species (representing <6% of all collected fish) decreased in overall density. Three of these decreases were significant (Achilles Tang, Multiband Butterflyfish and Black Surgeonfish).

The FRAs were „effective" (increases in FRAs relative to long term MPAs) for eight of the top 10 collected species with three being statistically significant. With only a single exception, the FRAs were highly effective in increasing the abundance of Yellow Tang within their areas spread along the West Hawai′i coastline. While habitat characteristics, FRA size, and density of adult fishes are important factors influencing the effectiveness of FRAs, successful recruitment of young fish is a fundamental requirement. Poor recruitment appears to be a key factor in the population declines within the FRAs of some aquarium species.

The effect of the FRAs on the aquarium fishery itself has been positive overall. The number of commercial aquarium collectors in West Hawai′i increased 19% over the past 10 years, catch increased 25%, and its value 71%. In terms of conflict reduction between stakeholder groups, survey data indicated that for both aquarium fishers and SCUBA dive operators, more individuals felt the FRAs were effective than not.

As a management adjunct to the FRAs, the WHFC has recommended a „white list" of 25 species which can be harvested by aquarium collectors. All other species would be off limits. 12+ other species of special concern, with particular ecological and cultural importance, were also proposed for protected (i.e. no-take) status. To prevent the continued unbridled growth of the aquarium fishery, the WHFC has proposed the implementation of a limited entry program for West Hawai′i, which would be the first of its kind in state waters.

The day-use mooring buoy system is well established with limited expansion anticipated in the near future. As part of a 10-Year Strategic Management Plan for the day-use mooring system, the Malama Kai Foundation is working with DLNR to write and refine objectives for the system and develop bio-physical criteria for site selection.

Somewhat delayed progress on the establishment of no-take reef fish reserves is being realized. Educational and outreach efforts have been reinvigorated recently and survey results indicate increasing acceptance of the utility and benefit of such marine protected areas. Several local communities are actively engaged in developing management recommendations which include some form of a highly protected nearshore area.

Eight no lay gill netting areas were established in West Hawai′i in 2005, comprising 25% of the coastline (including already protected areas). Preliminary nearshore monitoring results do not find major differences in food fish abundance in/out of the no netting areas. The lack of a marked effect of protection may be due to several factors including the relatively low number of lay gill nets that are presently being used (i.e. registered) in West Hawai′i.

Although not formally established by statute, the West Hawai′i community"s formation of the WHFC has been, and continues to be, invaluable and instrumental in achieving the objectives of Act 306, SLH 2008. Recent WHRFMA initiatives which are in the process of administrative rule making include a ban on SCUBA spearfishing, species of special concern listing and resolution of aquarium related conflict at Pebble Beach, South Kona. Based on over a decade of experience, the WHFC has been a model system for the resolution of issues surrounding reef fisheries resources. Based on this review, a number of specific recommendations are proposed.

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BACKGROUND

The WHRFMA was conceived and established primarily in response to the activities of aquarium collectors along the West Hawai'i coastline. Overall, the marine aquarium fishery in the State of Hawai'i is one of the most economically valuable commercial inshore fisheries with Fiscal Year (FY) 2009 reported landings of 557,673 specimens and a total value of $1.08 million. The reported values may be underestimated by a factor of approximately 2 to 5X (Cesar et al. 2002, Walsh et al. 2003). Walsh et al. 2003 provides an historical overview of the commercial aquarium fishery in Hawai'i.

The aquarium collecting industry in Hawai'i and especially in West Hawai'i has long been a subject of controversy. In contrast to other areas in the State, in West Hawai'i the aquarium fishery has undergone substantial and sustained expansion over the past 30 years (Figure 1). Presently 75% of fish caught in the State and 67% of the total aquarium catch value comes from the Big Island and almost exclusively from West Hawai'i (Table 1). As the number of collectors in West Hawai'i began to rise and the numbers of animals collected increased markedly, conflict escalated along the coast, most particularly between dive tour operators and collectors. A short-lived informal "Gentleperson‟s Agreement" was reached in 1987 whereby aquarium collectors agreed to refrain from collecting in certain areas. In return, charter operators agreed not to initiate legislation opposing collecting and to cease harassment. In 1991 four of the areas from

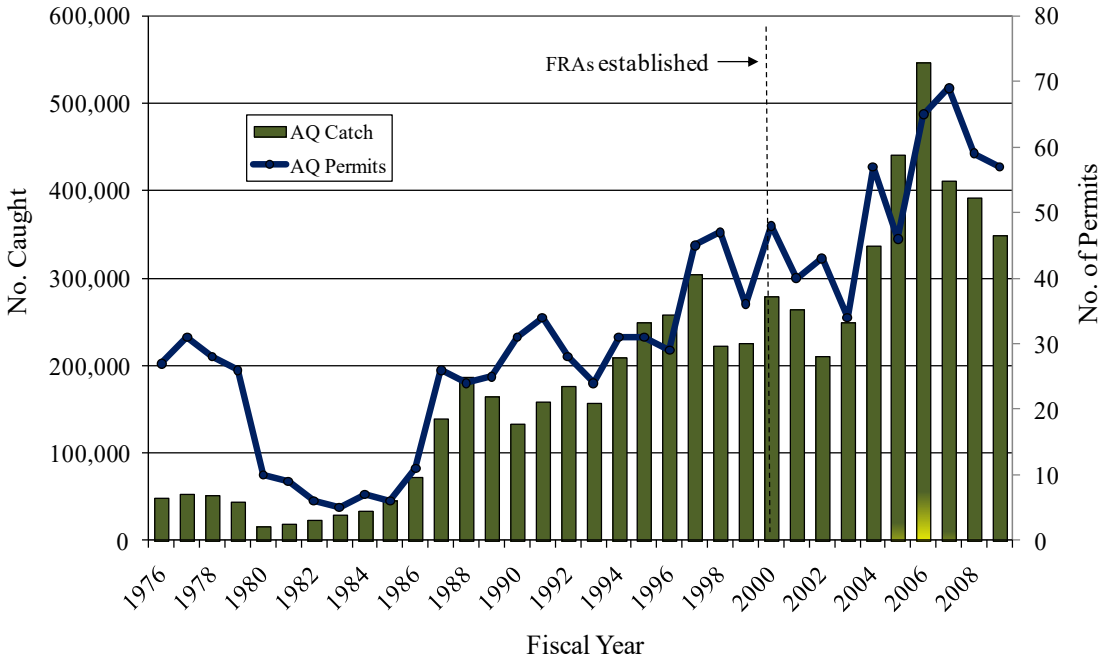

Figure 1. Number of aquarium animals collected and number of commercial aquarium permits in West Hawai'i for Fiscal years 1976-2009.

the Gentleperson‟s Agreement were established as the Kona Coast Fisheries Management Area (FMA) within which aquarium collecting is prohibited (§13-58, Hawaii Administrative Rules (HAR)).

In spite of these management efforts, controversy and conflict over aquarium collecting continued unabated. Various meetings were held and legislative resolutions and bills were drafted to address the issue. A 1996 House Concurrent Resolution (HCR 184) requested DLNR, in conjunction with a citizens‟ task force, to develop a comprehensive management plan to regulate the collection of aquarium fish. A West Hawai'i Reef Fish Working Group (WHRFWG) involving over 70 members of the West Hawai'i community including aquarium collectors and charter operators and other stakeholders held nine meetings over a 15 month period. The WHRFWG opened a dialog between user groups and community members and provided a forum for the education of its members on social and biological issues involved in resource management

Table 1. Changes in West Hawai'i aquarium fishery since implementation of the FRAs. Dollar value is adjusted for inflation.

	FY 2000	FY 2009	Δ
No. Permits	48	57	19% ↑
Total Catch	279,606	349,250	25% ↑
Total Value	$745,129	$1,271,329	71% ↑
% of State Fish Catch	70%	75%	5% ↑
% of State Fish Value	67%	69%	2% ↑
% of State Total Catch	55%	63%	8% ↑
% of State Total Value	59%	67%	8% ↑

The WHRFWG identified "hot spots" along the coast where conflict over ocean resources was especially intense and also proposed a wide range of management recommendations, some of which were included in the 1997 DLNR legislative package. Working directly with the people of Ho'okena and Miloli'i, DAR developed comprehensive FMA rule proposals for each of these communities. To finally begin investigating the biological impact of collecting, DAR also commenced a joint research project with the University of Hawai'i-Hilo. Due in part to opposition by O'ahu aquarium collectors, only one legislative recommendation of the WHRFWG passed; establishing licenses for aquarium exporters. Similarly, recommendations involving the DAR FMA rule proposals languished.

Act 306, SLH 1998

In response to the perceived lack of success in adequately dealing with aquarium collecting, a number of citizens, including several members of the WHRFWG formed a grassroots organization, the Lost Fish Coalition (LFC), to push for a total ban on aquarium collecting in West Hawai'i. They collected almost 4,000 signatures on a petition to ban such collecting. In January 1997, Representative (Rep.) Paul Whalen (R-Kona, Ka'u) introduced legislation (House Bill (HB) 3349) which proposed an outright

ban on all collecting between Kawaihae and Miloli'i. Shortly thereafter, Rep. David Tarnas (D-N. Kona, S. Kohala) introduced HB 3457. This bill proposed establishing a West Hawai'i Regional Fishery Management Area (WHRFMA) along the entire 147 mile West Hawai'i coast (Upolu Pt. to Ka Lae) to provide for effective management of marine resources. Among several provisions of this bill was a requirement to set aside 50% of the WHRFMA as Fish Replenishment Areas (FRAs) where aquarium collecting was prohibited. In February 1998, HB 3348 was put on hold. During committee hearings on HB 3457, the 50% provision for FRAs was reduced to "a minimum of 30%." Aquarium collectors and other user groups endorsed the bill and it was passed by the Legislature as Act 306, SLH 1998; effective 13 July 1998.

Given the longstanding and contentious nature of the aquarium issue in West Hawai'i, the importance of government action in finally addressing the issue cannot be underestimated. It was only when organized and concerted community effort was applied directly via the legislative process that the means for resolution was made possible. It seems highly likely that without the direct legislative mandates of Act 306, SLH 1998, which provided DLNR with the administrative authority to manage the fishery and region, little progress would have been made in successfully managing this controversial fishery. However, as this report later notes, additional legislative action is needed to provide authority to adopt a limited entry management tool.

Act 306, SLH 1998, established a West Hawai'i Regional Fishery Management Area along the entire west coast of the Island of Hawai'i (§188F-4, HRS). Overall, the purposes of Act 306 are to:

(1) Effectively manage fishery activities to ensure sustainability;
(2) Enhance nearshore resources;
(3) Minimize conflicts of use in this coastal area.

There were also four specific management objectives to be accomplished by DLNR:

(1) Designate a minimum of 30% of coastal waters as Fish Replenishment Areas (FRAs) where aquarium collecting is prohibited.
(2) Establish a day-use mooring buoy system and designate some high-use areas where no anchoring is allowed.
(3) Establish a portion of the FRAs as fish reserves where no fishing of reef-dwelling fish is allowed.
(4) Designate areas where the use of gill nets is prohibited.

A review of the WHRFMA management plan was to be conducted every five years in cooperation with the UH.

Additionally, Act 306, SLH 1998, also directed DLNR/DAR to identify the specific areas and restrictions "after close consultation and facilitated dialogue with working groups of community members and resource users" mandating "substantive involvement of the community in resource management decisions" was a unique and key aspect of the legislation rather than a purely "top-down" (i.e. government-driven) approach which

specified all the details of required management actions, Act 306, SLH 1998, instead directed the community to actively participate in the development of such actions. This approach was at once both innovative and far-reaching.

The West Hawai'i Fisheries Council (WHFC)

In order to accomplish the mandates of Act 306, SLH 1998, with substantive community input, The West Hawai'i Fisheries Council (WHFC) was convened June 16, 1998 under the aegis of DLNR and the University of Hawai'i Sea Grant. Consisting of 24 voting members and 6 ex-officio agency representatives from DLNR, Sea Grant, and the Governor‟s Office, the WHFC‟s members represented diverse geographic areas and various stakeholder, community and user groups in West Hawai'i. Four aquarium representatives (three collectors and one aquarium shop owner) were members of the WHFC, 40% of the WHFC were kanaka maoli and most of the members were previously on the WHRFWG.

The WHFC provided the vehicle for stakeholders to participate directly in the development of management recommendations. Such participation has important benefits for increasing legitimacy of decisions in the eyes of stakeholders, as well as increasing compliance with decisions and rules subsequently established (Kessler 2004).

The first mandate of Act 306 was the establishment the FRAs. FRAs were mandated to address concerns over user conflict and localized resource depletion caused by aquarium fish collectors in West Hawai'i. Working under a punishing deadline, the WHFC, by determination, consensus and vote, developed an FRA plan consisting of nine separate areas along the coast (Figure 2) encompassing a total of 35.2% of the West Hawai`i coastline (including already protected areas). Perhaps somewhat surprisingly the areas specifically recommended as FRAs by the aquarium collecting representatives on the Council showed remarkable congruence with those selected by the WHFC as a whole.

The WHFC‟s FRA plan was subsequently incorporated by DLNR into administrative rules. The 28 April 1999 public hearing on the FRA Rule (§13-60.3, HAR) was the largest ever conducted by DAR with at least 860 attendees. The Plan received overwhelming support (93.5% of 876 testimonies) from a wide range of community sectors. The FRA administrative rule was signed into approval by Governor Benjamin Cayetano on 17 December 1999 becoming effective 31 December 1999.

The FRAs prohibit all collecting of aquarium animals within their boundaries as well as non-fishing related fish feeding. The seaward boundaries of the FRAs extend to a depth of 100 fathoms and distinctive signs mark the boundaries on shore.

The WHFC and the FRA development process have been the focus of a number of in-depth reports and scientific case studies (Walsh 1999, Capitini et al. 2004, Tissot 2005, Maurin and Peck 2008, Tissot et al. 2009, Gregory 2009) making it one of the most intensively studied community driven management efforts in the State of Hawai'i.

In addition to the development of the FRA network the WHFC, in conjunction with DAR and UH Sea Grant, has been successful in achieving a number of other accomplishments (after Maurin and Peck, 2008):

- **Sea Urchin Limited Harvest**: The WHFC developed a management plan permitting the sustainable harvest of *wana* (long-spine/black sea urchin) at Makae'o, the Old Kona Airport Marine Life Conservation District (MLCD). This recommendation was adopted by DLNR as an administrative rule.
- **The West Hawai'i Youth Fisheries Council**: An outreach component of the WHFC, the Youth Fisheries Council worked with the Hawai'i County Council to ban smoking at Kahalu'u Beach Park.
- **Gill Net Rules**: The WHFC developed a set of gill net rule recommendations focused on limiting impacts of large-scale commercial netting while providing for subsistence netting (see Gill Net Section). This recommendation was adopted as an administrative rule).
- **Day-Use Mooring Buoys**: In collaboration with the Malama Kai Foundation, the WHFC is a working partner in the site selection process and educates communities on the value of day use moorings to preserve our coral reefs (See Mooring Buoy Section).
- **SCUBA Spear Fishing Recommendations**: The WHFC set forth a set of recommendations to ban SCUBA spear fishing in West Hawai'i. This recommendation was adopted by DAR and is currently in the administrative rule making process.
- **Pebble Beach User Conflict**: The WHFC drafted recommendations addressing a conflict between aquarium collectors and this South Kona community. It recommended creating a new FRA in the Pebble Beach area and opening up to collecting a similarly sized section of another FRA (by a non-residential area). This recommendation was adopted by DAR and is currently in the administrative rule making process.
- **Species of Special Concern:** Based on scientific input from DAR, the WHFC developed a list of 25 species which can be harvested by aquarium collectors. Several other species of special concern are to be protected from all harvesting. This recommendation was adopted by DAR and is currently in the administrative rule making process.
- **Limited Entry Aquarium Program:** The WHFC recommended to DAR that Limited Entry Rules be adopted for further management of the Aquarium Industry. Capping the number of permitted aquarium collectors on the reef will curtail unregulated expansion of the aquarium fishery and ensure that participation in fishery requires a high level of skill, experience and regulatory compliance. The rules will enhance the economic value of the reefs and their marine life and will serve as an economic incentive to fishers to promote good stewardship of the reefs. This recommendation, which would be the first of its kind in state waters, has been passed on to DAR.
- **Informal Council Involvement:** The WHFC has helped mediate between a community group and a live aboard dive operator, to ensure minimal disruption to the endangered Hawksbill sea turtle nesting and hatching.

The creation and functioning of the WHFC is entirely attributable to the volunteer commitment of time, energy and resources of its members. The 62 members of the community who have been members at one time or another of the WHFC have contributed nearly 5,000 hours of their own time at no cost to the State. While not directly authorized by state law, this community-based advisory body represents a valuable tool to state government in terms of its approach to and recommendations on marine resource management. These efforts have been assisted by the support of community organizations such as the Hawai'i Community Foundation, The Nature Conservancy, Community Conservation Network and the Harold Castle Foundation, all of whom recognize the significance and value of the WHFC and its role in assisting in effective management of our marine resources.

West Hawai`i Aquarium Project (WHAP)

Although Act 306, SLH 1998, mandated review and evaluation (thus monitoring) of the FRAs in conjunction with the UH, no funding was provided to accomplish this. In order to investigate the effectiveness of the FRAs to replenish depleted fish stocks, a consortium of researchers established the West Hawai'i Aquarium Project (WHAP) in early 1999. Funding was secured for the early years of the project through the Hawai'i Coral Reef Initiative Research Program (HCRI-RP), a federal initiative under the aegis of the National Oceanic and Atmospheric Administration (NOAA). Subsequent funding has been provided by Coral Reef Monitoring Grants under NOAA‟s Coral Reef Conservation Program. The initial project researchers were Dr. Brian Tissot, Washington State University, Dr. William Walsh, DAR/DLNR and Dr. Leon Hallacher, University of Hawai'i-Hilo. They have been joined in recent years by Dr. Ivor Williams, National Marine Fisheries Service, Dr. Mark Hixon, Oregon State University and Dr. Helen Fox, World Wildlife Fund.

WHAP established 23 study sites (Figure 2) along the West Hawai'i coastline in early 1999 at 9 FRA sites, 8 open sites (aquarium fish collection areas) and 6 previously established Marine Protected Areas (MPAs) to collect baseline data both prior to and after the closure of the FRAs. The MPAs are MLCDs and Fishery Management Areas (FMAs), which have been closed to aquarium collecting for at least 9 years and were presumed to have close to "natural" levels of aquarium fish abundances. They serve as a reference or „control‟ to compare with the FRAs and open areas.

The overall goals of WHAP were two-fold: 1) To evaluate the effectiveness of the FRA network by comparing targeted aquarium fishes in FRAs and open areas relative to adjacent control sites and, 2) To evaluate the impact of the FRA network on the aquarium fishery.

Detailed explanations of the study sites and survey methodology are contained in Tissot et al. 2004 and Division of Aquatic Resources 2004. To briefly summarize: Densities of all fish and selected invertebrate species are visually estimated along four 25X4m strip transects at each of 23 permanent sites in the three types of management areas. All survey divers either have extensive experience in conducting underwater fish surveys in Hawai'i

or received training through the UH‟s Quantitative Underwater Ecological Survey Techniques (QUEST) training course prior to collecting data (Hallacher and Tissot, 1999). In addition to the transect surveys, a 10 minute „free-swim‟ survey is also

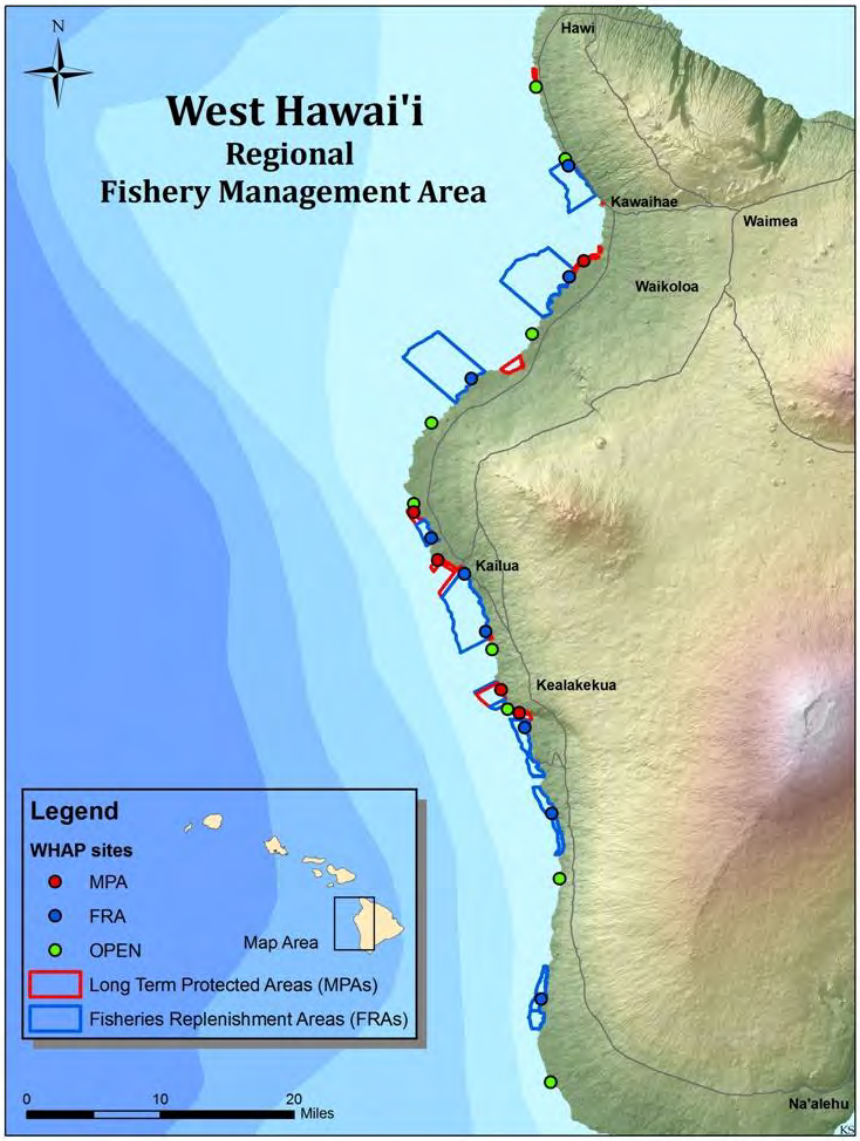

Figure 2. Locations of Fish Replenishment Areas (FRAs) in West Hawai'i and DAR monitoring sites (6 MPAs, 9 FRAs and 8 open sites).

conducted by two divers in the areas surrounding the actual transects. The purpose of this survey is to better census uncommon or rare species and species of particular ecological interest such as taape, roi, terminal phase parrotfish, cleaner wrasses and crown-of-thorns starfish. All sites are surveyed at least four times a year. As of December 2009, a total of 55 survey rounds of all study sites have been completed (>5,000 transects). Six rounds were conducted prior to FRA closure in 1999.

The general rationale for WHAP"s goals was based on the premise that changes in FRAs and open areas can best be estimated by comparing them to other areas which have been protected for relatively long periods of time. These areas (MPAs) serve as control areas against which the FRAs are measured both before and after the closure of the FRAs. This rationale is derived from a well-known statistical procedure known as the BACI (Before-After-Control-Impact) procedure (Tissot et al, 2004) which is an appropriate and statistically powerful method for examining FRA effectiveness.

The BACI procedure attempts to take into account changes that may be affecting the ecosystem but are unrelated to the workings of the FRAs. For example, there could be several years of widespread and plentiful recruitment of aquarium fish to the reefs of West Hawai'i. The numbers of fish would thus increase in the FRAs (as well as other areas) over time, but the increase in a particular FRA may not have anything to do with it being protected from aquarium collecting. Instead, the increase in fish could just be the result of favorable ocean currents or more food available during the fish"s offshore larval stage which results in more young fish recruiting to the reefs. The BACI procedure separates out these factors by comparing the FRAs (or open areas) to control areas which serve as reference points to gauge change.

For this study FRA effectiveness (R) is measured statistically as the change in the difference between each FRA and the mean of all MPA sites during each survey (control vs. impact) from before (1991-2000) vs. after (2007-2009) FRA establishment. Details on this procedure are covered in (Tissot et al, 2004, Division of Aquatic Resources 2004).

R measures the changes within the FRA as a percent of the baseline abundance relative to control sites. In the case of this study, R is a measure of the effectiveness or „protective value" of the FRAs. That is, what effect is increased protection having on targeted fish?

Scientific studies on reef fishes are notoriously difficult due to the very high variability of fish abundance in both time and space. Even with a rigorous statistical design (such as BACI) and 11 years of study, it is difficult to statistically detect changes in abundances except for the most common species that exhibit relatively large changes.

FINDINGS AND EVALUATION

Fish Replenishment Areas (FRAs)

The overall changes in fish abundance and effectiveness of the FRAs are shown in Table 2. Young-of-Year (YOY) fishes (i.e. newly settled/recruited) are not included in analyses since their initial abundance is not directly related to aquarium collecting. The top 20 aquarium fishes in general have shown only a minor, nonsignificant increase and most of the increase is attributable to the two most heavily collected species, the Yellow Tang and Goldring Surgeonfish (Table 3). These two species account for 91% of total fish catch over the last five years (Appendix A) and thus are key indicators of the protective value of the FRAs and the sustainability of the aquarium fishery.

Table 2. Overall FRA effectiveness for fishes. 'Before' = Mean of 1999-2000; 'After'= Mean of 2007-2009. YOY not included.

GROUP	MEAN DENSITY (NO/100M^2)		OVERALL% CHANGE IN DENSITY	ρ	R	ρ
	Before	**After**				
Top 20 aquarium species	64.75	66.38	+3%	0.80	+6%	0.57
Aquarium fishes w/o Yellow Tang	52.01	46.43	-11%	0.27	**-17%**	0.02
Non-aquarium fishes	70.10	113.95	**+63%**	<0.01	**+95%**	0.03

Bold = statistically significant at ρ≤ 0.05

Changes for the ten most collected aquarium fishes across all FRAs are shown in Table 3. Yellow Tang density increased markedly (and significantly) in the FRAs while seven of 10 decreased (Achilles Tang, Multiband Butterflyfish and Brown Surgeonfish decreased significantly). These seven species represent <6% of the total West Hawai'i aquarium catch (Appendix A).

The FRAs were „effective" (increases in FRAs relative to long term MPAs) for eight of the top 10 collected species with three being statistically significant. As with density there were significant decreases in effectiveness for the Multiband Butterflyfish and Brown Surgeonfish. Both of these species are not very heavily collected averaging <2000 individuals per year over the last 5 years (Appendix A) and are fairly abundant on the reef. It"s thus not clear why their numbers are declining in the FRAs. These two species exhibited overall declines in all three types of areas with the greatest decrease in the protected areas (FRAs and MPAs). For the Brown Surgeonfish this may be the result of a competitive interaction with Yellow Tang and/or Goldring Surgeonfish. As their numbers have increased the Brown Surgeonfish"s has decreased. Both Yellow Tang and Brown Surgeonfish are herbivore browsers with quite similar diets (Jones 1968). In a possibly similar relationship Barlow (1974) found the numbers of Brown Surgeonfish and manini (*Acanthurus triostegus*) to be negatively correlated and this was attributed to the aggressive dominance of the Brown Surgeonfish.

Table 3. Overall FRA effectiveness for the top ten most aquarium collected fishes. 'Before' = Mean of 1999-2000; 'After' = Mean of 2007-2009. YOY not included.

COMMON NAME	SCIENTIFIC NAME	MEAN DENSITY (NO/100M^2)		OVERALL% CHANGE IN DENSITY	ρ	R	ρ
		Before	**After**				
Yellow Tang	*Zebrasoma flavescens*	12.73	19.95	**+57%**	0.01	**+77%**	<0.01
Goldring Surgeonfish	*Ctenochaetus strigosus*	28.38	32.01	+13%	0.23	+83%	0.39

Achilles Tang	*Acanthurus achilles*	0.26	0.05	**-81%**	0.01	+2%	0.09
Clown Tang	*Naso lituratus*	0.81	0.59	-27%	0.10	+2%	0.37
Black Surgeonfish	*Ctenochaetus hawaiiensis*	0.18	0.16	-12%	0.77	+3%	0.41
Longnose and Forcepsfish	*Forcipiger spp.*	0.64	0.84	+32%	0.13	**+4%**	0.03
Multiband Butterflyfish	*Chaetodon multicinctus*	5.20	3.49	**-33%**	0.02	**-5%**	<0.01
Brown Surgeonfish	*Acanthurus nigrofuscus*	8.58	4.06	**-53%**	0.03	**-26%**	0.01
Orangeband Surgeonfish	*Acanthurus olivaceus*	0.13	0.10	-20%	0.63	+3%	0.45
Ornate Wrasse	*Halichoeres ornatissimus*	0.94	0.65	-31%	0.08	+2%	0.14

Bold = statistically significant at $\rho \leq 0.05$

With only a single exception all of the FRAs have proven to be effective (positive R value) in enhancing Yellow Tang stocks (Figure 3). Seven of the eight increases were statistically significant. The single FRA which was ineffective was Waiakailio Bay in North Kohala (Appendix B). This FRA had very low Yellow Tang recruitment throughout the study period and additionally the area may have been impacted by a sedimentation event in October 2006 on nearby reefs.

An examination of multiple factors associated with effective FRAs (Tissot et al., 2003) found that habitat quality, FRA size (especially reef width) and density of adult fishes are associated with significant recovery of fish stocks. Of particular importance are areas of high finger coral (*Porites compressa*) cover which is critical habitat for juvenile Yellow Tang and other fishes (Walsh, 1987). Live coral cover at Waiakailio declined 17% between 1999 and 2007 (DAR unpublished data).

The overall average changes in Yellow Tang abundance in the three management areas are shown in Figure 4. Yellow Tang exhibited a delayed increase in abundance in all areas following a strong recruitment year in 2002. Relatively low recruitment in 5 of the 7 following years resulted in subsequent downward trends in all areas. Even with low recruitment in 6 of the past 11 years the number of adult Yellow Tang has increased by 57% in the FRAs since they were established (Table 3).

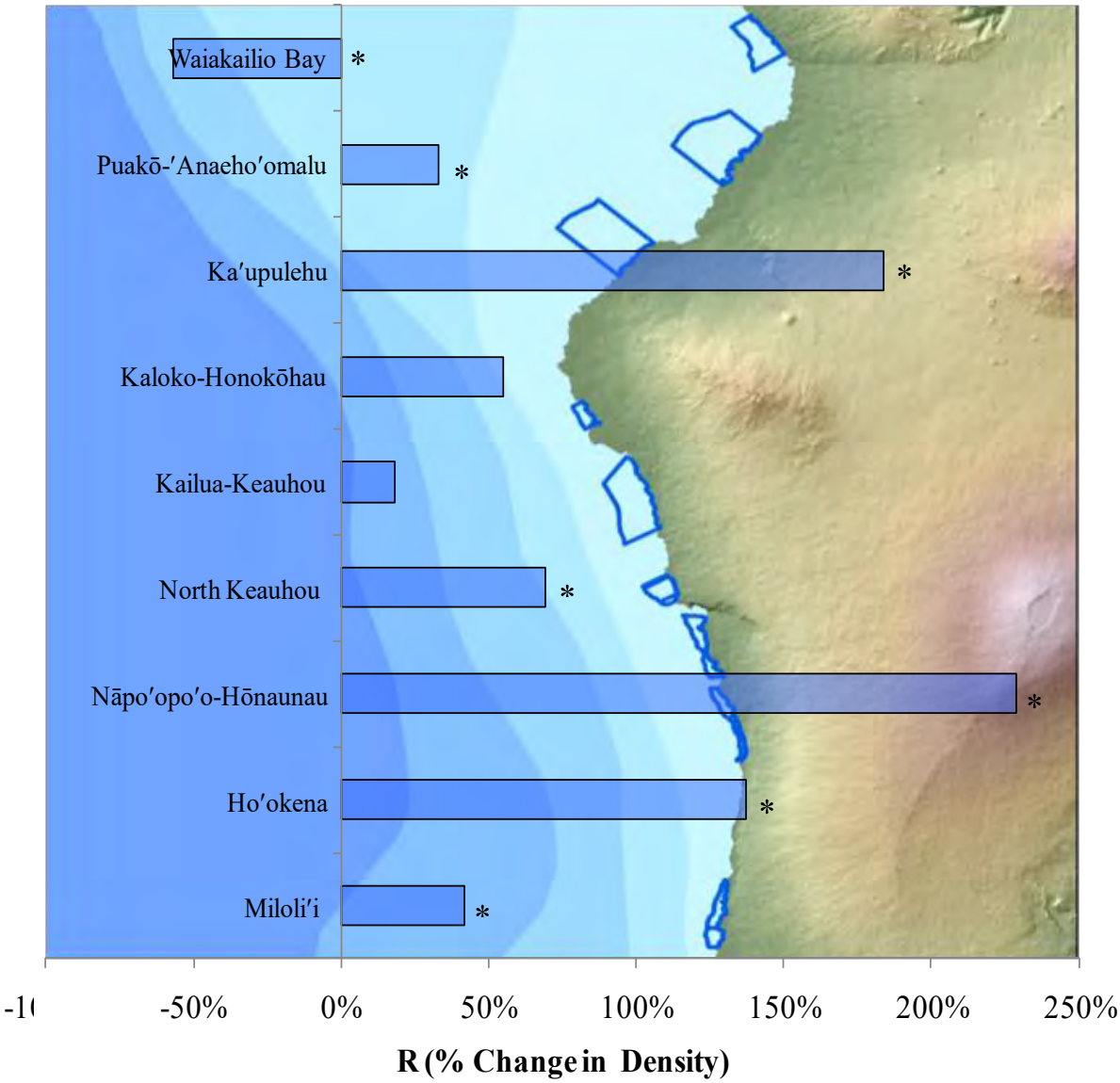

Figure 3. Effectiveness of individual FRAs to replenish Yellow Tangs, 1999-2009. *= Statistically significant at ρ≤0.05

Recent work (Claisse 2009) has shown that when Yellow Tang reach sexual maturity they leave the deeper coral rich reef areas where they settled (and where WHAP transects are located) for shallower reef habitat. For females this occurs at approximately 4-5 years of age and for males at age 5-7. Thus in the absence of substantial input of Young-of-the-Year fish, (i.e. low recruitment) Yellow Tang populations will invariably decline over time due to the emigration of mature fish in addition to natural mortality. This apparently is what has occurred over the last six years in the protected areas. The

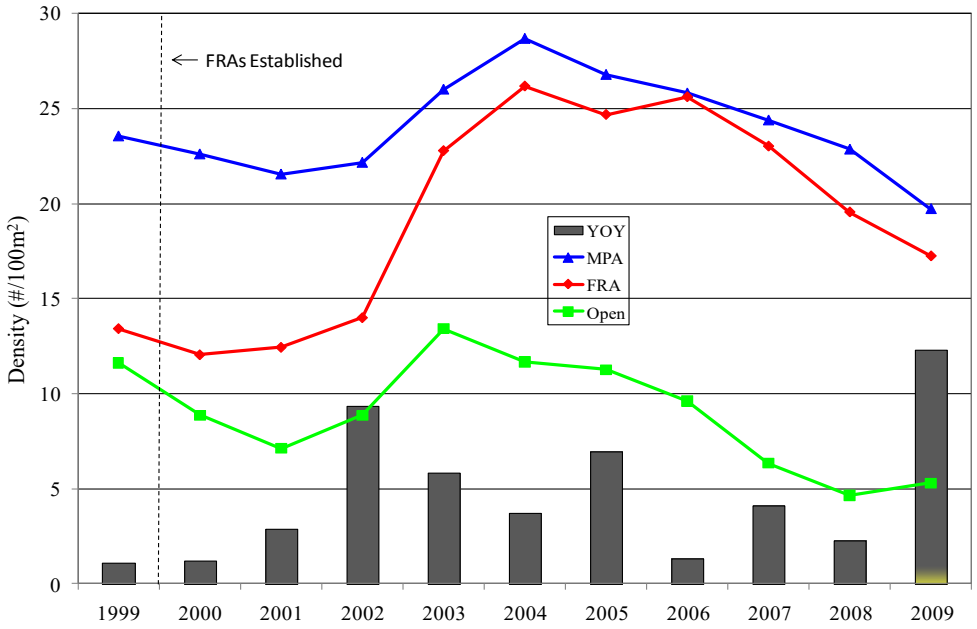

Figure 4. Overall changes in Yellow Tang abundance in FRAs, MPAs and Open areas, 1999-2009. Yellow bars indicate mean density (June-Nov) Yellow Tang Young-of-Year (YOY). YOY are not included in trend line data.

decrease of Yellow Tangs in open areas to below baseline levels is attributable to the above factors as well as an increase in the number of aquarium collectors and collected animals relative to the period when the FRAs were established (Figure 1). The continuing decline of Yellow Tang in areas open to collecting has prompted several additional proposed management actions including restricting which species can be collected (See Species of Special Concern section) and the establishment of a limited entry program for the fishery. Recruitment in 2009 is the highest in the past 11 years which is likely to ameliorate current downward trends at least over the short term.

The fishing/reserve (i.e. FRA/MPA) impacts described above are striking, but of greater significance to the role such reserves have in enhancing and sustaining West Hawai'i populations and the fishery which depends on those, are effects of the reserve network on Yellow Tang breeding stocks. To supplement long-term monitoring of juvenile habitats, DAR initiated a series of surveys in 2006 of the shallow reef habitats utilized by adult Yellow Tang (Williams et al. 2009).

Adult densities were highest within protected areas and in "boundary" areas (open areas adjacent to protected areas). Densities were lowest in open areas far from protected areas (Figure 5). The high densities in boundary areas are evidence of „spillover" (outward movement from reserves into surrounding open areas) and indicate that protected areas supplement adult stocks not only within their own boundaries, but also in open areas up to a kilometer or more away. Thus, the 35% of the coastline in reserves sustains yellow tang breeding stocks in about 50% of the coastline.

Although reserves are already important source areas for adult Yellow Tang (2006 densities were 48% higher in FRAs, and 41% higher in boundary areas than in open areas far from boundaries), the reduced supply of new adults from open areas following recent increases in effort and catch mean they are likely to become even more important in coming years.

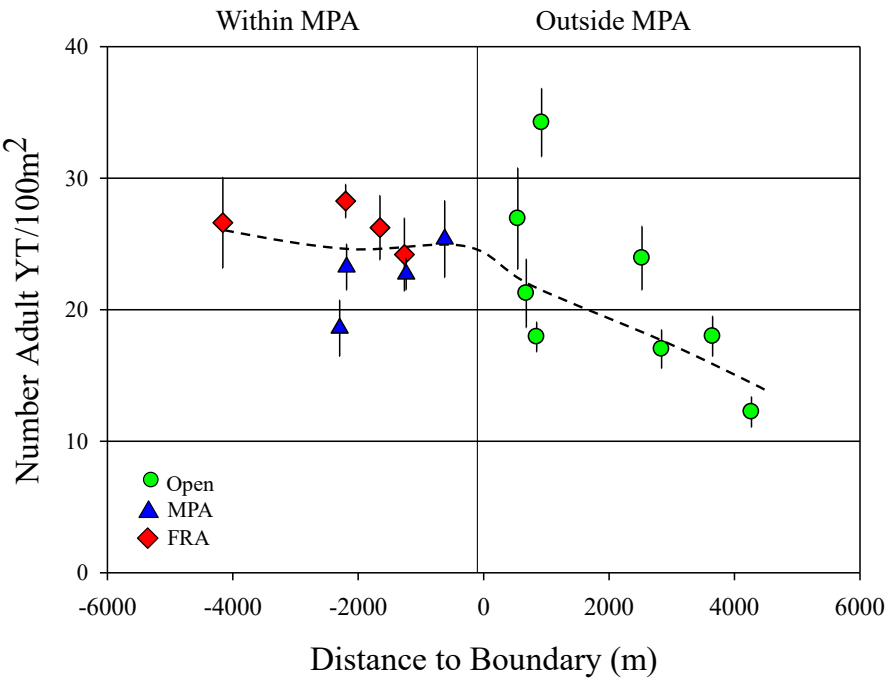

Figure 5. Abundance of adult Yellow Tang in and out of MPAs. Trend line was generated using a LOESS smoothing function.

Goldring Surgeonfish (Figure 6) exhibited trends quite similar to Yellow Tang but since they are more abundant and much less collected than the Tangs, open areas have been relatively stable. Overall, Goldring Surgeonfish have increased by 13% since FRA establishment (Table 3). As with Yellow Tang, recruitment levels have been relatively high thus enabling densities to increase in the protected areas. It is unknown at present if Goldring Surgeonfish makes a habitat change as they reach sexual maturity. Recruitment patterns are markedly similar between the two species, likely due to similarities in spawning seasonality, location and daily timing (Walsh 1984, 1987).

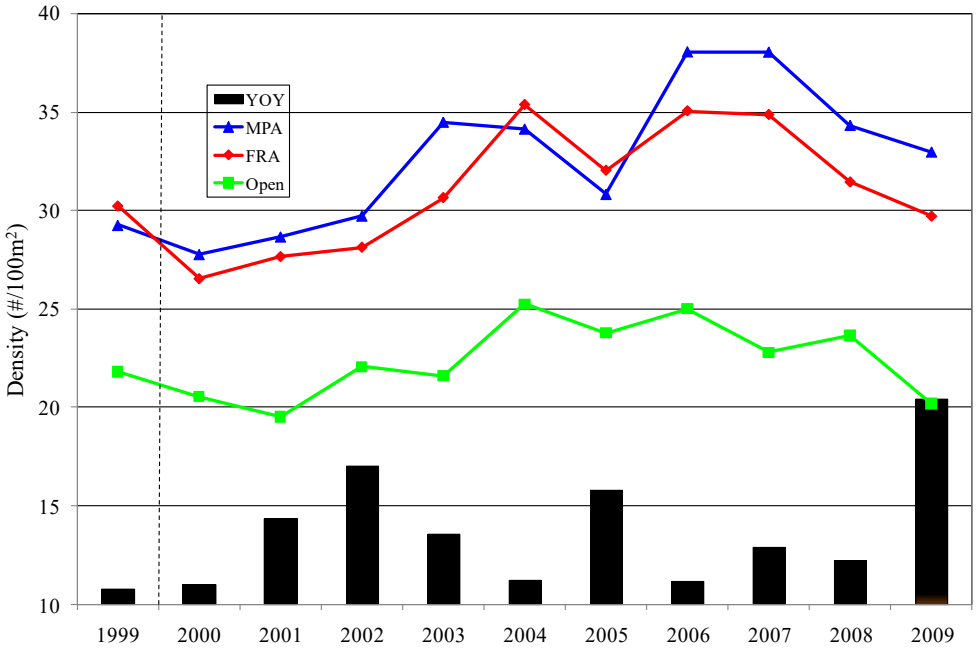

Figure 6. Overall changes in Goldring Surgeonfish abundance in FRAs, MPAs and Open areas, 1999-2009. Bars indicate mean density (June-Nov) of Goldring Surgeonfish Young-of-Year (YOY). YOY are not included in trend line data.

Achilles Tang (Figure 7) has generally shown a highly variable pattern in all management areas in the early years of the study with an overall decline in the last four years. Average densities of this species is very low ($\bar{x}$ = 0.26/100m^2) on all transects. The deeper reef areas where the WHAP transects are located is not the prime habitat for adults of this species. They prefer the high energy shallower surge zones more typical of the shoreline drop-offs areas in West Hawai'i. Presumably algal food resources are more abundant in these areas. These shallower reef areas are being surveyed by a different type of monitoring program (Shallow Water Resource Surveys) presently being conducted by DAR. Initial results from this program and other ancillary longer terms studies suggest there should be concern for the sustained abundance of this species. Achilles Tangs are a very popular food fish as well as an aquarium fish and thus are being harvested both as juveniles and adults. Low levels of recruitment over the past 11 years ($\bar{x}$ (Jun-Nov) = 0.09/100m^2) appear insufficient to compensate for the existing levels of harvest. DAR is currently in the process of developing a comprehensive package of size and bag limits for a number of popularly targeted species. There is a recommended bag limit of 10 Achilles Tangs/person/day which would apply to all harvesters including commercial fishers and aquarium collectors.

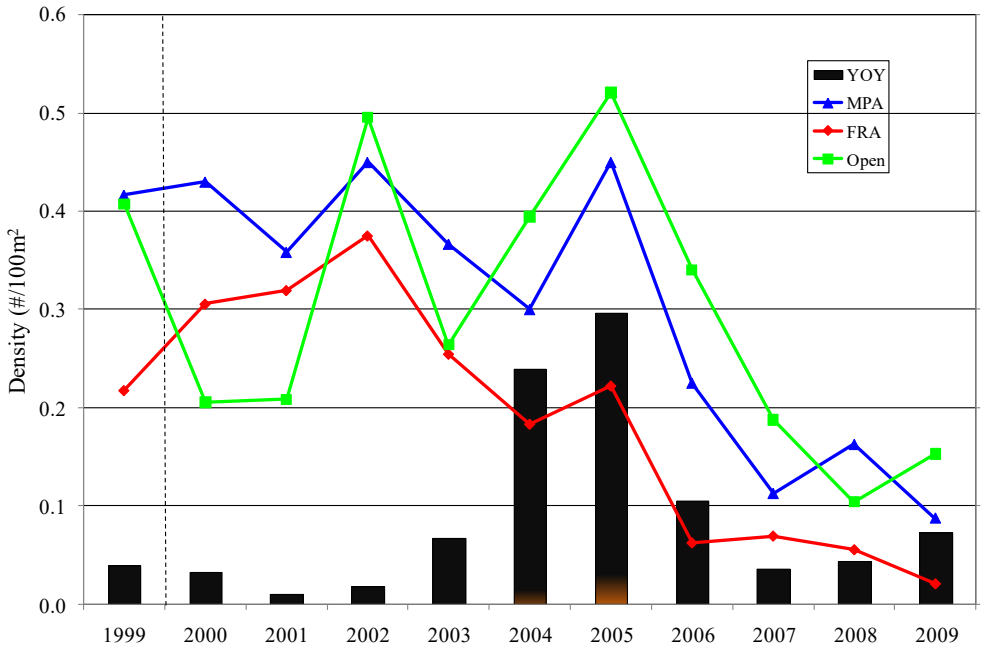

Figure 7. Overall changes in Achilles Tang abundance in FRAs, MPAs and Open areas, 1999-2009. Bars indicate mean density (June-Nov) of Achilles Tang Young-of-Year (YOY). YOY are not included in trend line data.

The abundance/recruitment trends of the Clown Tang and Black Surgeonfish, the fourth and fifth most collected species (Table 3, Appendix A), are quite similar to Achilles Tang (Figures 8 & 9). Here again the primary adult habitat is not the deeper, coral rich areas, where the WHAP transects are located. Additionally the Clown Tang is also widely taken as a food fish as well as being an important aquarium fish. The abundance of both these species on the transects closely tracks recruitment with an upturn during 2004/2005 when there was somewhat higher recruitment followed by declining trends in subsequent years that had low recruitment. Overall, recruitment has been minimal over the last decade for both Clown Tang ($\bar{x}$ = 0.05/100m^2) and Black Surgeonfish ($\bar{x}$ = 0.05/100m^2).

As observed in previous work (Walsh 1987) and emphasized again in this study, for some species, recruitment can be highly variable between years and repeated low levels of recruitment is a regular occurrence. Without substantial input of the YOY, overall abundances on the deeper reef transects decrease over time due to ontogenetic movement out of settlement habitat and natural mortality. This decrease can occur even in areas which are not subject to aquarium collecting pressure (i.e. FRAs and MPAs).

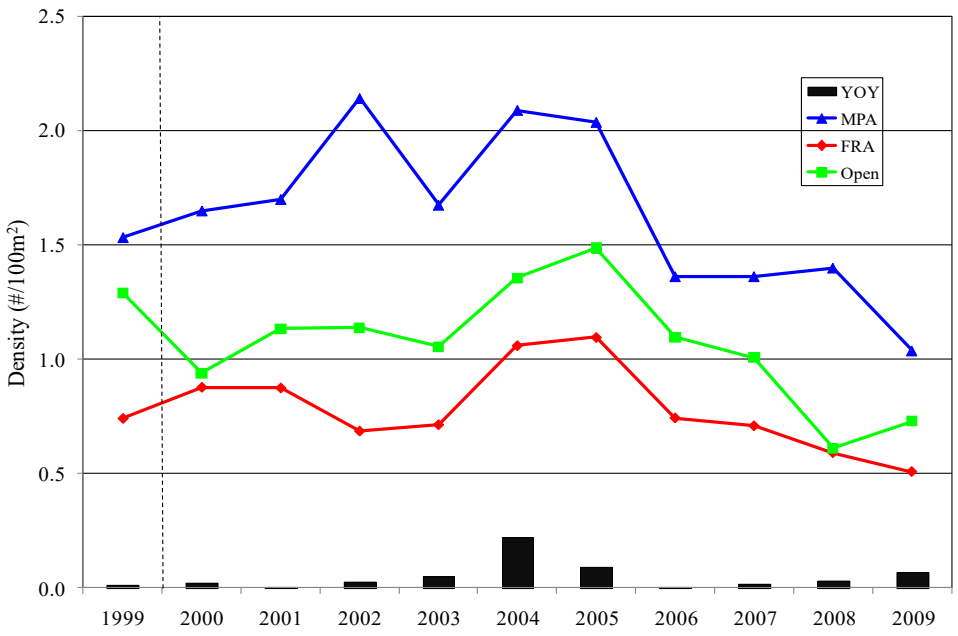

Figure 8. Overall changes in Clown Tang abundance in FRAs, MPAs and Open areas, 1999-2009. Bars indicate mean density (June-Nov) of Clown Tang Young-of-Year (YOY). YOY are not included in trend line data.

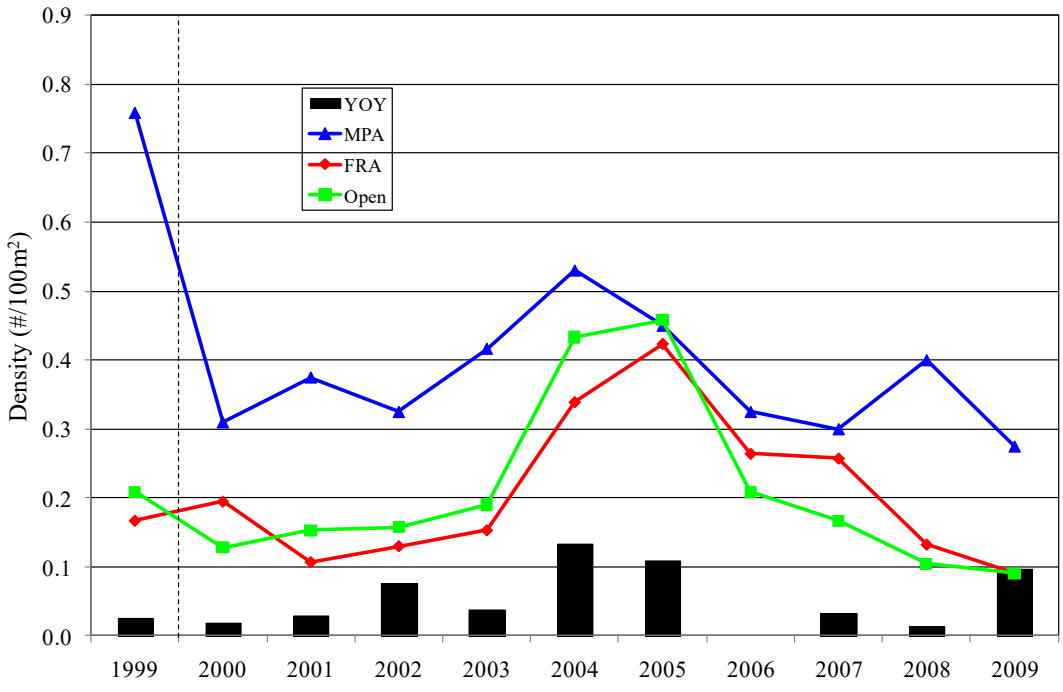

Figure 9. Overall changes in Black Surgeonfish abundance in FRAs, MPAs and Open areas, 1999-2009. Bars indicate mean density (June-Nov) of Black Surgeonfish Young-of-Year (YOY).

Although only a few species comprise the bulk of the West Hawai'i aquarium fishery, over 200 different species of fishes and invertebrates have been collected from the reefs over the last five years (Appendix A). Some of these species are uncommon or even rare and presumably have a low resilience to harvesting pressure. Even in protected areas a considerable amount of time may be required for populations of these species to increase. A good example seems to be the Flame Angel, *Centropyge loricula*. This very attractive but uncommon species is highly desired in the aquarium trade. Demand far exceeds the supply Hawai'i can provide so substantial numbers of this species are imported to Hawai'i (for subsequent reshipping) from other locales (e.g. Christmas Island). Flame Angels were rarely sighted on transect or free swim surveys during the first seven years of the study (Figure 10). Beginning in 2006 however they have become noticeably more abundant presumably due to one or more years of good recruitment. The recruits are apparently cryptic so not readily surveyed.

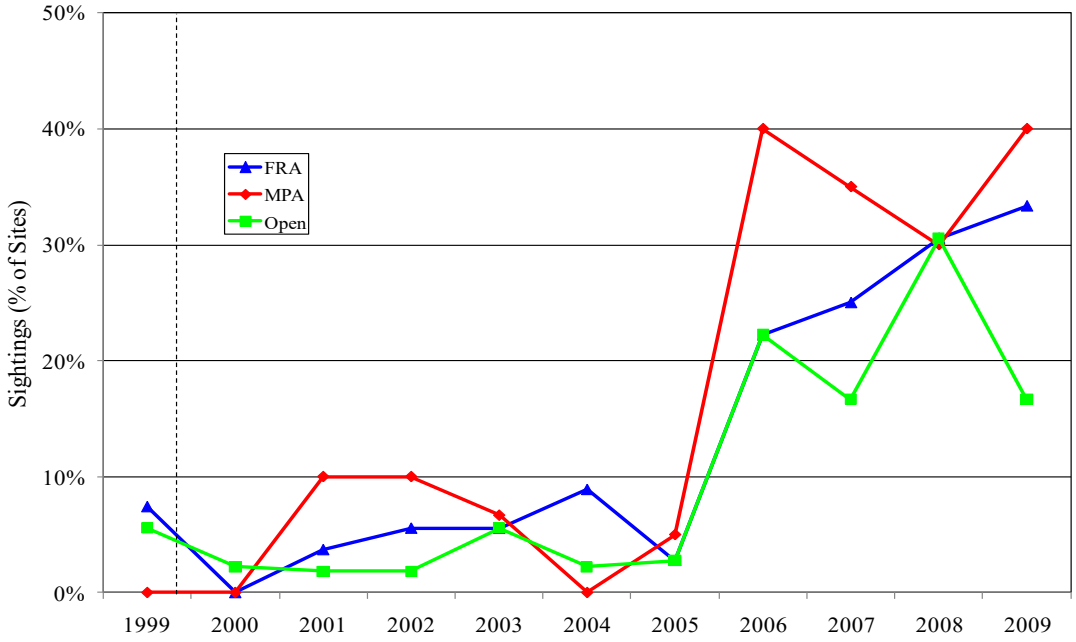

Figure 10. Sightings of Flame Angels in FRAs, MPAs and Open areas, 1999-2009.

FRAs and Conflict Reduction

One of the primary objectives associated with Act 306 was to reduce conflict between opposing reef users by spatially separating the groups via the FRAs where conflict was reportedly high. In 2007 and 2008, Washington State University researchers surveyed recreational scuba diving operators (referred to as divers) and aquarium fishers (referred to as fishers) to examine their perceptions regarding the effectiveness of Act 306 for alleviating conflict between reef user groups and enhancing reef fish populations. They surveyed 23 fishers, comprising ~62% of the active fisher population in West Hawai'i,

and 11 divers, who ranged in expertise from boat captains, master divers, to shop managers using a post test survey design.

Fishers were slightly more inclined to feel the FRAs were effective (34.8%) for alleviating conflict than ineffective (30.4%); however, a similar number of fishers reported having neutral perceptions (34.8%). Likewise, more divers felt the FRAs were effective (36.4%) than ineffective (18.2%), but the majority held neutral perceptions (45.5%). Divers reported having greater conflict with extractive user groups (i.e., aquarium fishers, recreational fishers, and skin divers/spearfishers) than non-extractive user groups (i.e., dive/snorkel operators, kayakers, surfers, scuba divers, and snorkelers) (Figure 11). Informal interviews with fishers revealed that "conflict" was interpreted as conflict within and between their own and other user groups. Some fishers suggested the FRAs aggregated them into smaller geographic regions, thus increasing the competition and conflict within their own group.

In addition to alleviating conflict, Act 306 mandated using the FRAs as an aquarium fisheries management tool to enhance reef fish populations. Nearly all divers (83.3%) felt the FRAs were effective for enhancing reef fish populations; however, 47.8% of fishers felt the FRAs were ineffective while 21.2% felt they were effective, with the remaining 31% indicating neutral perceptions. The contrasting difference between the fishers and divers may be largely influenced by how they interact with the FRAs. Most dive boats operate inside the FRA boundaries where Yellow Tang abundance (including YOY) has increased +95%, whereas the fishers operate outside the FRAs where abundance of Yellow Tang has declined by 11% since 1999/2000. What is more, although Williams et al. (2009) documented spillover of adult Yellow Tang from the FRAs, it has been suggested that significant spillover of juvenile Yellow Tang (the target size class by fishers) into open areas is highly unlikely (M. E. Manuel, pers. comm.). Thus it seems reasonable that more fishers held negative perceptions regarding the FRAs since they felt they were not directly benefiting from them. It should be noted that as a whole the catch of aquarium fishery has increased 25% and the value of the catch by 71% since the inception of the FRA network (Table 1).

Although a substantial proportion of fishers question the efficacy of the FRAs for enhancing the aquarium fishery, evidence suggests socioeconomic indicators associated with veteran fishers have improved since the inception of the FRAs. We surveyed 14 fishers who were active in the West Hawai'i"s aquarium fishery for 10+ years to determine if their satisfaction with bank savings, employment, health, family, economic status, and overall well-being changed since the implementation of the FRAs. Nearly all socioeconomic attributes were either unchanged, better, or much better subsequent to establishing the FRAs, with the exception of two fishers who said their health and bank savings worsened. Unchanged responses are viewed favorably because fishers frequently perceive the least benefits from protected area management (Jacobson and Marynowski 1997).

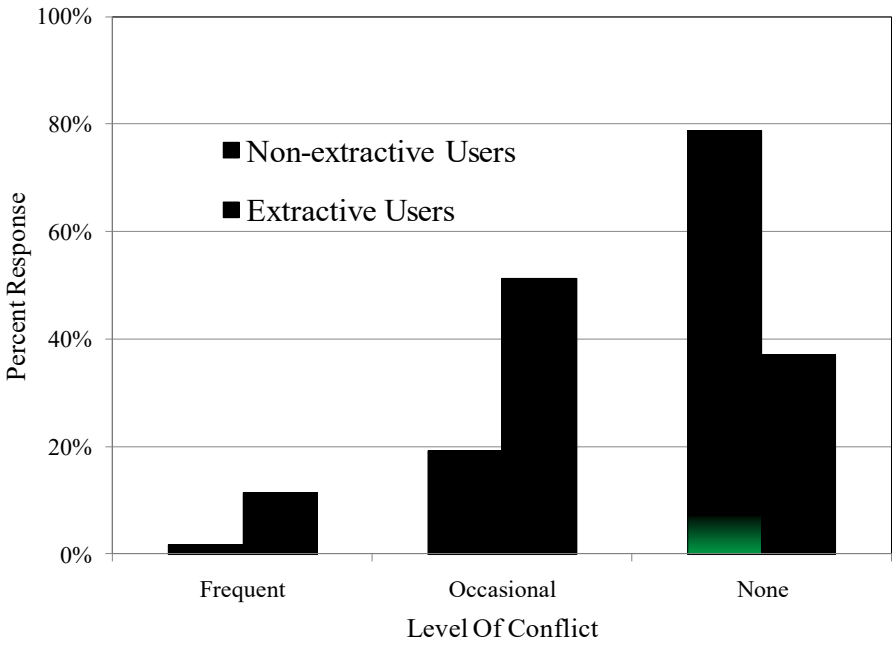

Figure 11: Level of conflict divers reported having with non-extractive vs. extractive reef user groups.

Species of Special Concern

Coral reef animals have multiple values and they serve fundamental biodiversity and ecosystem functions. They‘re important not only to aquarium collectors and other fishers but also to the commercial ocean recreation industry, their visitors and Hawai'i ocean users in general. Management of this resource needs to balance these values and uses. A number of reef fish species are particularly vulnerable to depletion because they may be naturally uncommon or rare but command high prices in the aquarium trade and are thus highly sought after by collectors. Examples include the Dragon Moray, Zebra Moray, Tinker‘s Butterflyfish, Banded Angelfish and Hawaiian Turkeyfish. All of these species (and others) are worth more (sometimes considerably more) than $20 each when collected (Appendix A).

For uncommon or rare species or those that occur in deeper reef habitats, it is difficult and/or unfeasibly expensive to gather solid information on their status and trends. Nevertheless for some of these species such as the Hawaiian Turkeyfish there is considerable anecdotal evidence that they have declined in recent decades. It‘s also clear from a number of long term studies presently being conducted in West Hawai'i (Puakō, Ke'ei and Hōnaunau) that a number of fairly conspicuous species have likewise declined in abundance over time – most obviously several species of butterflyfish and, in particular, the Bandit Angelfish.

In a recent study of the Florida marine aquarium fishery (Rhyne et al. 2009), researchers noted the once small ornamental fish fishery has grown dramatically in recent years to

become a large scale invertebrate-dominated industry. Similar to the West Hawai′i fishery, a relatively small number of species (15) represent the bulk of the fishery (92% in 2007). What was noteworthy was the change in species composition attributable to a shift from the collection of purely ornamental species to ones providing biological services in home aquaria. Invertebrate grazers (e.g. snails, urchins, crabs) are now the most heavily collected animals because they can control algal growth. Noting the important role such organisms play in the wild the authors concluded the intensive collecting of such species was ecologically unsound and the fishery was "crawling to collapse."

FRAs are a key component of the sustainable management of the West Hawai′i aquarium fishery. They encompass many of the areas most utilized by residents and dive/snorkel business, and help maintain the biodiversity of our reefs people expect and visitors are willing to pay for. The FRAs do not of course provide protection for species in the open areas. While they do provide a population reservoir, intensive fishing pressure on species with low natural abundances across most of West Hawai′i‟s reefs is problematic. Concerns over continued expansion of the fishery (up 25% in the last decade) and harvesting effects in the open areas (65% of the coast), necessitate additional management measures.

To address such issues, DAR in conjunction with the WHFC developed a „white list‟ of species which could be taken by aquarium fishers (Table 4). The approach taken by the Council was based on the fact that the West Hawai'i aquarium fishery is very heavily focused on a relatively small number of species. Six species (Yellow Tang, Goldring Surgeonfish, Achilles Tang, Clown Tang, Black Surgeonfish and Tinker‟s Butterfly) make up 96% of the total catch value averaged over the last 5 years. The 25 species on the white list make up 99% of the total catch value so the great majority of species taken (over 180 species - Appendix A) have very little individual or collective value; nonetheless they are important components of the reef ecosystem. It should be noted no invertebrates are included on the white list.

Table 4. List of species which may be collected for Aquarium purposes within the West Hawai′i Regional Fisheries Management Area.

Common Name	Scientific Name	Hawaiian (local) Name
Yellow Tang	*Zebrasoma flavescens*	*lau'īpala*
Goldring Surgeonfish	*Ctenochaetus strigosus*	*kole*
Achilles Tang	*Acanthurus achilles*	*pāku'iku'i*
Clown Tang	*Naso lituratus*	*umaumalei*
Black Surgeonfish	*Ctenochaetus hawaiiensis*	black *kole*
Forcepsfish	*Forcipiger flavissimus*	*lauwiliwilinukunuku'oi'oi*
Multiband Butterflyfish	*Chaetodon multicinctus*	*kikākapu*
Brown Surgeonfish	*Acanthurus nigrofuscus*	*māi'i'i'*
Orangeband Surgeonfish	*Acanthurus olivaceus*	*na'ena'e*
Ornate Wrasse	*Halichoeres ornatissimus*	*ōhua*

Fourspot Butterflyfish	*Chaetodon quadrimaculatus*	*lauhau*
Moorish Idol	*Zanclus cornutus*	*kihikihi*
Potter‟s Angelfish	*Centropyge potteri*	
Goldrim Surgeonfish	*Acanthurus nigricans*	
Saddle Wrasse	*Thalassoma duperrey*	*hinālea lauwili*
Yellowtail Coris	*Coris gaimard*	*hinālea 'akilolo*
Bird Wrasse	*Gomphosus varius*	*hinālea 'i'iwi*
Eyestripe Surgeonfish	*Acanthurus dussumieri*	*palani*
Tinker‟s Butterflyfish	*Chaetodon tinkeri*	
Unicorn spp.	Other *Naso spp.*	*kala*
Thompson‟s Surgeonfish	*Acanthurus thompsoni*	
Flame Wrasse	*Cirrhilabrus jordani*	
Peacock Grouper	*Cephalopholis argus*	*roi*
Bluestripe Snapper	*Lutjanus kasmira*	*taape*
Blacktail Snapper	*Lutjanus fulvus*	*toau*

In addition to the aquarium list of (permitted) species the WHFC also recommended that a number of ecologically and culturally important species be prohibited from being taken by anyone (Table 5). Note that Manta Rays have recently been afforded complete protection within the State by Act 92, SLH 2009.

Table 5. List of species for which all take is prohibited

Common Name	Scientific Name	Hawaiian (local) Name
Manta Rays	*Manta & Mobula spp.*	*hahalua*
Spotted Eagleray	*Aetobatis narinari*	*hīhīmanu*
Broad Stingray	*Dasyatis latus*	
Pelagic Stingray	*Dasyatis violacea*	
Hawaiian Stingray	*Dasyatis brevis*	
Tiger Shark	*Galeocerdo cuvier*	*Manō/niuhi*
Whale Shark	*Rhincodon typus*	*lele wa'a*
Whitetip Reef Shark	*Triaenodon obesus*	*manō lālākea*
Blacktip Reef Shark	*Carcharhinus melanopterus*	*manō pā'ele*
Gray Reef Shark	*Carcharhinus amblyrhynchos*	*manō*
Triton‟s Trumpet*	*Charonia tritonis*	*'olē*
Horned Helmet*	*Cassis cornuta*	*pū puhi*
*Cultural harvesting by permit		

The last focus of the species of special concern related to protecting the breeding stock of Yellow Tang. The WHFC recommendation, motivated largely by several aquarium fishers, is that for all fishers there is a bag limit of 5 fish/person/day of Yellow Tang ≥5" (Total Length). All of the species of special concern recommendations are presently undergoing rulemaking.

Day-Use Mooring Buoys

Act 306, SLH 1998, mandated the establishment of a day-use mooring buoy system in high-use coral reef areas to prevent anchor damage. Day-use mooring buoys have proven to be an effective tool around the world in reducing damage to coral reefs by providing boaters with a convenient means of securing their boats without dropping anchor. Such a day use mooring buoy system has been in place in West Hawai′i for almost 15 years.

The first day-use mooring buoys in West Hawai′i were approved by the Hawai′i Board of Land and Natural Resources in early 1990. Permission to rig the buoys for use was given by DLNR's Division of Boating and Ocean Recreation (DOBOR) in June 1990 and an Environmental Assessment was completed by DOBOR in March 1994. In June 1995, the United States (U.S.) Army Corps of Engineers (COE) issued a general permit to DOBOR for the statewide installation and maintenance of 277 day-use moorings. The most recent U.S. Army COE permit for the program was issued in 2005 for the installation of 15 moorings statewide which were previously permitted but not installed, five of which are in West Hawai′i.

At present, 80 moorings have been either permitted, installed or in use in West Hawai′i (Appendix C). Seven additional moorings are currently in the permit application process with DOBOR and the U.S. Army COE. DOBOR, in consultation with DAR, the WHFC and other community members and supported by the Malama Kai Foundation, is responsible for the process of selecting additional sites for mooring buoys, as well as maintaining the statewide system of buoys.

The mooring buoys are located in popular dive and snorkel spots along the West Hawai′i coastline (Figure 12). A no-anchoring zone exists within a 100 yd. radius of any day-use mooring. Costs for the buoy hardware and equipment have been paid primarily by private contributions, with some state funds, while buoy installation and maintenance have been supported by in-kind contributions from ocean recreation businesses (charter boat time, divers, air, fuel, food), and assisted by technical support services provided by the UH Sea Grant Extension Service, the Hawai′i Institute of Geophysics and the Malama Kai Foundation.

The mooring buoy system would probably not exist without the help of the Malama Kai Foundation and its many dedicated volunteer individuals and businesses. The Malama Kai Foundation raises funds through contributions and the Adopt-A-Buoy Program. Numerous sport divers as well as dive charter businesses from around the state collaborate with Malama Kai Foundation to install, monitor and maintain the buoys. As part of the DLNR Day-Use Mooring 10-Year Strategic Management Plan Malama Kai Foundation is working with DLNR Staff to write and refine objectives for the statewide day-use mooring system and develop bio-physical criteria for site selection.

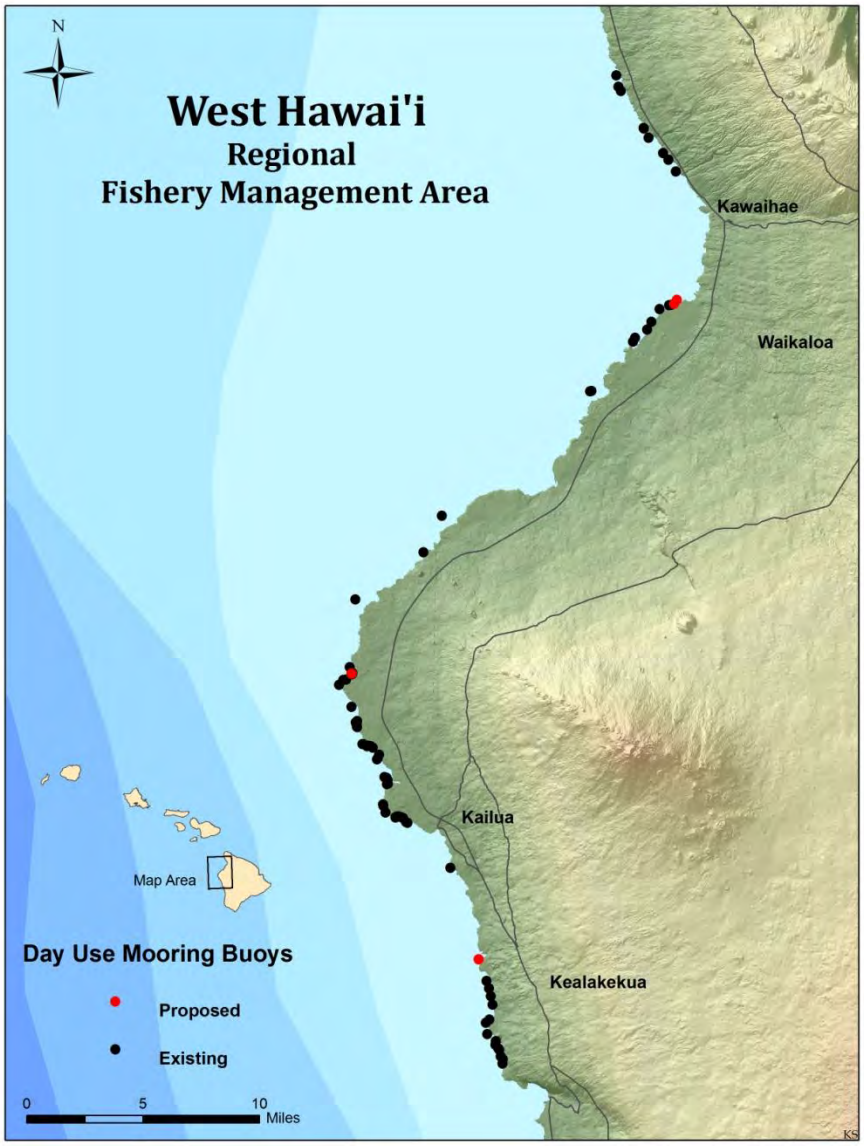

Figure 12. Locations of Day-use mooring buoys in West Hawai'i.

Gill Nets

As mandated by Act 306, SLH 1998, a laynet (i.e. gill net) management plan was developed over four years by the WHFC and DAR. The recommended plan became administrative rule in 2005. The rule provides for continued small-scale subsistence-level netting while effectively controlling large-scale commercial netting. Eight areas have been designated where the use of gill nets is prohibited. Along with existing no gill-netting areas, approximately 25% of the coastline now prohibits the use of such nets (Figure 13).

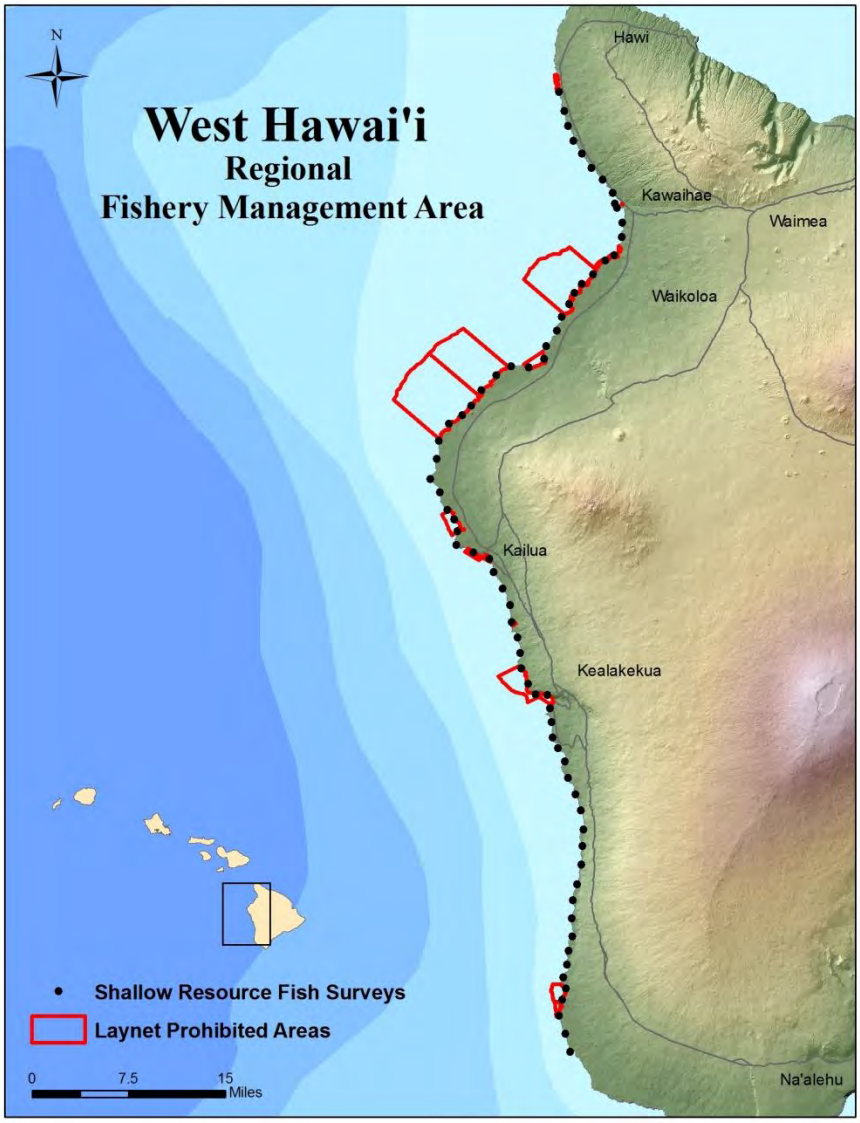

Figure 13. Locations of laynet prohibited areas in West Hawai'i and shallow water resource fish survey sites.

Additional provisions of the rule were designed to encourage responsible net use and enhance enforcement. These include such requirements as net registration and numbered identification (floats and tags), maximum soak time of four hours and maximum net length of 125‟. One area (Kaloko-Honokōhau FRA) was designated a Hawaiian cultural netting area where only locally constructed handmade nets of natural fibers may be used. The West Hawai′i laynet rules served as a model for the rest of the state and have generally been adopted elsewhere except for Maui which completely banned their use. It is noteworthy that only in West Hawai′i are nets measured, inspected, registered and tagged personally by DAR staff. Such interaction with the net fishers provides a good opportunity to educate people about the rules and use of lay gill nets. Additionally it

ensures the nets physically conform to the requirements of the rule and are correctly marked by identification tags and buoys.

Transects conducted in shallow water habitats most likely to be impacted by lay gill netters (Figure 13) indicate there is presently little difference in the biomass of targeted food fishes between areas open to netting and those prohibiting netting either beginning in 2005 or MPAs which have had longer (>10 years) prohibitions on laynetting (Figure 14).

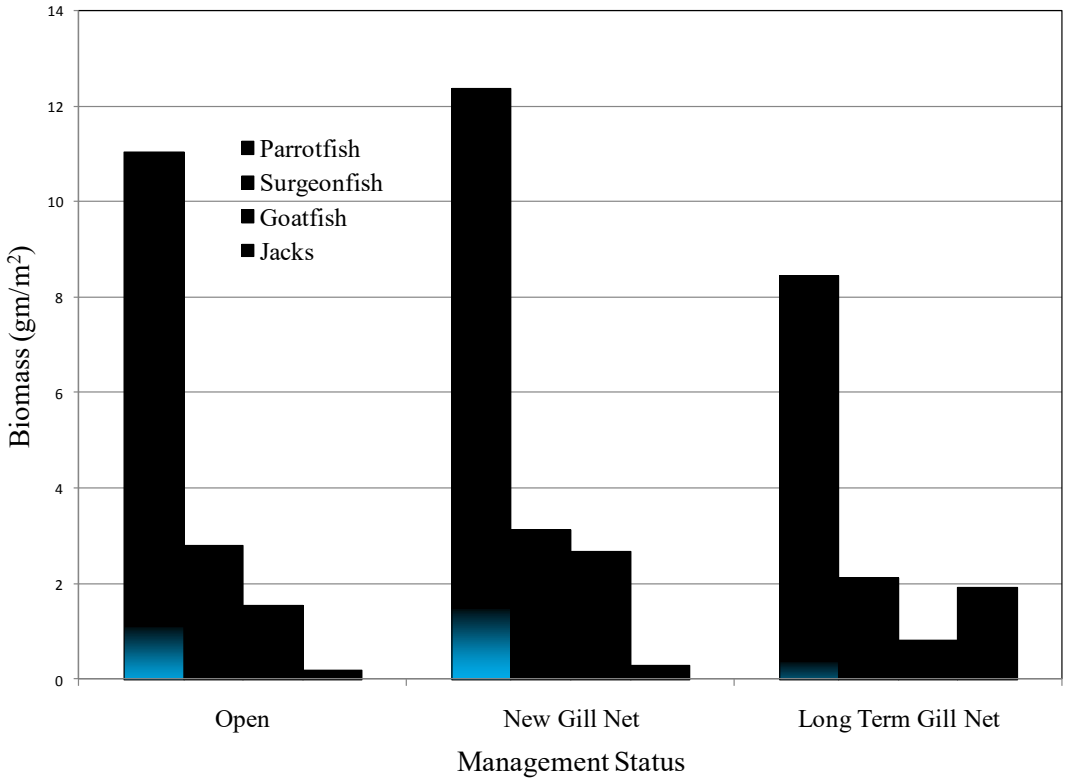

Figure 14. Biomass of 'Resource' (i.e. food) fish on shallow water transects. Only fish > 15 cm TL are censused. 'Open' denotes surveys (n=99) in areas where lay gill netting is permitted. 'New Gill Net' are survey areas (=32) which were closed to gill netting in 2005 and 'Long Term Gill Net' are survey sites (n=11) within MPAs which have prohibited netting for >10 years.

The reasons for the lack of differences between open and laynet protected areas may relate to one or more of several factors: (i) the newly protected areas haven't had sufficient time to work; (ii) the protected areas are not effectively enforced; (iii) the sites of many of the shallow water resource transects may be areas where netting is impractical (i.e. rocky shorelines, sharp reef drop-offs, etc.) and (iv) the overall level of laynet fishing is relatively low. This last factor is supported by the low number of lay gill nets registered in West Hawai'i as compared to the other islands (Figure 15).

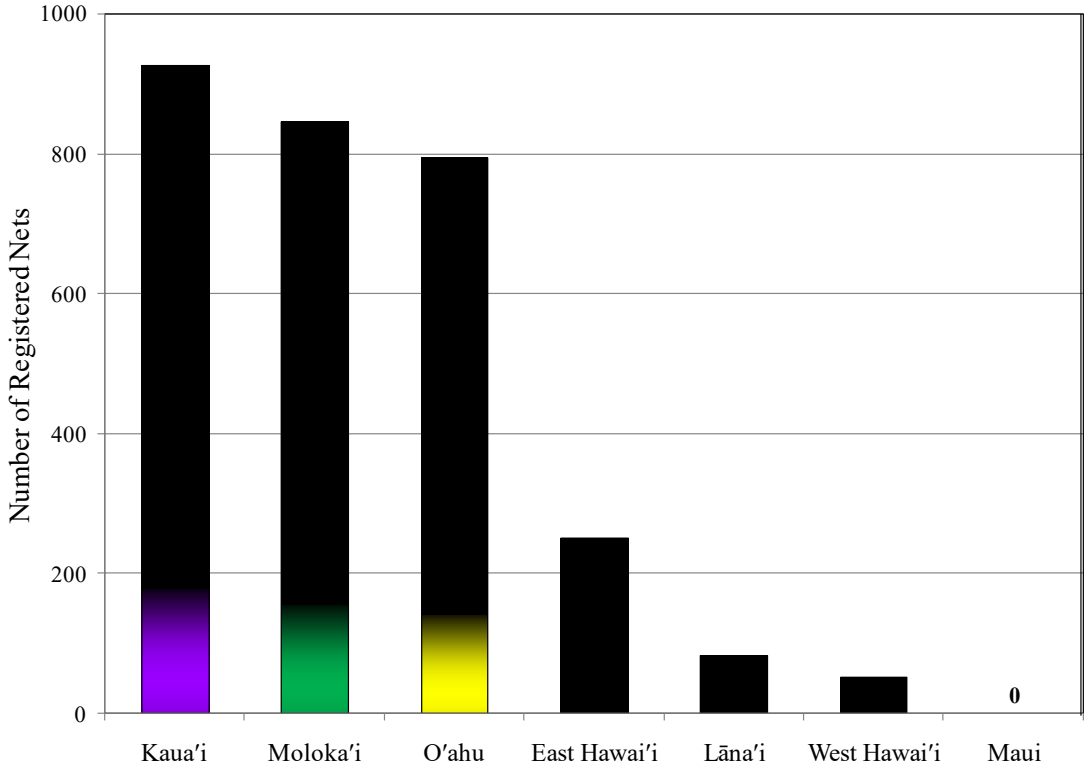

Figure 15. Number of registered lay gill nets in Hawai'i. Note that lay gill nets are prohibited on Maui and on Kaua'i all types of nets are registered.

Fish Reserves

Unlike the other mandates of Act 306, SLH 1998, and resulting statute (Chapter 188f, HRS) and administrative rule (§13-60.3, HAR), the establishment of fish reserves where no fishing is allowed is an ongoing effort and has not yet been realized. This is due in part to a generalized resistance from some segments of the fishing community and overall government reluctance.

There are exceptions however. Beginning in 2001 an initiative developed within the South Kona community of Miloli'i to develop rules which would allow management of their nearshore marine resources in a more traditional manner. In 2006, legislation was enacted which designated Miloli'i a Subsistence Fishing Area (SFA). Rules for the SFA were to be subsequently developed by the community in conjunction with DAR. The following year a SFA rule package was proposed which limited fishing in the nearshore waters of Miloli'i to subsistence purposes only. There were also a number of gear restrictions (e.g. nets and spears) and the establishment of a limited take refuge subzone

(Pu′uhonua). Unfortunately the proposed rule was scuttled at a public hearing in November 2007 when large numbers of offshore fishers objected to the subsistence only designation, fearing they would be prohibited from trolling through the area. A somewhat similar initiative is presently underway at Ho′okena also in south Kona. In this area a one mile no-take zone (for 10 years) is proposed.

There are indications that public perceptions of marine protected areas are changing. In a 2009 DAR survey of West Hawai′i fishers and other ocean users (n=89) in 78% responded affirmatively to the question; should additional No-Take Marine Protected Areas be established in West Hawai′i? When queried about what type of management actions should be employed MPAs were most often indicated (Figure 16).

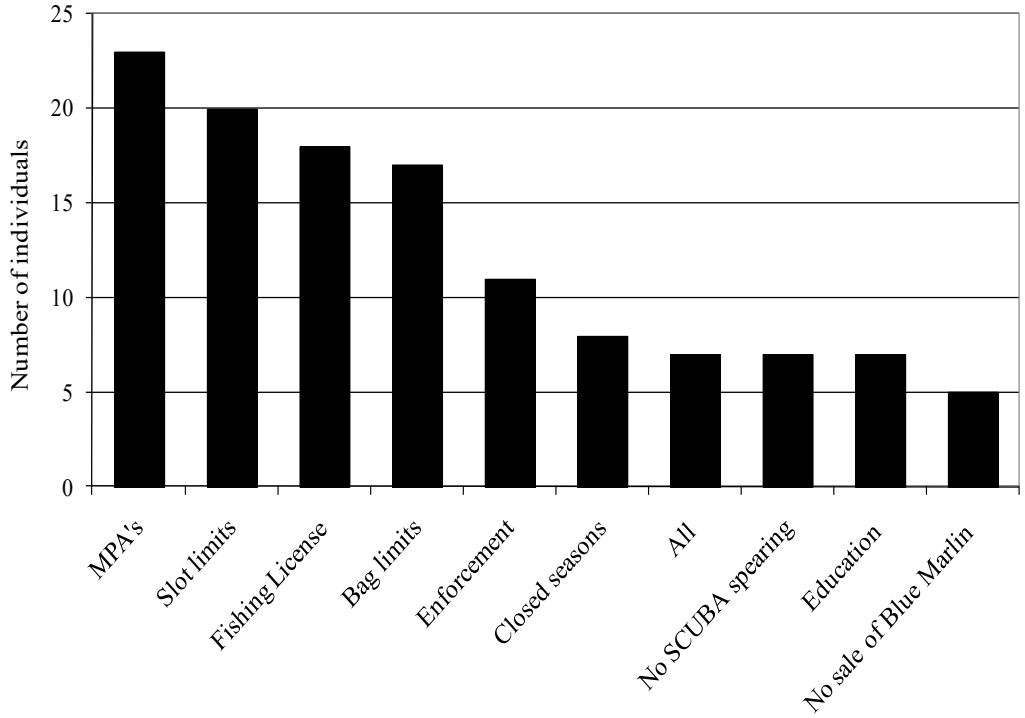

Figure 16. Top 10 methods for managing West Hawai′i Fisheries Resources as indicated in DAR size and bag limit questionnaire.

In response to this unfulfilled mandate, the WHFC convened a subcommittee in January 2009 to develop a strategy for working with communities to designate marine reserves within areas currently closed to aquarium collecting. Active members of the subcommittee include representatives from the commercial aquarium and SCUBA diving industries, educators, cultural advisors, and scientists.

The strategy outlined by this subcommittee has three phases:

Phase I: Compile relevant science from Hawai'i and elsewhere in the Pacific that demonstrates the benefits of properly designed and enforced marine reserves and marine reserve networks.

Phase II: Provide outreach to schools, community members, and the general public summarizing the benefits of marine reserves.

Phase III: Identify and support communities in designing and designating marine reserves in biologically viable areas by providing scientific and technical guidance and facilitating community education and outreach.

As a first step, the subcommittee has compiled scientific papers documenting marine reserve benefits to coral reef habitat, fish biomass, biodiversity, and fisheries yield in adjacent areas. Additionally, the subcommittee obtained studies that emphasize the importance of a network of marine reserves in combating the detrimental effects of natural disasters and climate change. This information will be used to develop a fact sheet highlighting reserve benefits to be made available to educators and concerned community members. Commercial aquarium collectors in West Hawai'i have pledged tentative support for the initiative provided it does not increase the percentage of coastline currently prohibiting aquarium collecting.

Kona school teachers at Kealakehe High School and Hualalai Academy have been approached to encourage their students to develop appropriate video and print media that explains the necessity of marine reserves. Verbal commitments have been made that such projects will be incorporated into their curriculums. The subcommittee is exploring re-activation of the West Hawaiʻi Youth Fisheries Council, which organized students to successfully lobby for a smoking prohibition at Kahaluʻu Beach Park.

A subcommittee member has identified a West Hawaiʻi community interested in the possibility of designating a marine reserve within their area of interest. This community has an existing advisory comprised of Hawaiian lineal descendents from the relevant geographic area, land owners and lessees, cultural advisors, educators, community coordinators and representatives from the Office of Hawaiian Affairs. Thus far, representatives from the WHFC have attended six advisory group meetings to provide information relevant to discussing designation of a Marine Reserve in an existing FRA.

Advisory group meetings have been attended by officers from DLNR‟s Division of Conservation and Resources Enforcement (DOCARE) who have provided useful information related to enhancing compliance and enforcement, designating penalties, and building support for regulations. This community group is also dedicated to supporting education and outreach regarding this initiative and related coral reef topics at the Kalaemanō Interpretive Center at Kaʻupulehu.

The subcommittee has also responded to interest by the Puakō community related to amending existing FMA regulations to protect this coral reef from destructive and wasteful fishing practices and over-exploitation of existing stocks.

RECOMMENDATIONS

Based on the results of this review and evaluation the following recommendations are proposed:

1. Biological and fishery results to date indicate the FRAs are clearly working and are expected to increase in importance as time progresses. With one possible exception (Pebble Beach), there are no compelling reasons at present to alter the existing network of protected areas.

2. As monitoring and evaluation of the FRAs is required by law and necessary to further understand the dynamics of our coral reef ecosystem, a dedicated monitoring program similar to WHAP needs to be continued and supported.

3. Community input and co-management responsibility has proven to be critical in the establishment and legitimacy of the FRA network. Community advisory groups such as the WHFC should be encouraged and supported by DLNR.

4. Experienced facilitators preferably with training in environmental dispute resolution need to work with community advisory groups when addressing complex and contentious marine resource issues. This would also be desirable for DAR when holding particularly contentious community meetings and public hearings.

5. Strong community education/outreach efforts should be initiated and coordinated with "neutral" organizations already working in this capacity, for example: UH Sea Grant College Program, some branches of NOAA and the U.S. Fish and Wildlife Service.

6. While FRAs are an excellent strategy to manage the most abundant and heavily collected aquarium species, uncommon, rare or ecologically important species require species-specific harvesting limitations in open areas. An alternative, less data dependent, approach is to delimit what species can be collected (e.g. species of special concern initiative).

7. FRA boundary coordinates in the HARs do not all correspond to the shapefiles from which the maps are created for the published regulations. Some of these discrepancies are minimal while some are rather significant. A review and updating of the official MMA shapefiles and/or the HAR coordinates could prevent confusion and potential enforcement issues in the future.

8. A limited entry aquarium fishery should be established in West Hawai′i at the earliest possible date.

9. In order to protect and enhance aquarium stocks on other islands, especially Maui and O′ahu, consideration should be given to establishing a system of FRAs on each island.

10. The existing aquarium catch report system needs to be revised to improve accuracy, remove ambiguities in fishing effort and provide for verification of catch.

11. A comprehensive verification of aquarium dealer and collector catch reports should be undertaken to determine reporting accuracy.

12. Collectors who continually fail to abide by the terms of their aquarium fish permit should be removed by DLNR from the fishery.

13. An effective DOCARE enforcement "presence" on the water and along coastal areas is essential for long term sustainability of our marine resources. Poaching can undermine monitoring results and make analyses of the effectiveness of protected areas problematic.

14. The effectiveness of the FRAs for aquarium fish suggests it would be prudent to establish MPAs for other resource species throughout Hawai′i as a precautionary measure against overfishing and for restoration of marine resources. Currently, less than 1% of the Main Hawaiian Islands is fully protected by MPAs (Clark and Gulko 1999).

15. MPAs should be large enough for self-recruitment of short distance dispersing propagules and spaced far enough apart that long distance dispersing propagules released from one reserve can settle in adjacent reserves.

16. An MPA network should encompass the proportion of the biomass necessary to sustain optimal yields of populations of concern.

17. Representative proportions of all habitat types should be included in MPAs, although rare and vulnerable habitats should be represented more fully. An initial step in this process would be to quantify/identify such habitats in West Hawai′i waters.

18. MPA efforts must recognize known ecological connections among habitat types, typically from shallow to deeper sites.

19. Diel movement patterns, such as from daytime foraging habitat to nocturnal resting areas must be considered in MPA establishment.

20. As recruitment is a key mechanism influencing the replenishment of nearshore populations, increased monitoring of recruitment and nearshore oceanography is necessary to better understand the dynamics of recruitment processes.

21. MPAs should have unambiguous and geographical distinct boundaries, as they are easier to recognize and enforce.

22. DAR staff should register lay gill nets at DAR offices on islands where such netting is allowed as this provides an excellent educational and net verification opportunity.

23. Support and implement co-management efforts at Miloli′i, Ho′okena and other interested communities.

24. A sustainable funding source for the day-use mooring buoy system needs to be established. Funds from coral damage related administrative fines and mitigation requirements could prove useful to this end.

25. Prohibit, by HAR, utilizing an illegally installed day-use mooring.

26. For continued safe and dependable operations, the DAR West Hawai′i vessel should be replaced. The 26‟ Glacier Bay catamaran used for all research and monitoring activities in West Hawai′i over the past 11 years has logged over 40,000 sea miles. Structural cracks have occurred on the deck and hull.

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The West Hawai′i Aquarium Project (WHAP) would not have been possible without initial support and funding by the Hawai′i Coral Reef Initiative Research Program (HCRI-RP). HCRI-RP was established in 1998 to support scientific research and monitoring to enhance the state's capacity to manage its coral reef resources. The Program is jointly managed by Hawai`i's Department of Land and Natural Resources/ Division of Aquatic Resources (DLNR/DAR) and the University of Hawai`i (UH). This partnership between resource managers and researchers is the foundation of HCRI-RP as it strives to become an innovative, results-driven, and science-based program.

Since FY 2002 the West Hawai′i coral reef monitoring program has been funded by the National Oceanic and Atmospheric Administration's (NOAA) Coral Reef Conservation Program under the National Centers for Coastal Ocean Science (NOAA/NCCOS).

Many people have played important roles in laying the groundwork for successful and adaptive marine resource co-management in West Hawai′i. David Tarnas is to be especially commended for his innovative and forward looking legislation. Sara Peck of UH Sea Grant College Program has been involved from the beginning and is instrumental in ensuring community participation and education. Many other people have played and continue to play important roles in West Hawai′i resource co-management. Some of them are listed below:

West Hawai'i Fisheries Council – 1998-2009:

Members:
Edward Ahuna Jr., Pete Basabe, Scott Brien, Jody Bright, Ben Casuga Jr., Lisa Choquette, David Dart, Neil Dart, Fred Duerr, Michael Forcum Sr., Rick Gaffney, Doug Genovia, Glennon Gingo, Donna Goodale, Robert Hajek, Luanakanawai Hauanio, Mike Henshaw, Doug Herkes, David Hoopaugh, Kahana Itozaki, Josephine Kamoku, Ernest Kanehailua Jr., Junior Kanuha, Willie Kaupiko, Damien Kenison, Karen Klein, Guy Kitaoka, Matthias Kusch, Gerald Lange, Stan Lavine, Kawika Leicher, Gordon Leslie, Jeffery Lorance, Len Losalio, Paul Masterjohn, Ruby McDonald, Jim Medeiros Sr., Steven Meyer, Tony Nahacky, Mike Nakachi, Teresa Nakama, Cynthia Nazara, Frank Ota Jr., Bob Owens, Tina Owens, George Paleudis, Richard Prohoroff, William Rickards, Doug Robbins, JR Rosario, Dale Sarver, Robert Shallenberger, Hannah Springer, Joseph Stewart, Bill Stockley, William Talley III, Leonard Torricer, Paul Warren, Andrew West, Chad Wiggins, Vern Yamanaka, Charles Young

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Ex-officio/Agency:
Jeff Bearman, Sallie Beavers, Alex Cadang, Brent Carman, Lt. Mike Heisler, Pete Hendricks, Marnie Herkes, John Kahiapo, Reggie Lee, Laura Livnat, Wayne Leslie, Jan Marsh (KNA Jan Koo), Lt. Brian McCaul, Mark McGuffie, Nancy Murphy, Dickie Nelson, Robert Nishimoto, Robert Pacheco, Sara Peck, Scott Shero-Amba, David Tarnas, Justin Viezbicke, Ann Irene Wilcox, Bill Walsh

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APPENDIX A.

List of Aquarium collected species in West Hawai'i. Due to catch report confidentiality requirements 57 fish and 16 invertebrate species are not listed. They are included in total catch and value.

		FY05-FY09	FY05-FY09
Common Name	**Scientific Name**	**Total Caught**	**Total Value**
Fishes			
Yellow Tang	*Zebrasoma flavescens*	1,621,053	$5,035,883
Goldring Surgeonfish	*Ctenochaetus strigosus*	181,121	$376,253
Achilles Tang	*Acanthurus achilles*	42,383	$274,111
Clown Tang	*Naso lituratus*	29,859	$122,090
Black Surgeonfish	*Ctenochaetus hawaiiensis*	19,631	$309,808
Forcepsfish	*Forcipiger flavissimus*	13,216	$27,393
Multiband Butterflyfish	*Chaetodon multicinctus*	9,385	$7,127
Brown Surgeonfish	*Acanthurus nigrofuscus*	7,754	$6,833
Ornate Wrasse	*Halichoeres ornatissimus*	5,198	$11,415
Orangeband Surgeonfish	*Acanthurus olivaceus*	5,195	$9,654
Fourspot Butterflyfish	*Chaetodon quadrimaculatus*	4,909	$12,793
Moorish Idol	*Zanclus cornutus*	4,296	$9,492
Potter's Angelfish	*Centropyge potteri*	3,979	$23,343
Goldrim Surgeonfish	*Acanthurus nigricans*	3,969	$18,813
Saddle Wrasse	*Thalassoma duperrey*	3,831	$4,794
Yellowtail Coris	*Coris gaimard*	3,391	$13,049
Bird Wrasse	*Gomphosus varius*	2,559	$8,407
Hawaiian Cleaner Wrasse	*Labroides phthirophagus*	2,544	$9,550
Eye Stripe Surgeonfish	*Acanthurus dussumieri*	2,363	$3,753
Tinker's Butterflyfish	*Chaetodon tinkeri*	1,977	$156,240
Unicornfish	*Naso sp*	1,678	$6,348
Christmas Wrasse	*Thalassoma trilobatum*	1,190	$2,441
Arc-Eye Hawkfish	*Paracirrhites arcatus*	1,152	$1,426
Psychedelic Wrasse	*Anampses chrysocephalus*	1,146	$4,488
Thompson's Surgeonfish	*Acanthurus thompsoni*	1,143	$2,247
Teardrop Butterflyfish	*Chaetodon unimaculatus*	1,138	$2,930
Lei Triggerfish	*Sufflamen bursa*	1,106	$1,820
Bluelined Surgeonfish	*Acanthurus nigroris*	1,099	$1,453
Hawaiian Whitespotted Toby	*Canthigaster jactator*	932	$1,302
Smalltail Wrasse	*Pseudojuloides cerasinus*	876	$1,793
Shortnose Wrasse	*Macropharyngodon geoffroy*	849	$1,655
Hawaiian Dascyllus	*Dascyllus albisella*	821	$1,103
Fourline Wrasse	*Pseudocheilinus tetrataenia*	596	$3,419

Common Name	Scientific Name	Total Caught	Total Value
Eightline Wrasse	*Pseudocheilinus octotaenia*	588	$1,168
Spotted Boxfish	*Ostracion meleagris*	559	$2,076
Blacklip Butterflyfish	*Chaetodon kleinii*	491	$664
Flame Angelfish	*Centropyge loricula*	480	$5,969
Fisher's Angelfish	*Centropyge fisheri*	444	$1,810
Belted Wrasse	*Stethojulis balteata*	427	$713
Raccoon Butterflyfish	*Chaetodon lunula*	348	$1,732
Gilded Triggerfish	*Xanthichthys auromarginatus*	337	$2,414
Blackside Hawkfish	*Paracirrhites forsteri*	302	$712
Lantern Toby	*Canthigaster epilampra*	295	$1,300
Flame Wrasse	*Cirrhilabrus jordani*	270	$6,381
Milletseed Butterflyfish	*Chaetodon miliaris*	269	$414
Black Durgon	*Melichthys niger*	267	$1,189
Zebra Blenny	*Istiblennius zebra*	235	$248
Wrasse	Family Labridae	223	$470
Bandit Angelfish	*Desmoholacanthus arcuatus*	216	$16,784
Special Anthias	*Pseudoanthias hawaiiensis*	197	$3,210
Damselfish	Family Pomacentridae	195	$313
Pyramid Butterflyfish	*Hemitaurichthys polylepis*	193	$1,460
Reticulated Butterflyfish	*Chaetodon reticulatus*	159	$360
Disappearing Wrasse	*Pseudocheilinus evanidus*	158	$314
Rockmover Wrasse	*Novaculichthys taeniourus*	153	$858
Surgeonfish	Family Acanthuridae	143	$1,598
Ringtail Surgeonfish	*Acanthurus blochii*	134	$182
Oval Butterflyfish	*Chaetodon lunulatus*	133	$1,370
Bluestripe Snapper	*Lutjanus kasmira*	128	$149
Yellowfin Surgeonfish	*Acanthurus xanthopterus*	124	$321
Trumpetfish	*Aulostomus chinensis*	113	$471
Squirrelfish/Soldierfish	Family Holocentridae	95	$214
Ringtail Wrasse	*Oxycheilinus unifasciatus*	91	$84
Frogfish	*Antennarius sp.*	80	$1,463
Crown Toby	*Canthigaster coronata*	73	$194
Ornate Butterflyfish	*Chaetodon ornatissimus*	72	$118
Threadfin Butterflyfish	*Chaetodon auriga*	68	$372
Brick Soldierfish	*Myripristis amaena*	67	$149
Bluestripe Butterflyfish	*Chaetodon fremblii*	65	$82
Whitley's Boxfish	*Ostracion whitleyi*	62	$1,147
Blue-eye Damselfish	*Plectroglyphidodon johnstonianus*	62	$53
Longnose Hawkfish	*Oxycirrhites typus*	59	$1,100
Dragon Moray	*Enchelycore pardalis*	57	$14,550

Common Name	Scientific Name	Total Caught	Total Value
Fantail Filefish	*Pervagor spilosoma*	57	$205
Snowflake Moray	*Echidna nebulosa*	55	$629
Pearl Wrasse	*Anampses cuvier*	55	$267
Redbar Hawkfish	*Cirrhitops fasciatus*	54	$198
Yellowfin Goatfish	*Mulloidichthys vanicolensis*	51	$85
Stout Moray	*Gymnothorax eurostus*	49	$216
Hawaiian Squirrelfish	*Sargocentron xantherythrum*	49	$54
Pinktail Durgon	*Melichthys vidua*	48	$239
Bigscale Soldierfish	*Myripristis berndti*	48	$106
Whitebar Surgeonfish	*Acanthurus leucopareius*	47	$135
Bicolor Anthias	*Pseudanthias bicolor*	46	$380
Blenny	Family Blenniidae	44	$227
Parrotfish	Family Scaridae	42	$194
Manybar Goatfish	*Parupeneus multifasciatus*	42	$63
Whitemouth Moray	*Gymnothorax meleagris*	39	$246
Porcupine Fish	*Diodon hystrix*	34	$34
Reef Triggerfish	*Rhinecanthus rectangulus*	33	$210
Leaf Scorpionfish	*Taenianotus triacanthus*	32	$205
Blackfin Chromis	*Chromis vanderbilti*	27	$9
Shortbodied Blenny	*Exallias brevis*	24	$126
Bluespine Unicornfish	*Naso unicornis*	24	$68
Longnose Butterflyfish	*Forcipiger longirostris*	22	$55
Brighteye Damselfish	*Plectroglyphidodon imparipennis*	22	$2
Orangefin Filefish	*Cantherhines dumerilii*	19	$48
Hawaiian Hogfish	*Bodianus albotaeniatus*	19	$28
Speckled Butterflyfish	*Chaetodon citrinellus*	19	$18
Cardinalfish	Apogon sp.	18	$2
Surge Wrasse	*Thalassoma purpureum*	16	$96
Elegant Coris	*Coris venusta*	16	$76
Hawaiian Sergeant Major	*Abudefduf abdominalis*	16	$0
Hawaiian Turkeyfish	*Pterois sphex*	15	$570
Thompson's Anthias	*Pseudanthias thompsoni*	14	$66
Goatfish	Family Mullidae	13	$24
Threespot Damselfish	*Chromis verater*	13	$17
Ruby Cardinalfish	*Apogon erythrinus*	13	$0
Bay Cardinalfish	*Foa brachygrammus*	11	$0
Zebra Moray	*Gymnomuraena zebra*	10	$222
Twospot Hawkfish	*Amblycirrhitus bimacula*	10	$21
Thompson's Butterflyfish	*Hemitaurichthys thompsoni*	10	$15

Common Name	Scientific Name	Total Caught	Total Value
Invertebrates			
Opae ula	*Halocaridina rubra*	116,100	$6,670
Shrimp		56,384	$41,567
Hermit Crab	Family Diogenidae	12,074	$2,086
Sea Star	Class Asteroidea	616	$1,364
Common Linckia	*Linckia multifora*	455	$910
Urchin		243	$215
Sponge		274	$1,759
Coral-Banded Shrimp	*Stenopus hispidus*	153	$1,026
Spiny Lobster	Family Palinuridae	95	$475
Echinoderm		64	$43
Cowry	Family Cypraeidae	73	$92
Mann's Anemone	*Cladactella manni*	47	$610
Anemone Crab	*Dardanus gemmatus*	36	$35
Brittlestars	Family Ophiocomidae	21	$24
Yellow Hairy Crab	*Aniculus maximus*	22	$310
Cleaner Shrimp	*Lysmata amboinensis*	40	$199
Green Shrimp	Family Hippolytidae	25	$130
Ghost Shrimp	*Stenopus pyrsonotus*	24	$177
Miscellaneous Crab		19	$33
Sea Cucumber	Family Holothuroidea	16	$137
Bubble Shell	Order Cephalaspidea	14	$140
Harlequin Shrimp	*Hymenocera picta*	11	$174
	Grand Total	**2,179,361**	**$6,613,443**

APPENDIX B.

Summarized below are the changes (Δ) observed in each individual FRA over time. „Before" density is the mean of 1999-2000 and „After" is the mean of 2007-2009. „Aquarium Fish" consist of the top 20 collected species (without yellow tangs since they account for the majority of the catch). The Figure shows Yellow Tang densities in each FRA relative to the closest MPA and Open area.

North Kohala FRA

Table A. Changes in fish groups in the North Kohala (Waiakailio Bay) FRA.

	Density (#/100m^2)					
Group	Before	After	Δ	ρ	R	ρ
Yellow Tang	16.34	11.77	**-28%**	0.01	**-57%**	0.01
Aquarium Fish w/o Yellow Tang	34.78	30.54	-12%	0.27	-26%	0.17
Non-aquarium fishes	46.37	34.52	-26%	0.14	+39%	0.07

Bold = statistically significant at ρ≤0.05

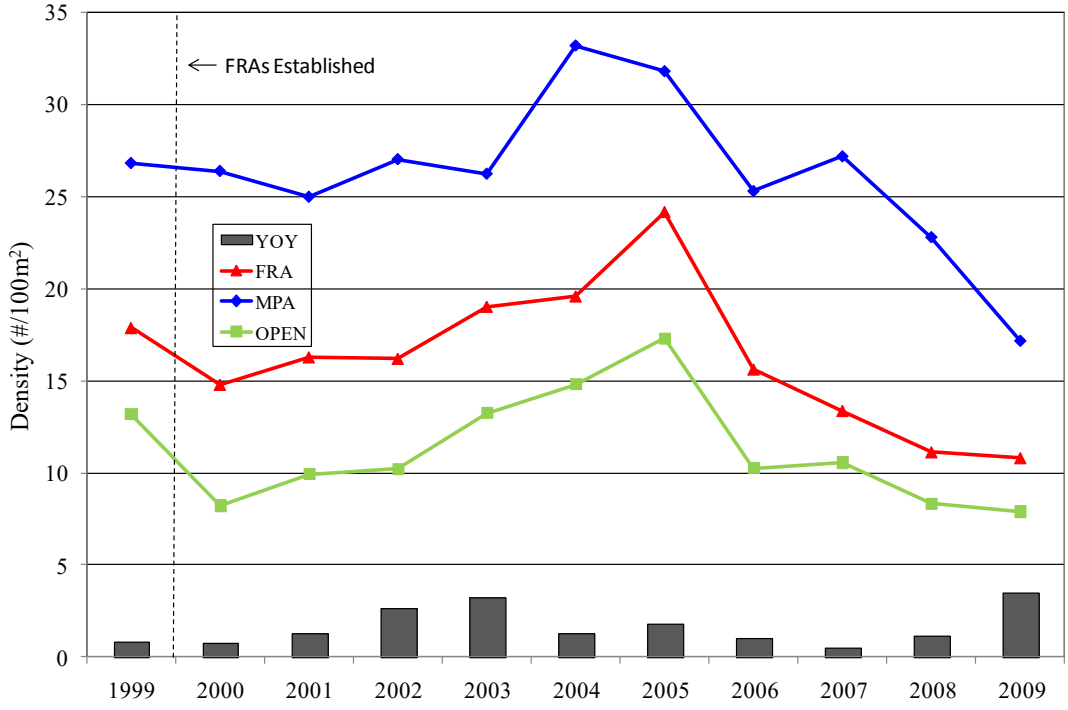

Figure 15. Changes in Yellow Tang abundance over time in FRA, MPA (Puakō) and Open (Kamilo Gulch) areas. Bars denote mean density (June-Nov) of Young- of-the-Year (YOY).

Puakō-ʻAnaehoʻomalu FRA

Table B. Changes in fish groups in the Puakō-ʻAnaehoʻomalu FRA.

Group	Density (#/100m^2) Before	After	Δ	ρ	R	ρ
Yellow Tangs	11.59	14.62	**+26%**	0.04	**+33%**	0.01
Aquarium spp. w/o Yellow	45.70	42.35	-7%	0.52	-45%	0.24
Non-aquarium fishes	25.82	20.65	**-20%**	0.03	**+38%**	**0.03**

Bold = statistically significant at ρ≤ 0.05

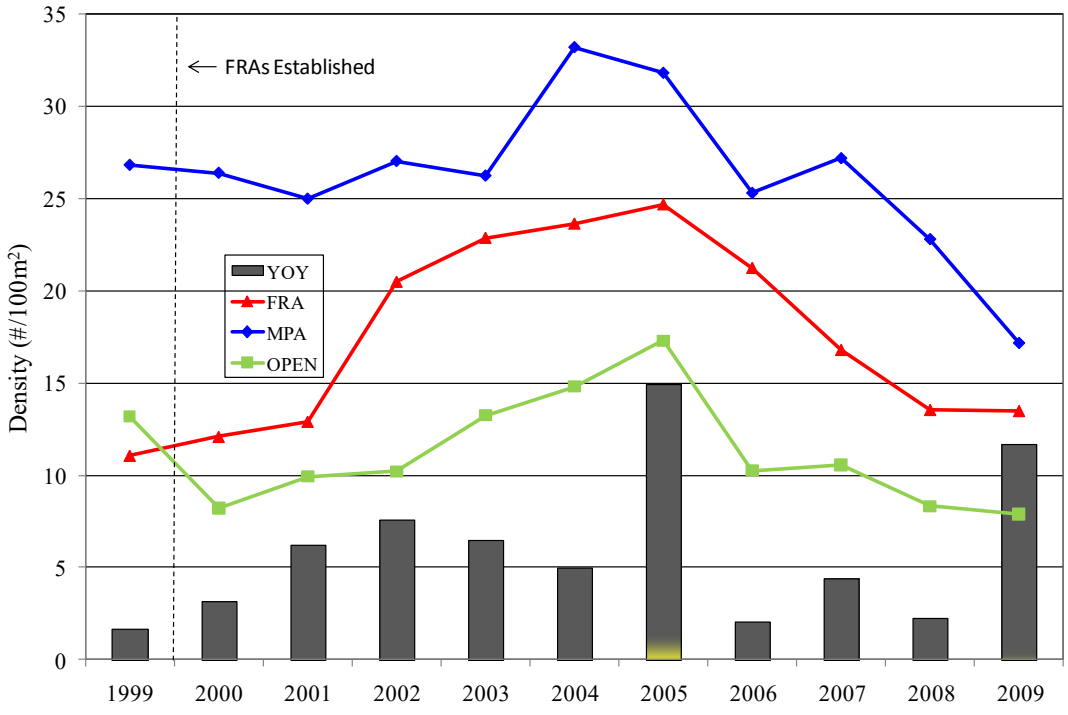

Figure 16. Changes in Yellow Tang abundance over time in FRA, MPA (Puakō) and Open (Keawaiki) areas. Bars denote mean density (June-Nov) of Young- of-the-Year (YOY).

Ka′upulehu FRA

Table C. Changes in fish groups in the Ka′upulehu FRA.

	Density (#/100m^2)					
Group	Before	After	Δ	ρ	R	ρ
Yellow Tang	17.45	27.05	**+55%**	0.01	**+184%**	0.01
Aquarium spp. w/o Yellow Tang	55.69	59.98	+8%	0.32	+761%	0.26
Non-aquarium fishes	31.60	25.40	-20%	0.24	**+39**	0.05

Bold = statistically significant at ρ≤ 0.05

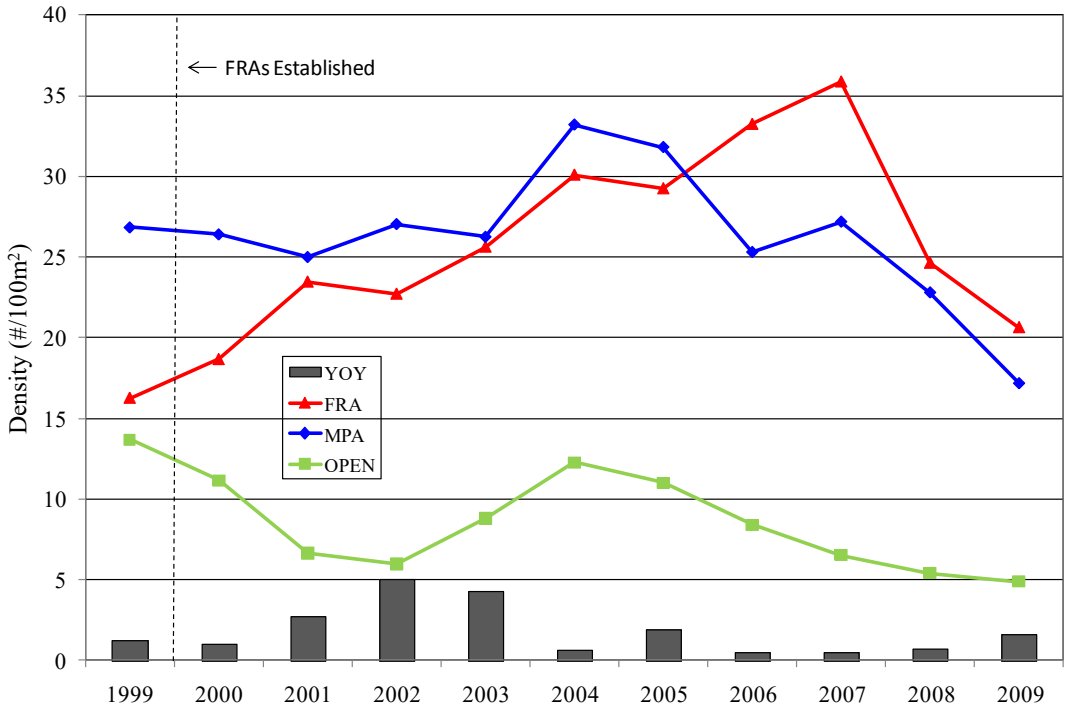

Figure 17. Changes in Yellow Tang abundance over time in FRA, MPA (Puakō) and Open (Makalawena) areas. Bars denote mean density (June-Nov) of Young- of-the-Year (YOY).

Kaloko-Honokōhau FRA

Table D. Changes in fish groups in the Kaloko-Honokohau FRA.

	Density (#/100m^2)					
Group	Before	After	Δ	ρ	R	ρ
Yellow Tang	17.42	19.77	+14%	0.28	+55%	0.10
Aquarium spp. w/o Yellow Tang	59.45	44.15	-26%	0.11	**-493%**	0.02
Non-aquarium fishes	82.03	94.19	+15%	0.42	**+123%**	0.03

Bold = statistically significant at ρ≤0.05

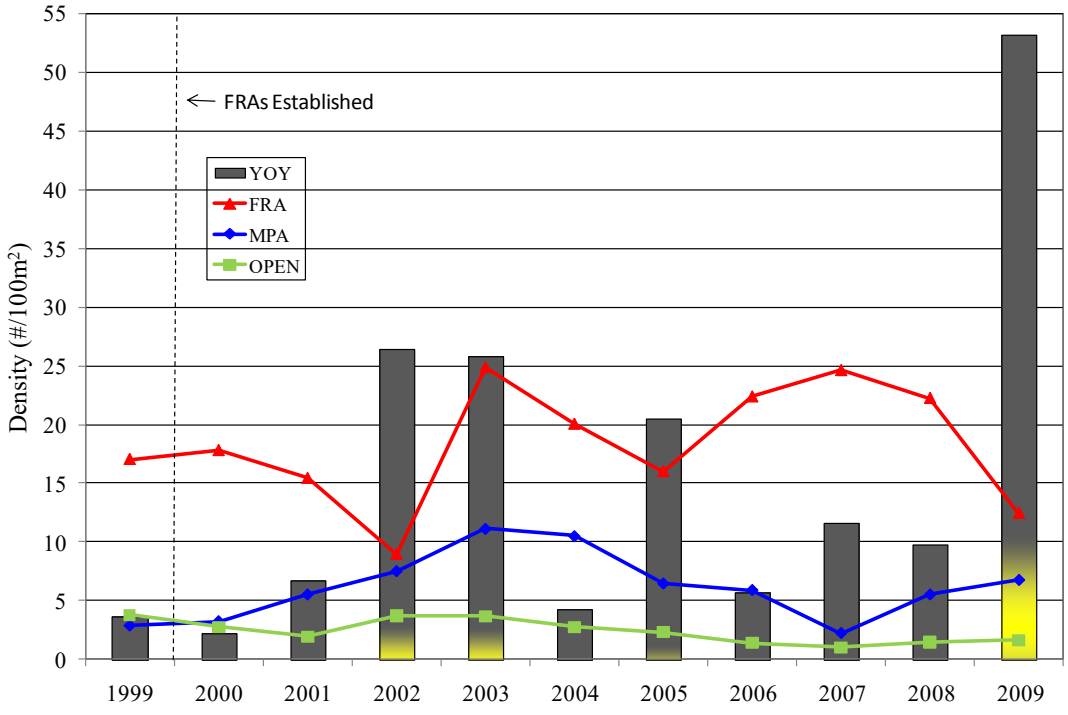

Figure 18. Changes in Yellow Tang abundance over time in FRA, MPA (Wawaloli) and Open (Wawaloli Beach) areas. Bars denote mean density (June-Nov) of Young- of-the-Year (YOY).

Kailua-Keauhou (South Oneo Bay) FRA

Table E. Changes in fish groups in the Kailua-Keauhou FRA.

	Density (#/100m^2)					
Group	Before	After	Δ	ρ	R	ρ
Yellow Tang	11.77	13.04	+11%	0.53	+18%	0.33
Aquarium spp. w/o Yellow Tang	39.54	30.54	**-23%**	0.04	**-63%**	<0.01
Non-aquarium fishes	44.50	29.90	-33%	0.08	**+35%**	<0.01

Bold = statistically significant at ρ≤ 0.05

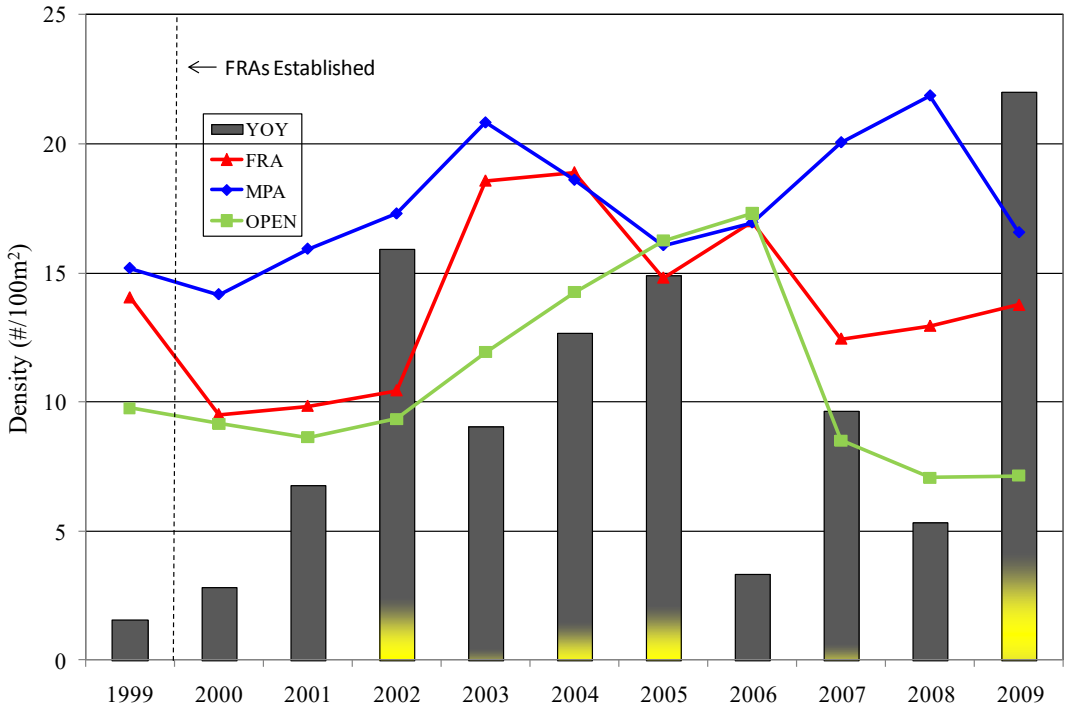

Figure 19. Changes in Yellow Tang abundance over time in FRA, MPA (Papawai) and Open (Kualanui Point) areas. Bars denote mean density (June-Nov) of Young- of-the-Year (YOY).

North Keauhou (Kailua-Keauhou) FRA

Table F. Changes in fish groups in the North Keauhou FRA.

Group	Density (#/100m^2) Before	After	Δ	ρ	R	ρ
Yellow Tang	6.50	17.17	**+164%**	0.01	**+69%**	0.01
Aquarium spp. w/o Yellow Tang	48.25	34.25	**-29%**	0.02	**-196%**	0.04
Non-aquarium fishes	32.47	19.54	**-40%**	0.05	**+32%**	0.05

Bold = statistically significant at ρ≤ 0.05

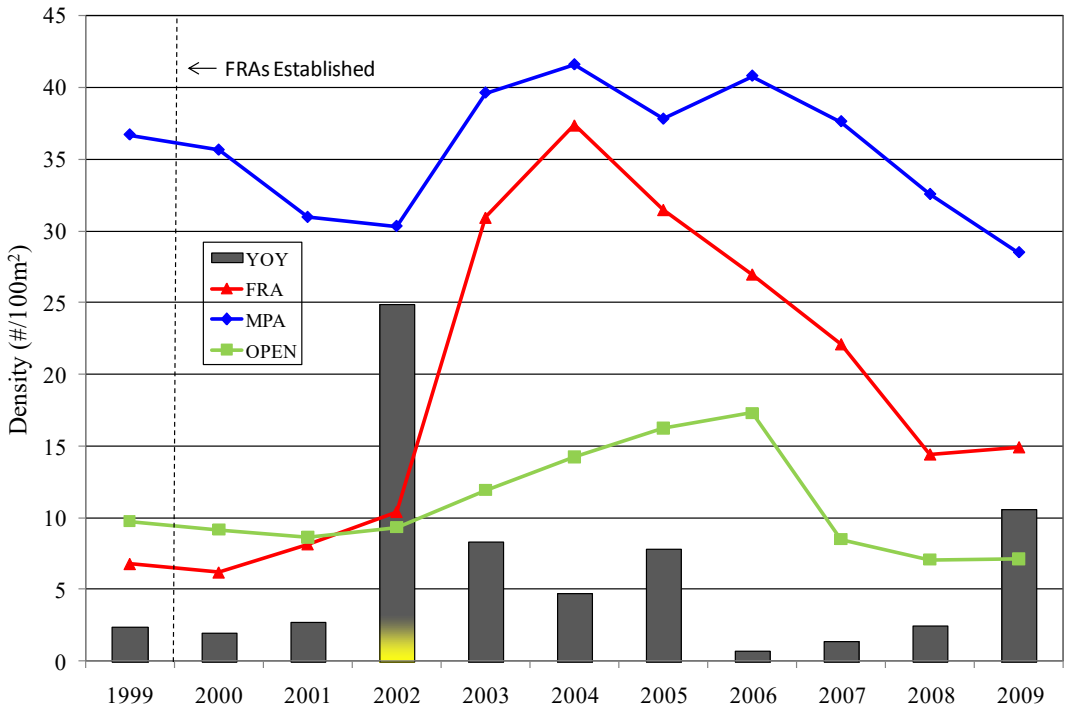

Figure 20. Changes in Yellow Tang abundance over time in FRA, MPA (Red Hill) and Open (Kualanui Point) areas. Bars denote mean density (June-Nov) of Young- of-the-Year (YOY).

Nāpoʻopoʻo-Hōnaunau (Keʻei) FRA

Table G. Changes in fish groups in the Nāpoʻopoʻo-Hōnaunau FRA.

	Density (#/100m^2)					
Group	Before	After	Δ	ρ	R	ρ
Yellow Tang	12.81	35.54	**+178%**	0.01	**+229%**	0.01
Aquarium spp. w/o Yellow Tang	48.34	49.10	+2%	0.88	-8%	0.71
Non-aquarium fishes	59.13	44.46	-25%	0.07	+42%	0.08

Bold = statistically significant at ρ≤0.05

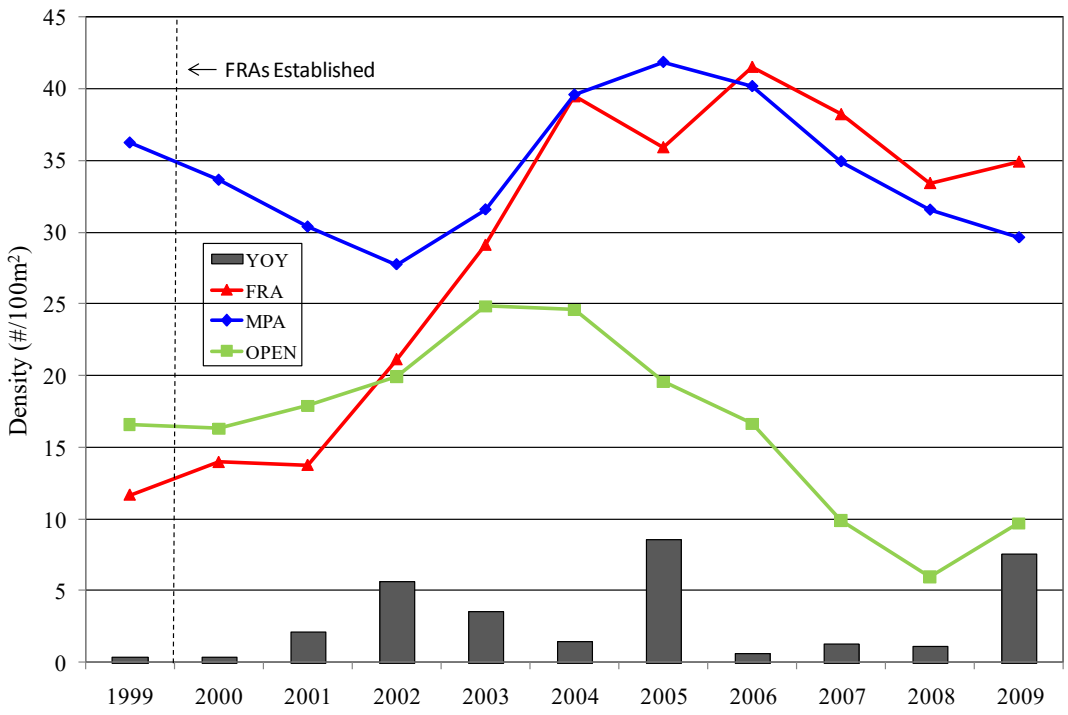

Figure 21. Changes in Yellow Tang abundance over time in FRA, MPA (Kealakekua Bay) and Open (Keopuka) areas. Bars denote mean density (June-Nov) of Young- of-the-Year (YOY).

Ho′okena (Kalahiki Beach) FRA

Table H. Changes in fish groups in the Ho′okena FRA.

Group	Density (#/100m^2) Before	After	Δ	ρ	R	ρ
Yellow Tang	11.91	26.46	**+122%**	0.01	**+137%**	0.01
Aquarium spp. w/o Yellow Tang	73.00	63.96	-12%	0.40	-61%	0.21
Non-aquarium fishes	49.61	42.29	-15%	0.14	**+47%**	0.03

Bold = statistically significant at ρ≤0.05

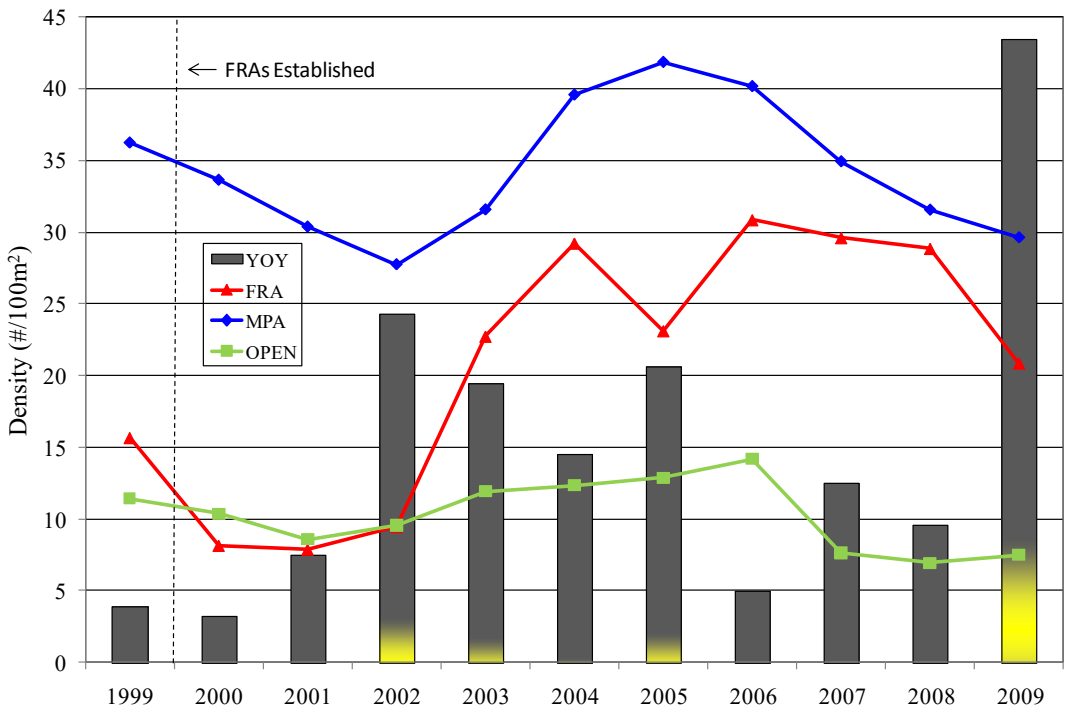

Figure 22. Changes in Yellow Tang abundance over time in FRA, MPA (Kealakekua Bay) and Open (Au′au Crater) areas. Bars denote mean density (June-Nov) of Young- of-the-Year (YOY).

Miloli′i FRA

Table I. Changes in fish groups in the Miloli′i (Omaka′a) FRA.

	Density (#/100m^2)					
Group	Before	After	Δ	ρ	R	ρ
Yellow Tang	8.82	14.11	**60%**	0.01	**+42%**	0.01
Aquarium spp. w/o Yellow Tang	63.35	63.02	-1%	0.96	-23%	0.66
Non-aquarium fishes	103.16	78.38	-24%	0.14	+77%	0.38

Bold = statistically significant at ρ≤0.05

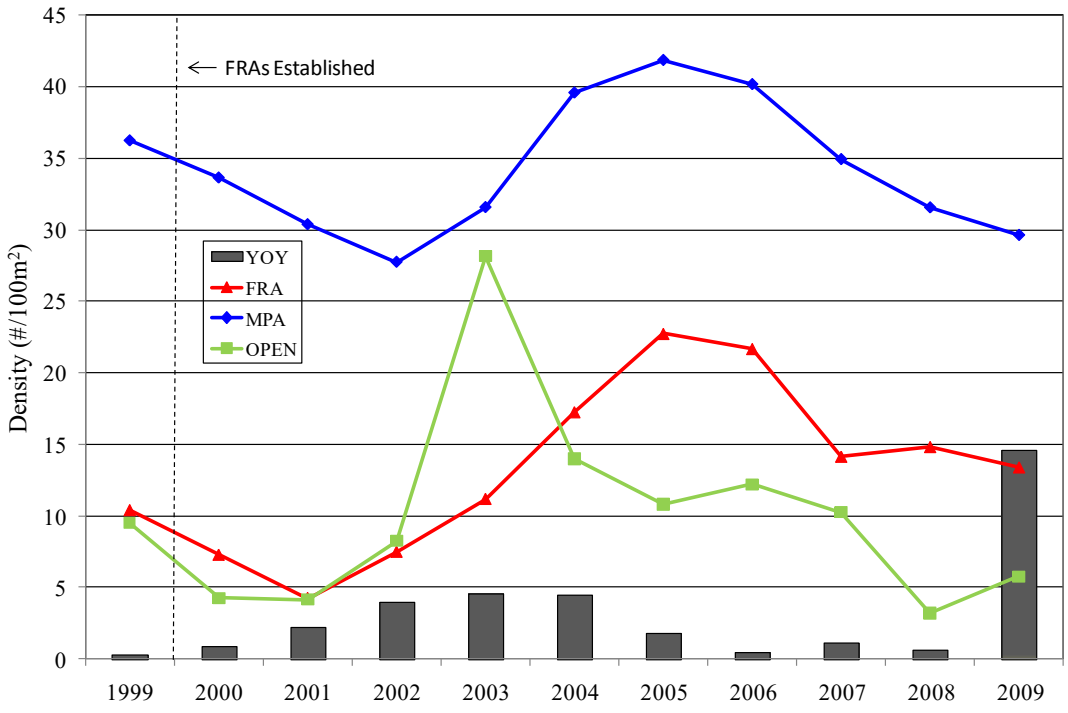

Figure 23. Changes in Yellow Tang abundance over time in FRA, MPA (Kealakekua Bay) and Open (Manuka) areas. Bars denote mean density (June-Nov) of Young- of-the-Year (YOY).

APPENDIX C

List of West Hawai'i day-use mooring buoys. Moorings in blue are installed but have not yet been written into Hawaii Administrative Rule. NR=not rigged (missing).

Name	Local Area Name	DM #	ft	N Latitude	W Longitude
Black Point (N)	Keawanui Bay	1	48	20° 6.775'	155° 53.177'
Black Point	Mala'e Pt (N)	2	55	20° 6.349'	155° 53.086'
Black Point (S)	Mala'e Pt (S)	3	53	20° 6.203'	155° 52.988'
Kei Kei Caverns (N) (Horseshoe)	Pōhakuloa Gulch (N)	4	51	20° 4.824'	155° 52.058'
Kei Kei Caverns (S)	Pōhakuloa Gulch (S)	5	42	20° 4.803'	155° 52.038'
Ulua Caverns	Waiakailio Bay	6	30	20° 4.462'	155° 51.861'
Frog Rock	Kapae Gulch	7	54	20° 3.895'	155° 51.266'
Lava Dome Rock	Kaiōpae	8	40	20° 3.654'	155° 51.058'
Crystal Cove	Honokoa	9	43	20° 3.220'	155° 50.749'
Puakō	Puakō	9A	40	19° 58.217'	155° 50.837'
Secrets	Waimā Pt (Puakō)	9B	35	19° 58.203'	155° 50.924'
Pine Tree	Kapuniau Pt	9C	18	19° 58.052'	155° 51.309'
Paniau N	Paniau N	9D	20	19° 56.590'	155° 51.595'
Paniau S	Paniau S	9E	40	19° 57.566'	155° 51.619'
Makaiwa Bay (Turtles)	Keanapukalua Pt	10	28	19° 56.957'	155° 52.259'
Haunted Cavern	Makaiwa Bay	11	34	19° 56.809'	155° 52.339'
Pentagon	'Anaeho'omalu Bay	12	18	19° 54.940'	155° 53.940'
Kua Bay	Kua Bay	12.04	23	19° 48.776'	156° 0.487'
Hoover's Tower (Keahole) (3)	Unualoha	12A	35	19° 44.422'	156° 3.333'
Garden Eels (N)	Makako Bay	12A1	26	19° 44.230'	156° 3.240'
Garden Eels West	Makako Bay	12A2	27	19° 44.202'	156° 3.235'
Garden Eels East	Makako Bay	12A3	19	19° 44.198'	156° 3.215'
Garden Eels (S)	Makako Bay	12A4	23	19° 44.161'	156° 3.235'
Tako City (Keahole)	Ho'ona Bay	13	35	19° 43.955'	156° 3.467'
Keahole Wash Rock	Ho'ona Bay	14	32	19° 43.934'	156° 3.578'
Pipe Dreams	Keahole Pt.	14A	39	19° 43.747'	156° 3.735'
Black Hole	Wawaloli Beach	14B	55	19° 42.932'	156° 3.238'
Dotti's Reef	Pūhili Pt.	14C	28	19° 42.406'	156° 3.001'
Rabbi's Reef (Lionfish Arch)	Pūhili Pt.	14D	47	19° 42.359'	156° 3.056'
Phantom Ridge (High Rock)	Pūhili Pt.	15	38	19° 42.295'	156° 3.016'
Carpenter's House	Pūhili Pt.	16	34	19° 42.283'	156° 3.009'
Golden Arches (N)	Pūhili Pt.	17	40	19° 42.203'	156° 3.007'
Golden Arches (S)	Pūhili Pt.	17A	26	19° 42.176'	156° 2.991'
Pyramid Pinnacle 1	Wawahiwa'a Pt.	18	65	19° 41.552'	156° 2.742'
Pyramid Pinnacle 2	Wawahiwa'a Pt.	19	38	19° 41.551'	156° 2.775'
Skunk Hollow 1 (Inside)	Wawahiwa'a Pt.	20	32	19° 41.483'	156° 2.582'

Skink Hollow 2 (Outside)	Wawahiwa′a Pt.	21	40	19° 41.466'	156° 2.588'
Suck 'Em Up Cave	Wawahiwa′a Pt.	22	35	19° 41.480'	156° 2.538'
Lone Tree	Wawahiwa′a Pt.	23	40	19° 41.468'	156° 2.445'
Freeze-Face Cave	Wawahiwa′a Pt.	23A	23	19° 41.425'	156° 2.365'
Windows	Kaloko Fishpond	23B	33	19° 41.154'	156° 2.099'
Kaloko Ledges (Kaloko Arches1)	Kaloko Pt	24	43	19° 40.991'	156° 2.192'
Kaloko Arches (Kaloko Arches2)	Kaloko Pt	24A	35	19° 41.019'	156° 2.152'
Terrapin Station	Honokōhau Bay	24A1	35	19° 40.330'	156° 1.875'
Turtle Pinnacle	Honokōhau Bay	24B	32	19° 40.305'	156° 1.830'
Turtle Pai	Honokōhau Bay	24C	21	19° 40.302'	156° 1.791'
Turtle Heaven	Maliu Pt.	24D	22	19° 40.223'	156° 1.750'
Honokohau Inside	Honokōhau Bay (S)	24E	18	19° 40.076'	156° 1.739'
Honokohau Middle	Honokōhau Bay (S)	24F	16	19° 40.072'	156° 1.747'
Honokohau Outside	Honokōhau Bay (S)	24G	20	19° 40.064'	156° 1.768'
Eel Cove (N)	Kaiwi Pt	25	33	19° 39.302'	156° 1.910'
Eel Cove (S)	Kaiwi Pt	26	15	19° 39.249'	156° 1.893'
Outhouse	??	26A	47	19° 39.002'	156° 1.806'
Kaiwi Wash Rock 1 (Pawai Bay)	Pawai Bay	27	40	19° 38.816'	156° 1.410'
Kaiwi Wash Rock 2 (Pawai Bay)	Pawai Bay	28	40	19° 38.830'	156° 1.403'
Kaiwi Arch Cave (Pawai Bay)	Pawai Bay	29	40	19° 38.840'	156° 1.375'
Kaiwi Sand Channel (Pawai Bay)	Pawai Bay	30	40	19° 38.849'	156° 1.348'
Kaiwi Kamanu (Pawai Bay)	Pawai Bay	31	45	19° 38.857'	156° 1.308'
Disneyland	??	32	33	19° 38.830'	156° 1.186'
Airtanks	??	32A	28	19° 38.802'	156° 1.108'
Old Airport	Pohakuloa Rock	33	40	19° 38.648'	156° 0.990'
Sharkfin Rock (Old Airport S)	Pohakuloa Rock	34	36	19° 38.620'	156° 0.940'
Casa Cave	Puapua′a Pt.	34A	38	19° 36.963'	155° 59.209'
Mano Point (Fantasy Reef)	Kualanui Pt.	35	42	19° 32.757'	155° 57.700'
Chimney	Kuamo′o Pt.	36	41	19° 32.475'	155° 57.600'
Leinokano Point	Leinokano Pt.	37	NR	19° 32.180'	155° 57.520'
Pa′aoa Bay	Pa′aoa Bay	38	NR	19° 31.860'	155° 57.440'
Coral Domes	Keikiwaha Pt. (N)	39	33	19° 31.307'	155° 57.562'
Keikiwaha Point	Keikiwaha Pt. (S)	40	NR	19° 31.180'	155° 57.690'
Henry's Cave	Pu′u Ohau (N)	40A	43	19° 30.496'	155° 57.292'
Sharkey's (Bay of Pig)	Pu′u Ohau (S)	41	49	19° 30.371'	155° 57.305'
Nenue Point	Nenue Point	42	NR	19° 30.760'	155° 57.630'
Amphitheater (Long Lava Tube)	Nawawa Bay (N)	43	52	19° 30.239'	155° 57.183'
Amphitheater (Octocoral)	Nawawa Bay (S)	44	40	19° 30.185'	155° 57.145'
Driftwood	??	45	42	19° 29.929'	155° 57.088'
The Dome	Keawekaheka Bay (N)	45A	36	19° 29.823'	155° 57.002'
Ridges	Keawekaheka Bay (S)	46	32	19° 29.665'	155° 57.010'
A-Bay Arches	Kapalaoa	12.01	20	19° 54.919'	155° 54.001'
Black Coral Arch	??	12.02	40	19° 50.154'	155° 59.789'
Touch of Grey	??	12.03	58	19° 46.962'	156° 3.159'

Proposed Additional Moorings					
Puako Condos	Puakō Pt.		37	19° 58.405'	155° 50.615'
Puako Puffer Canyon	Puakō reef		37	19° 58.260'	155° 50.729'
Garden Eel Cove 1	Makako Bay		50	19° 44.186'	156° 3.260'
Garden Eel Cove 2	Makako Bay		85	19° 44.186'	156° 3.260'
Keauhou Manta 1	Kaukalaelae Pt.		25	19° 33.558'	155° 58.023'
Keauhou Manta 2	Kaukalaelae Pt.		35	19° 33.558'	155° 58.023'
Keauhou Manta 3	Kaukalaelae Pt.		40	19° 33.558'	155° 58.023'
Kealakekua Bay	Ka′awaloa			TBD	TBD

Long-Term Monitoring of Coral Reefs of the Main Hawaiian Islands

Final Report

2009 NOAA Coral Reef Conservation Program

State of Hawai'i Monitoring Report

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Hawai`i DAR

Division of Aquatic Resources

Department of Land & Natural Resources

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SUMMARY OF FINDINGS

O'ahu:

- Fifteen permanent survey sites were established on O'ahu, with sites on each shore of the island, as well as in a spectrum of management regimes
- Baseline data from all of these sites has been collected, and time series are being developed
- Lay Net Restricted sites appear to have the highest fish biomass on average, and both these and MLCD sites have higher biomass than fully open areas. The MMA site had intermediate biomass, and was not clearly different from MLCD or open sites.
- Lay Net Restricted areas compared favorably with MLCD and Open sites in species composition and biomass. A longer time series will be needed to determine if these areas are inherently healthy coral reef areas or are responding to the recent restrictions on the use of lay gill nets
- The surgeonfish family is by far the dominant fish family on O'ahu reefs by biomass, followed by triggerfish, goatfish, wrasse, and parrotfish families.

Maui

Benthic

- Nine of the 20 currently monitored coral reefs have experienced significant changes (paired t-tests of first survey year vs. most recent survey year, $p<0.05$), with coral cover declining at 7 sites and increasing at 2 sites.
- Coral cover declines at three sites (Honolua Bay, Mā'alaea Bay, and Papaula Point) were so severe that these individual reefs may have already experienced a total coral reef ecosystem collapse.
- Sites experiencing significant coral reef declines appear to be affected by anthropogenic impacts such as land based pollution, sedimentation and overfishing.
- Monitoring sites with stable high coral cover (Kanahena Bay, Olowalu, and Molokini) appear to be away from urban areas, are fairly remote or are located offshore.

Fish

- Comparisons between fully protected reserves versus areas open to fishing show that marine reserves have consistently higher resource fish biomass levels, larger sized fish, greater numbers of apex predators, and the greater abundances of schooling grazers.

Shallow Water Habitat and Fish Surveys (lay-net regulation assessment surveys)

- Fish biomass levels were higher in areas where past lay-net fishing effort was lower.
- Qualitative habitat assessments show the areas that experienced the highest past lay-net fishing effort had the most degraded reef habitats with algal cover at 20% or higher at most of these survey locations.

Kahekili Herbivore Baseline

- 42 Sites have been surveyed to establish a firm baseline of fish, benthic cover, and urchin populations.
- Benthic community structure and fish biomass varied significantly by habitat, and therefore may have markedly different responses to the management implementation.

Volunteer Herbivore Grazing Assessments

- Over 100 trained volunteer community members have participated in 532 surveys, totaling over 2400 contributed hours
- General grazing trends for both acanthurids and scarids were similar. A significant negative correlation for grazing rate versus fish size was observed, which is intuitive because smaller fishes require continuous energy for growth. Conversely, bite sizes increased with fish size.
- The area of algae scraped by scarids over a year has a significant positive linear relationship to size (i.e. larger fish have a greater impact on algal removal).
- Both scarids and acanthurids are critical grazers for controlling algae on the reefs. Not enough data was gathered on kyphosids due to infrequent presence of this family in the study sites.

Roi Control Assessments

- Data has been collected on community efforts to reduce roi populations on Maui. Most of this effort has been at one location, Olowalu.
- When data on both CPUE and the number of roi escaped are combined, a significant decline in roi abundance can be seen.
- While roi have been substantially reduced, they are still present in moderate densities despite months of removal effort.
- Ciguatera analysis of fish weighing over one pound indicates that 69% of the population contains ciguatoxin.

Coral Disease Assessments

- HIMB researchers' data showed a 47% decrease in coral cover over a period of one year at a site known as Montipora Pond, wherein a nearly monotypic stand of Montipora capitata has a chronic outbreak of Montipora white syndrome. DAR Maui took over monthly monitoring efforts to learn more about this outbreak. The outbreak shows patterns of waxing and waning, with an increase in coral mortality.
- NOAA and DAR Maui have partnered to gather data on coral disease at four sites on Maui in order to test a satellite predictive tool model for Hawai′i. The first of two years of data collection has been completed.

Hawai'i

Benthic

Coral and Habitat Surveys

- Total Coral cover declined significantly at 6 northern sites in West Hawai'i between 2003 and 2007. A strong winter storm in 2004 was likely responsible for the declines but a major sediment event in 2006 may also have affected sites at Kamilo Gulch and Waiaka'ilio Bay on the North Kohala coast.
- No invasive alien algal or coral species were detected at any site. Macroalgal cover was very low at all sites.
- The distribution of the octocoral *Sarcothelia edmonsoni* around developed areas near Kona and its virtual absence around undeveloped shoreline areas suggests possible anthropogenic (pollution) influence. Since other studies have cited octocoral as a pollution indicator and shoreline development in West Hawai'i is expected to continue to increase, further studies should be undertaken to determine the relationship between octocoral presence and land based pollution.

Coral Disease Surveys

- The following coral diseases were recorded at West Hawai'i monitoring sites in 2010: *Porites* growth anomaly, *Porites* tissue loss syndrome, *Porites* multifocal tissue loss, *Porites* trematodiasis, *Montipora* growth anomaly, *Pavona varians* hypermycosis, *Pocillopora* tissue loss.
- *Porites spp.* were the most susceptible to disease (mean prevalence of 3.76 ± 3.58%), with the most widespread diseases including growth anomalies, trematodiasis, and tissue loss syndrome of *Porites spp*.
- Though thought to be a common condition, the possible senescence reaction of *Pocillopora meandrina* (i.e. progressive age-related colony death) was observed at only two sites likely attributed to the low number of Pocilloporids present at monitoring sites.
- Overall disease prevalence and prevalence of *Porites* growth anomalies were positively correlated with total estimated size and total number of submarine groundwater (SGD) "plumes".
- West Hawai'i sites show a significant negative relationship between disease prevalence and distance from harbors/boat ramps (overall disease prevalence: $r = -0.402$, $p = 0.028$), particularly for *Porites* growth anomalies ($r = -0.658$, $p = 0.000$) and *Porites* tissue loss syndrome ($r = -0.701$, $p = 0.000$).
- No significant changes in disease densities were found between survey years 2007 and 2010 for ten DAR monitoring sites ($p = 0.18$). However, instances of *Porites* growth anomalies and *Porites* tissue loss syndrome slightly increased at four sites located in close proximity to harbors/boat ramps.
- No statistically significant relationships were found between prevalence of coral diseases and abundances of corallivorous butterflyfishes and parrotfishes for West Hawaii's reefs.

Fish

- The abundance of both aquarium and food fishes increased significantly in West Hawai'i over the last 11 years. The overall number of fishes not substantially harvested for either food or for the aquarium trade, did not change significantly although individual species within this group may have.
- Examination of the temporal trends of some of the most common reef fish families indicates that acanthurids have been increasing over the past eleven years while labrids have decreased. Overall, chaetodontids and pomacentrids have been relatively stable although some species within the family have either increased or declined.

Introduced Species/Fish Die-Off

- Transect data reflects overall low abundance of ta'ape in the reef areas of the study sites and they are rarely found in the shallower water where resource fish surveys are conducted. Ta'ape are numerous in some locales usually along drop-offs and deeper reef areas but their distribution is highly patchy and they are not at all abundant in many reef areas in West Hawai'i. Ta'ape numbers also appear to have declined from earlier periods.

- There has been a marked decrease in roi abundance both on West Hawai'i transect (56% decrease) and free swim surveys (55% decrease). This decline may be related in part to an unusual fish die-off in West Hawai'i which first became apparent in May 2006.

- Early in 2010 a die-off of large puffers, with external symptoms quite similar to the previous mortalities, began to occur on Maui and Hawai'i Island. Over the ensuing months low numbers of dead and dying puffers were progressively reported up the island chain as far as Kaua'i (Oct. 2010).

- West Hawai'i monitoring data indicates a substantial decline has occurred in the abundance of the Hawaiian spotted toby (*Canthigaster jactator*) and the spotted puffer (*Arothron meleagris*) with a precipitous drop of the latter species in 2009/2010.

- As of November 2010 a total of 106 puffers have undergone both gross and microscopic examination. All assays for viruses (including electron microscopy) have so far come up negative and all attempts to incriminate any infectious agent as a cause have come to naught.

- An examination of roi and two of the most abundant species in roi's prime habitat the yellow tang (*Zebrasoma flavescens*) and kole (*Ctenochaetus strigosus*) fails to indicate direct negative impact on either species.

- Examination of the relationship between roi abundance and the abundance of various species and functional groups shows no significant negative relationships. In other words having more roi in an area does not result in having less total fish, small prey fish, other piscivores, yellow tang Young-of-Year (YOY), kole YOY or all YOY.

- The estimated roi population in West Hawai'i in the 30'-60' depth range (hard bottom only) is 58,839 individuals.

Aquarium Species

- Ten years after closure of the FRAs, the top 20 aquarium species showed a small overall increase in abundance relative to the period before the FRAs were operational. Most of the increase was attributed to the top two species Yellow Tang and Goldring Surgeonfish (kole) which comprise 91% of the West Hawai'i Aquarium catch.

- Seven of the top 10 most collected species (representing <6% of all collected fish) decreased in overall density. Three of these decreases were significant (Achilles Tang, Multiband Butterflyfish and Black Surgeonfish).

- The FRAs were 'effective' (increases in FRAs relative to long-term MPAs) for eight of the top 10 collected species with three being statistically significant. With only a single exception the FRAs were highly effective in increasing the abundance of Yellow Tang along the West Hawai'i coastline.

- A decrease of yellow tang in open areas to below baseline levels is largely attributable to an increase in the number of aquarium collectors and collected animals relative to the period when the FRAs were established. kole are more abundant and much less collected than the yellow tangs and open areas have been relatively stable. Achilles tangs are in a declining trend.

- Concerns over continued expansion of the aquarium fishery and harvesting effects in the open areas has prompted DAR and the West Hawai'i Fisheries Council (WHFC) to develop a 'white list' of 40 species which can be taken by aquarium fishers. All other species are off limits.

- Based on an analysis of the differences in density between open and protected areas there was clear evidence of an aquarium collecting impact for only 5 species of the 34 white list species which were analyzed. Four of the 5 are among the 10 most heavily collected species. For the others, it appears that inclusion on the white list poses little or no threat to their populations.

- Based on a comparison of catch and estimated population abundance in the 30'-60' depth range aquarium collecting is having the largest impacts on Achilles and yellow tang. Achilles tang has had low levels of recruitment over the past decade and substantial numbers of larger fish (i.e. 'breeders') are taken for human consumption. Yellow tang has generally recruited reliably but aquarium take has risen dramatically to currently unsustainable levels.

- For most of the species on the white list collecting impact, in terms of the % of the population being removed annually, is relatively low with 10 species having single digit % catch and 19 species having % catch values <1%.

- Eight no lay gill netting areas were established in West Hawai′i in 2005, comprising 25% of the coastline (including already protected areas). Nearshore monitoring results did not find major differences in food fish abundance in/out of the no netting areas. The lack of a marked effect of protection may be due to several factors including the relatively low number of lay gill nets that are presently being used (i.e. registered) in West Hawai′i.

Invertebrates

- Crown-of-thorns starfish have a low absolute abundance on West Hawai'i reefs and there has been an overall decreasing trend in abundance over the last four years.

- Three species of monitored urchins have been increasing on West Hawai'i reefs with the collector urchin, *T. gratilla* exhibiting the greatest increase. This increase is not related to an increase in benthic algae as a food supply.

East Hawai'i

- Abundance of fishes is significantly greater at both Waiopae MLCD and Waiopae open sites than at Richardson's Ocean Center (ROC). Species richness is higher in the MLCD as compared to ROC. The MLCD and ROC sites have the highest similarity in fish communities, and the OPEN and ROC communities have the lowest similarity.

- Over the 12 years of surveying of fishes at Waiopae and ROC, there appears to have been a slight increase in fishes observed between 1999 and 2006, followed by a three-year decline. No net increase in fish abundance has been observed at Waiopae MLCD since its establishment in 2003.

CONTRIBUTORS

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OBJECTIVES

Proposed work under this grant is directed to continuing and enhancing the coral reef monitoring program within the Hawai'i Division of Aquatic Resources (DAR) of the Department of Land and Natural Resources, State of Hawai'i. DAR is the agency responsible for management of nearshore and coral reef areas within state waters. Specific objectives include:

- Conduct resource fish surveys at 40 Maui sites three times per year
- Conduct integrated surveys of fish, benthic habitat, and macro invertebrates three times per year at five of the above Maui resource fish sites
- Continue to conduct annual surveys of the 20 established Maui CRAMP sites
- Conduct shallow water fish and habitat surveys three times a year at 56 transect sites that were in heavily lay gill-net fished areas prior to lay net fishing ban in Maui waters
- Establish survey sites and conduct quarterly resource fish and invertebrate surveys of 15 O′ahu monitoring sites, including sites on all shores
- Establish permanent transects and conduct initial benthic surveys of O′ahu monitoring sites
- Assist CRAMP in monitoring of 4 established West Hawai′i sites
- Conduct quarterly fish and invertebrate surveys of 28 West Hawai'i WHAP sites and 3 East Hawai'i sites
- Conduct quarterly resource fish monitoring surveys at 14 West Hawai'i sites
- Conduct 6 replicate Adult Yellow Tang surveys using Jet Boots at 16 West Hawai′i sites
- Conduct Shallow Water Resource Fish Surveys at 144 West Hawai′i sites
- Conduct 4 Random Fish Surveys at 3 West Hawai′i sites
- Conduct baseline Coral Disease Surveys at 30 West Hawai′i sites including 2 replicates at 4 NOAA sites
- Provide DAR personnel with monitoring tools to accomplish data collecting, analysis and dissemination
- Train DAR personnel to assist in data analysis, interpretation and database usage
- Continue development and integration of DAR monitoring data processing and analysis capability
- Disseminate the results of this work and make recommendations on the role of managed areas and the impacts of fishing to DAR, coral reef ecosystem managers, the scientific community, the West Hawai′i Fisheries Council and the public.

O'ahu Surveys

Methods

In 2007, O'ahu DAR staff designed and began to implement a long term monitoring program designed to track the trends in coral reef resource health around the island. The central component of this monitoring program is a series of "integrated" sites, where fish community and benthic cover data are collected along a series of permanently marked transects sites (Figure 1).

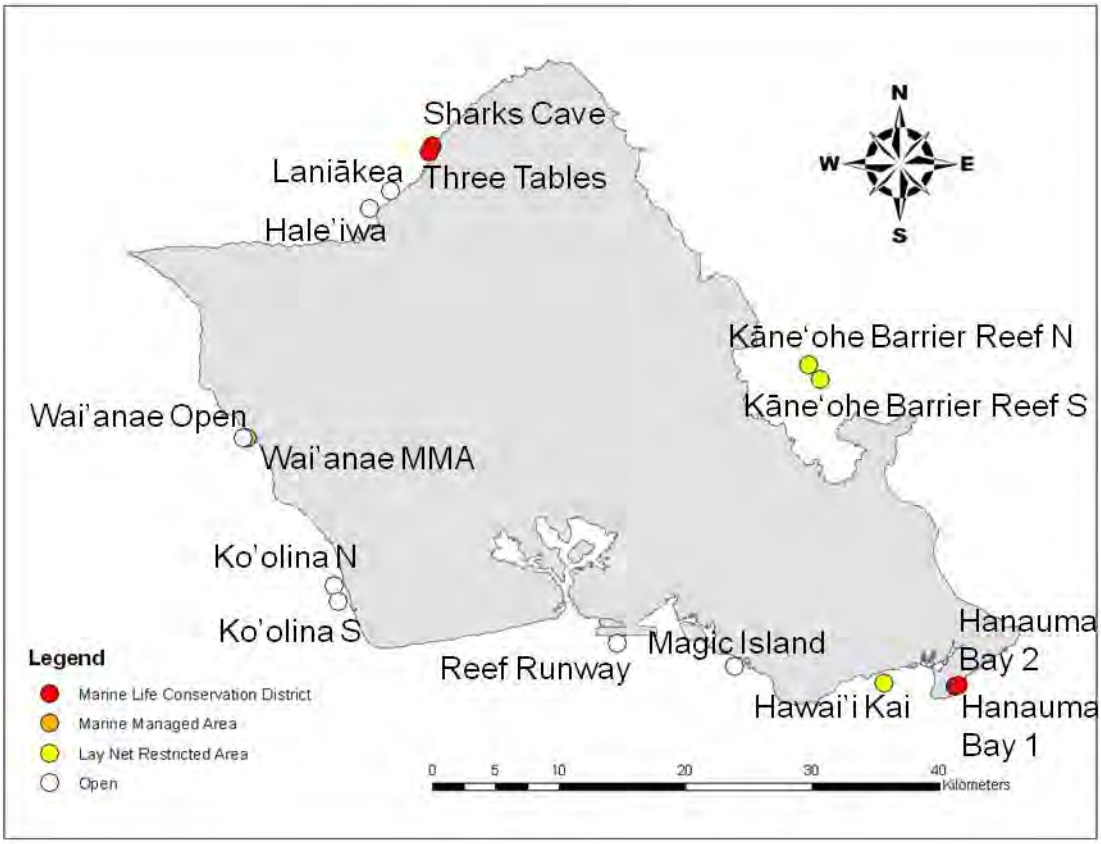


Figure 1. O'ahu integrated (co-located fish and benthic) survey sites

These sites are distributed around the island, and across a range of protection status. Marine Life Conservation Districts (MLCDs) on O'ahu are areas where no take of marine life is permitted. The Marine Managed Area (MMA) in Wai'anae only allows pole-and-line fishing, as well as limited netting of crabs and baitfish. Lay Net Restricted (LN Rest) areas prohibit the use of lay gill nets, but are otherwise open to fishing. And open areas have no take restrictions beyond state-wide limits on certain species and regulations concerning specific gear types.

The goal is to visit each of these sites three times per year, weather and staff time permitting, and collect data using the suite of methods described below.

Table 1. O'ahu integrated benthic monitoring sites with their corresponding district, location, depth, and management or protection status.

Site	District	Latitude	Longitude	Mean Depth (m)	Status
Hanauma Bay 1	East O'ahu	21.26757	-157.69363	12.3	MLCD
Hanauma Bay 2	East O'ahu	21.26887	-157.69157	10.7	MLCD
Kāne'ohe Barrier Reef S	East O'ahu	21.48529	-157.79003	12.3	Lay Net Restricted
Kāne'ohe Barrier Reef N	East O'ahu	21.49580	-157.79785	11.3	Lay Net Restricted
Hale'iwa	North O'ahu	21.60617	-158.10928	6.9	Open
Laniākea	North O'ahu	21.61900	-158.09483	7.8	Open
Sharks Cove	North O'ahu	21.65086	-158.06475	8.7	MLCD
Three Tables	North O'ahu	21.64603	-158.06706	11.1	MLCD
Hawai'i Kai	South O'ahu	21.26997	-157.74410	9.4	Lay Net Restricted
Magic Island	South O'ahu	21.28175	-157.85071	7.3	Open
Reef Runway	South O'ahu	21.29817	-157.93342	10.3	Open
Ko Olina N	West O'ahu	21.33910	-158.13505	8.3	Open
Ko Olina S	West O'ahu	21.32793	-158.13139	7.7	Open
Wai'anae MMA	West O'ahu	21.44361	-158.19628	7.0	MMA
Wai'anae Open	West O'ahu	21.44394	-158.19933	9.2	Open

Benthic Survey Methods

Fixed Photo-Transects

To obtain high-resolution data on the benthic cover of specific sites over time (i.e., to detect small to moderate percent change in key benthic components such as coral cover), a series of short (25-m-long) fixed transects were permanently installed in 2007. At each site, stainless steel eyebolts are drilled and epoxied into the reef at the start and end of 4 permanent transects. The transects are arrayed in an 'H' pattern: 2 parallel rows of 2 transects (one deep row and one shallow row), with 10 m between transects in each row and between rows. This methodology was initially developed on Hawai'i Island and forms the basis for both benthic and fish/invertebrate monitoring on both these islands.

Along each of these transects, a high quality digital still camera is used to take photographs at 1 m intervals along the length of the transect. Photographs are taken perpendicularly to the reef, and a camera stand is used to ensure that the camera is at a standard height of 0.75 m above benthos.

The data are subsequently analyzed using Photogrid computer software, with the composition of the benthic community under a series of 25 randomly generated points determined to the lowest possible taxonomic level possible (e.g., species of corals, genera of algae).

Due to the slow pace of change in benthic communities, these surveys are scheduled to be repeated every three years.

Benthic Assessments

As a complement to the high-resolution data collected by the fixed photo-transects described above, a series of benthic assessments are conducted over a broader area around each site. This method is not intended to detect fine-scale changes in benthic cover, but instead to detect ecosystem-level changes in dominant components of the benthic community. While this method is more subjective than photo-quadrat, it is a method of benthic habitat assessment that is currently also used in Florida for a cooperative monitoring program implemented by NOAA Fisheries, the National Park Service, the University of Miami, and the Florida Fish and Wildlife Research Institute. It has been evaluated over the course of these studies to be a viable means of assessing benthic cover—particularly when time constraints and oceanographic conditions preclude the use of other methods.

These assessments are conducted on the return leg of a 5-minute timed swim (targeting larger, more mobile fish) that typically covers 120-150m. At the “far end” of this swim, the diver buddy pair stops and does a benthic assessment, and then stops at one-minute intervals along the 5-minute return to conduct additional assessments, resulting in a total of six benthic assessments per diver per transect.

For each benthic assessment, each surveyor estimates the relative percent of benthos (reef bottom) in each of several general categories in a circle with a radius of 5 m. The surveyor first estimates the percent of substrate within this circle that is sand. Of the remaining hard bottom, the surveyor then estimates the percent cover of live coral, crustose coralline algae (CCA), macroalgae, other benthic cover (e.g. sponge or zoanthids), and bare substrate. For example, if 50% of benthos is sand, but ¾ of non-sand area is coral, that is recorded as 75% coral.

Unlike the fixed photo-transects, the benthic assessments are conducted every time the sites are surveyed, with a target of three survey periods per year.

Fish Survey Methods

To obtain high-resolution data on the fish community at specific sites over time, a series of short (25-m-long) fixed transects were permanently installed in 2007 (as above in the Benthic Monitoring section). At each site, stainless steel eyebolts are drilled and epoxied into the reef at the start and end of 4 permanent transects. The transects are arrayed in an ‘H’ pattern: 2 parallel rows of 2 transects (one deep row and one shallow row), with 10 m between transects in each row and between rows. Six stainless steel eyebolts (the circles in Figure 2) permanently mark the end points of the four 25m transect lines.

Each transect is surveyed by a pair of divers swimming in parallel on either side of the transect line, each diver recording all fishes within a 2 m-wide belt on their side of the line. Divers first swim rapidly down the transect recording larger mobile fishes transiting the line, mid-water species and any conspicuous rare or uncommon species. They then turn around and return back down the same transect slowly and carefully recording all other fishes in and around the benthos within the same 2m-wide belt.

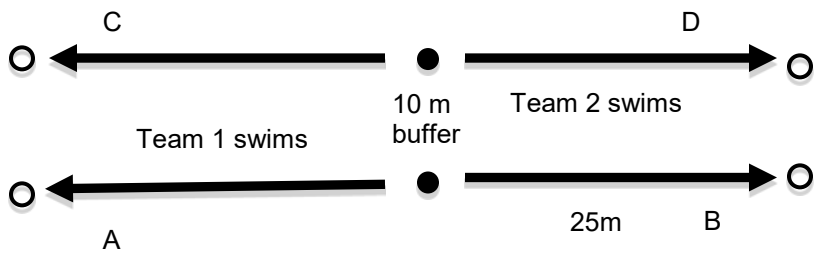


Figure 2. Diagram of 'integrated' fish survey transect configuration.

All species of fishes are recorded and sized, with particular attention to small site-attached or semi-cryptic species, fish recruits, and total fish community richness. Data from the two observers on a transect are then pooled into one 4 m x 25 m transect, with a total of four replicate 4 m x 25 m transects distributed across the 'H' sampling design.

The sizes of all fishes are visually estimated to the nearest 5 cm and recorded in 5cm bins (i.e. 1-5cm="A", 6-10cm="B", 11-15cm="C", etc.). Measured hash marks on the top of diver-held data slates serve as visual size references. Fishes whose sizes indicate they have recently recruited are noted as "R".

The size estimates of the fish are then converted to biomass using known length-weight relationships (www.fishbase.org) and unpublished data from the Hawai'i Cooperative Fishery Research Unit), with fish biomass per unit area being the most frequent unit of analysis. This methodology was initially developed on Hawai'i Island and is presently utilized both on O'ahu and Maui.

Results:

A total of fifteen permanent fish and benthic monitoring sites were established in 2007, and baseline data collected. Due to inclement weather and unsafe sea conditions, common at some of the survey sites, the desired frequency of three surveys per site per year was rarely achieved over the past three years (Table 2). The short time series available at present and low levels of temporal replication prohibited statistical analyses of these data (i.e., low statistical power to detect the modest changes likely within the limited time frame). However, data from both the fish and benthic monitoring is graphically summarized below.

Table 2. Summary of integrated survey sites and sampling frequency achieved over the first three years of this long term monitoring program.

Survey Summaries			
Site Name	**2007**	**2008**	**2009**
Hale'iwa	1	2	1
Hanauma Bay 1	1	1	2
Hanauma Bay 2		1	2
Hawai'i Kai	1	2	2
Kāne'ohe Bay Barrier Reef N	1	3	1
Kāne'ohe Bay Barrier Reef S	1	3	1
Ko'olina N	1	2	2
Ko'olina S	1	2	2
Laniākea	1	2	1
Magic Island	1	3	2
Reef Runway	1	3	1
Sharks Cove	1	2	1
Three Tables	1	2	1
Wai'anae MMA	1	3	1
Wai'anae Open	1	3	1

Benthic Surveys

Fixed Photo-Transects

An initial round off photographs was taken from all transects at each of the fifteen established permanent transects in 2007. These photos have not yet been analyzed. However DAR O'ahu recently hired a monitoring coordinator with expertise in benthic studies, and analysis of these photos (as well as the second round of photos collected in 2010) is currently underway.

Benthic Assessments

While the primary interest in the benthic assessments is to quantify the status and trends in hard-bottom communities, accurately describing the overall habitat and habitat quality requires estimation of the amount of sand present at the survey sites. Sand cover within the protection regimes varied from over 35% at the single MMA site surveyed, to < 10% for the LN Restricted sites (Figure 3).

Looking only at the hard-bottom habitat, similar trends are seen in the biological cover of the sites across the different protection regimes (Figure 4). Combined coral and reef-building crustose coralline algae (CCA) cover is approximately 40% at all sites, with the exception of the Waianae MMA. The dominant category in all protection regimes is

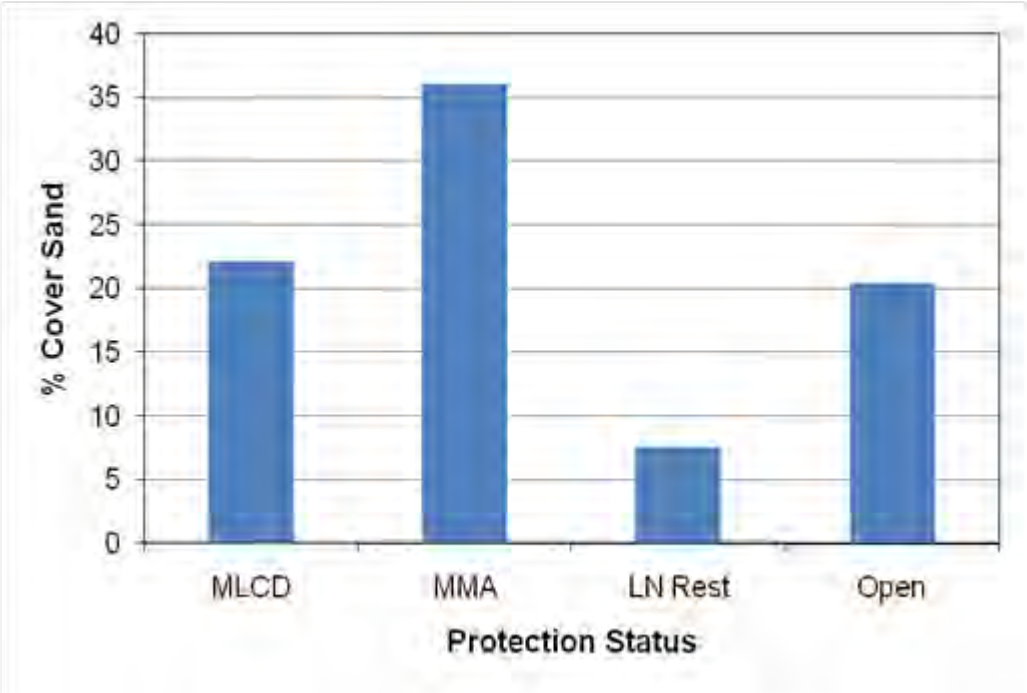


Figure 3. Mean percent cover of sand by protection status at all integrated monitoring sites around O'ahu. Data are averaged across all survey periods.

"substrate", which typically consists of fine turf algae growing on calcium carbonate reef. Macroalgae had low percent cover across all protection levels.

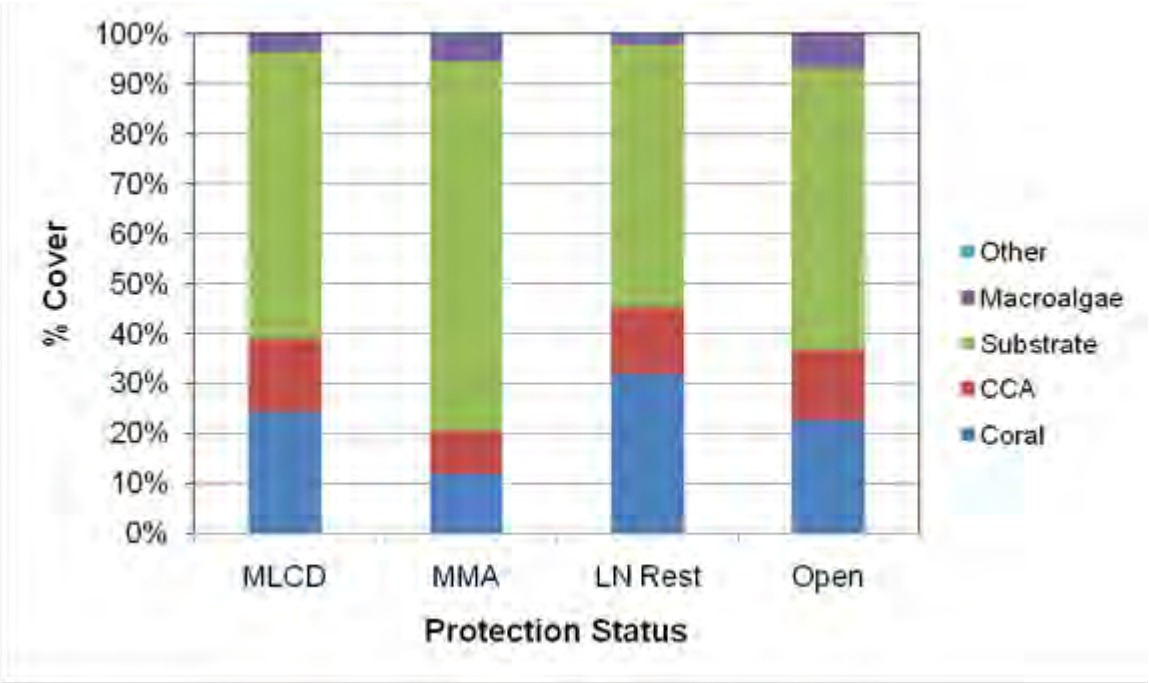


Figure 4. Mean percent cover of non-sand substrata by protection status at all integrated monitoring sites around O'ahu. Data are averaged across all survey time periods.

When the data are examined by site, it can be seen that there is a considerable amount of variability within a given management level for benthic cover by sand (Figure 5). MLCD sites, for instance, range from under 10% sand to over 40%.

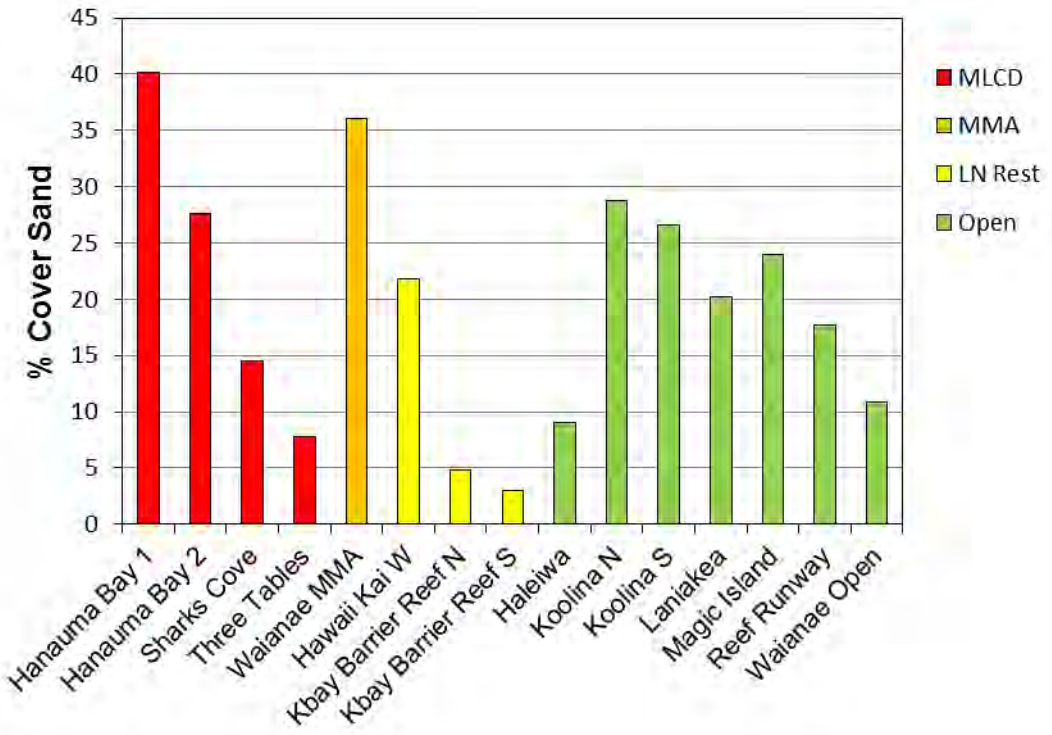


Figure 5. Mean percent cover of sand at individual integrated monitoring sites around O'ahu. Data are averaged across all survey time periods.

Similarly, biological cover varies substantially between sites (Figure 6). The relatively sheltered Hanauma Bay MLCD has 60% cover of coral and reef-building CCA, while the wave-exposed North Shore Three Tables and Shark's Cove MLCD sites have less than 20%. Protection status does not appear to be driving relationships in benthic coverage amongst these sites, as several LN Restricted and Open sites approach or exceed 50% cover of calcifiers (corals and CCA). Macroalgae are found in abundance at some sites, with the Open areas of Laniākea and Haleiwa both exceeding 10% cover, and greater than 20% cover in the case of Laniākea. Both of these sites are on the North Shore, and it is interesting to note that while these sites have similar coverage of reef calcifiers as the North Shore MLCD sites, the two Open sites have substantially more macroalgae.

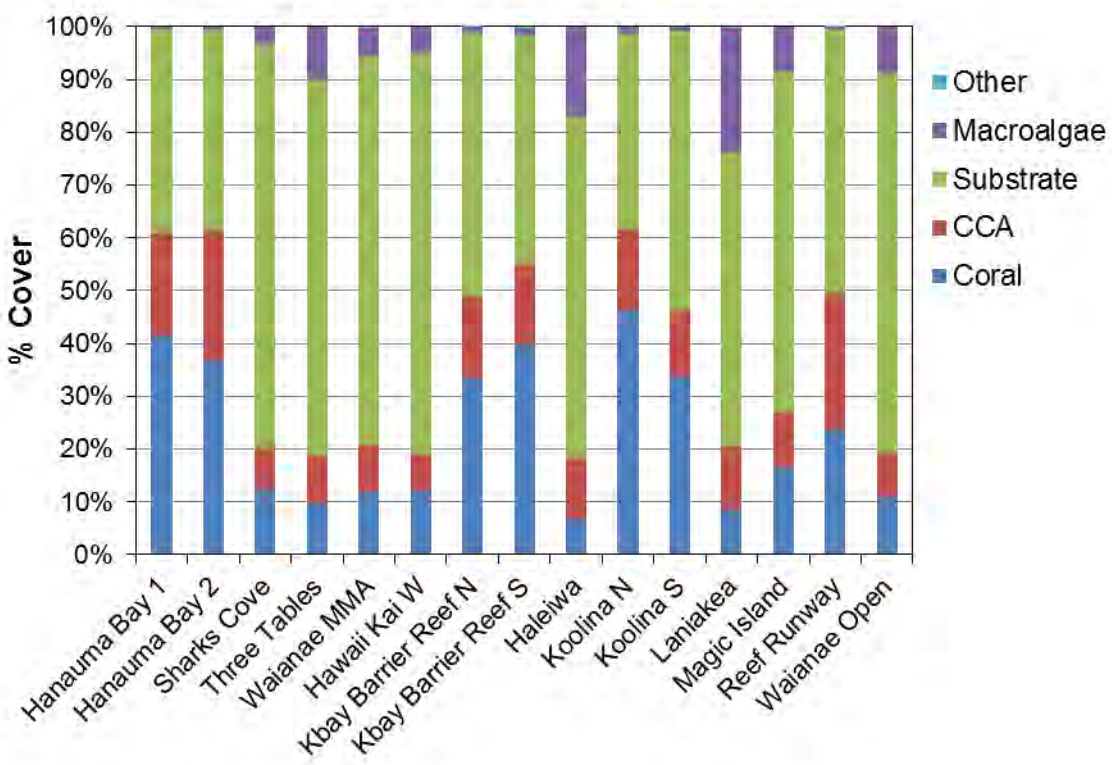


Figure 6. Mean percent cover of non-sand substrata at individual integrated monitoring sites around O'ahu. Data are averaged across all survey time periods.

While three years is a short time period over which to expect to see substantial changes in benthic community structure, there are suggestions of downward trends in calcifier cover in the sites at all protection levels except for the MMA site, which has the lowest coverage of corals and corallines of any protection status (Figure 7). It must be stressed, however these are preliminary data, and the trends rely heavily on unreplicated surveys from the inaugural monitoring year of 2007. These trends will be followed closely in future benthic assessment data, as well as in the fixed photo-transect surveys.

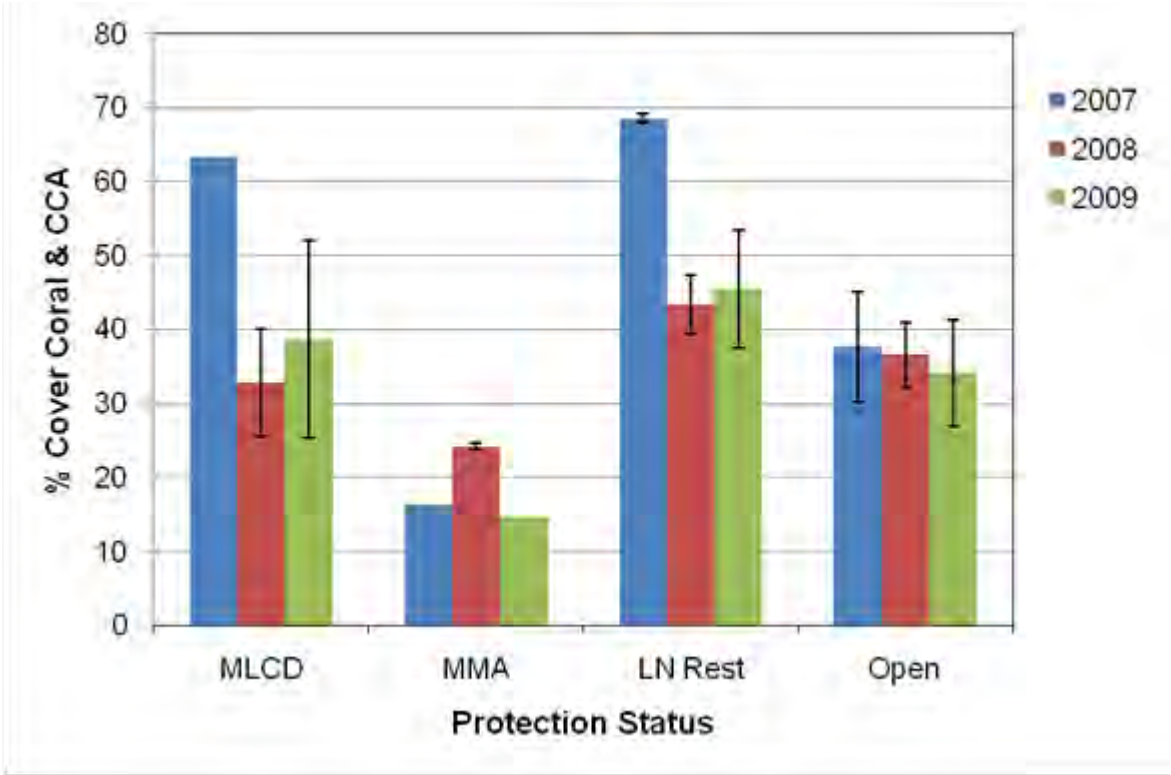


Figure 7. Mean percent cover (±SE) of coral and crustose coralline algae (CCA) at all integrated monitoring sites on O'ahu over time.

While coral and CCA cover are potentially declining, there is a suggestion that macroalgal cover is increasing across multiple protection regimes (Figure 8). The data on macroalgal cover is highly variable, and the trend is again largely based on the poorly replicated 2007 surveys. As with the coverage of the calcifiers, these trends will be followed over future survey years. Potential increases in macroalgal cover at the expense of coral and CCA coverage would be a significant management concern for long term trends in the health of coral reef communities.

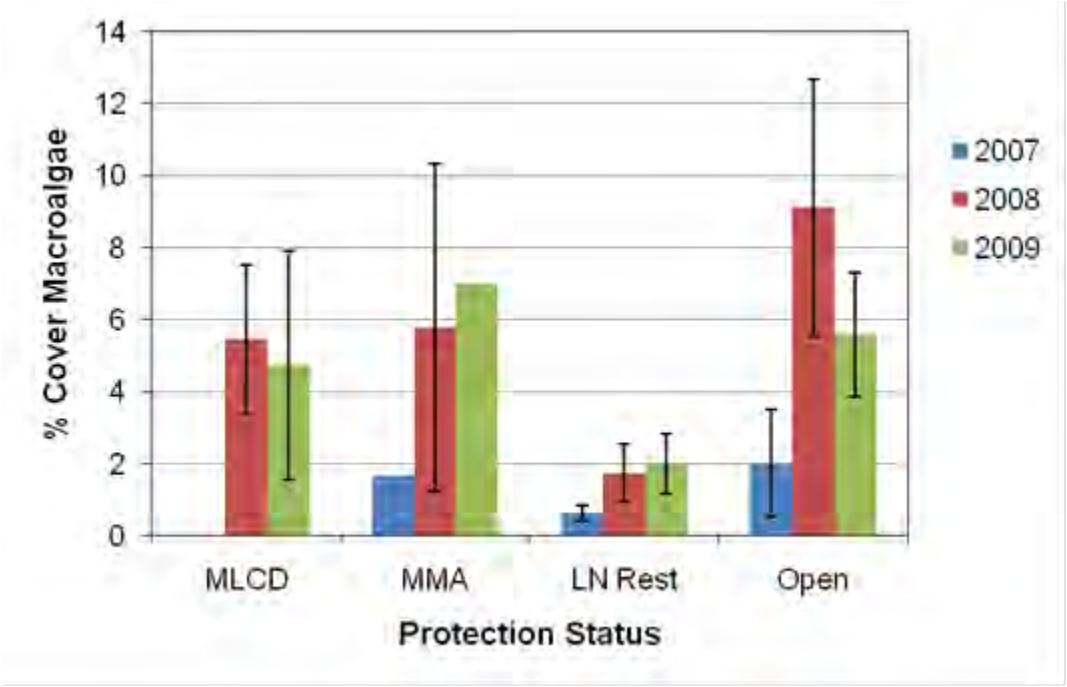


Figure 8. Mean percent cover (±SE) of macroalgae at all integrated monitoring sites on O'ahu over time. Lack of error bars indicates lack of replication in that protection status that year.

Fish Surveys:

The ability of marine protected areas to enhance the fish stocks in Hawai'i has been demonstrated in a number of rigorous studies to enable fish stocks (Friedlander et al 2003, 2007a, 2007b, Williams et al 2009). However, with the fifteen sites surveyed around O'ahu, the O'ahu MLCDs have lower total fish biomass than the largely-open Lay Net Restricted areas (Figure 9), and the mean value of approximately 25 g/m^2 is substantially less than other data from the Pūpūkea MLCD (Sharks Cove and Three Tables) and Hanauma Bay MLCD (each ca. 100 g/m^2 from Friedlander *unpublished data*, The Nature Conservancy *unpublished data*).

When examined at the level of the individual site, it can be seen that the Kāneʻohe Bay Barrier Reef sites are driving the difference between the Lay Net Restricted Sites and the MLCD sites (Figure 10), with the non-Kāneʻohe Lay Net Restricted sites having substantially lower biomass. Both MLCD and Lay Net Restricted sites appear to have higher biomass on average than the fully open areas.

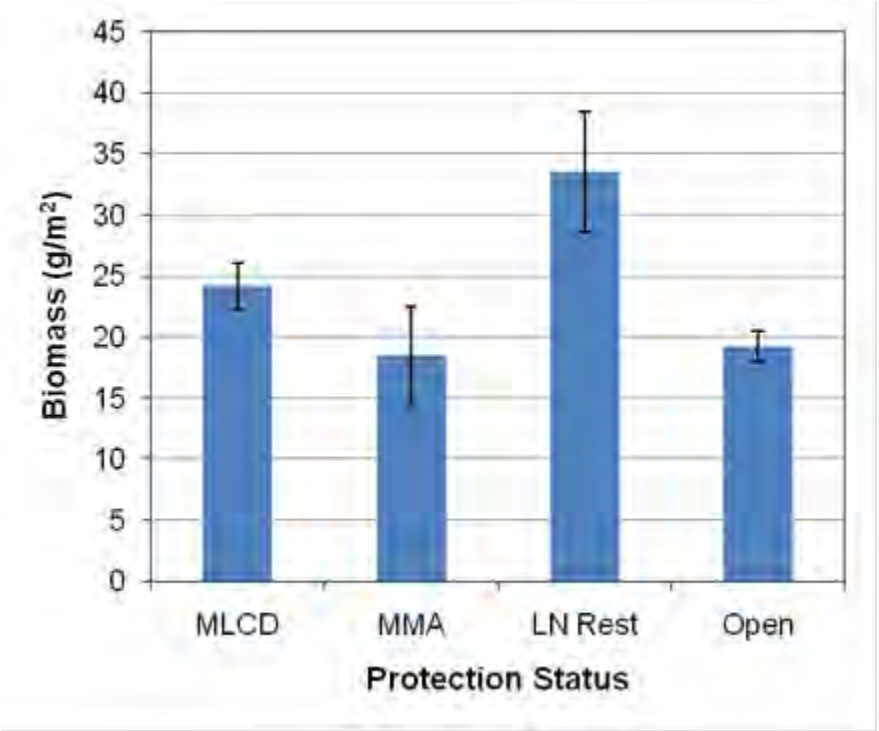


Figure 9. Mean total fish biomass (± SE) of all integrated survey sites on O'ahu. Data are averaged across all survey time periods.

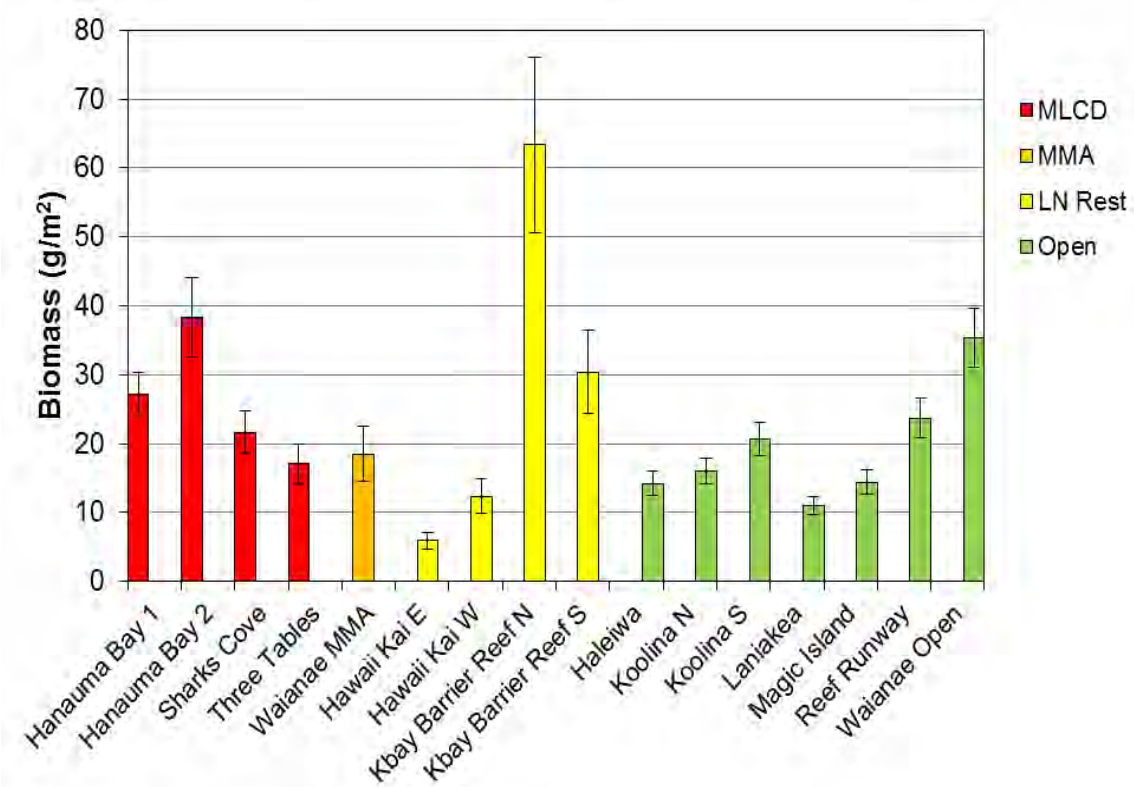


Figure 10. Mean total fish biomass (± SE) of all integrated survey sites on O'ahu by site and protection status. Data are averaged across all survey time periods.

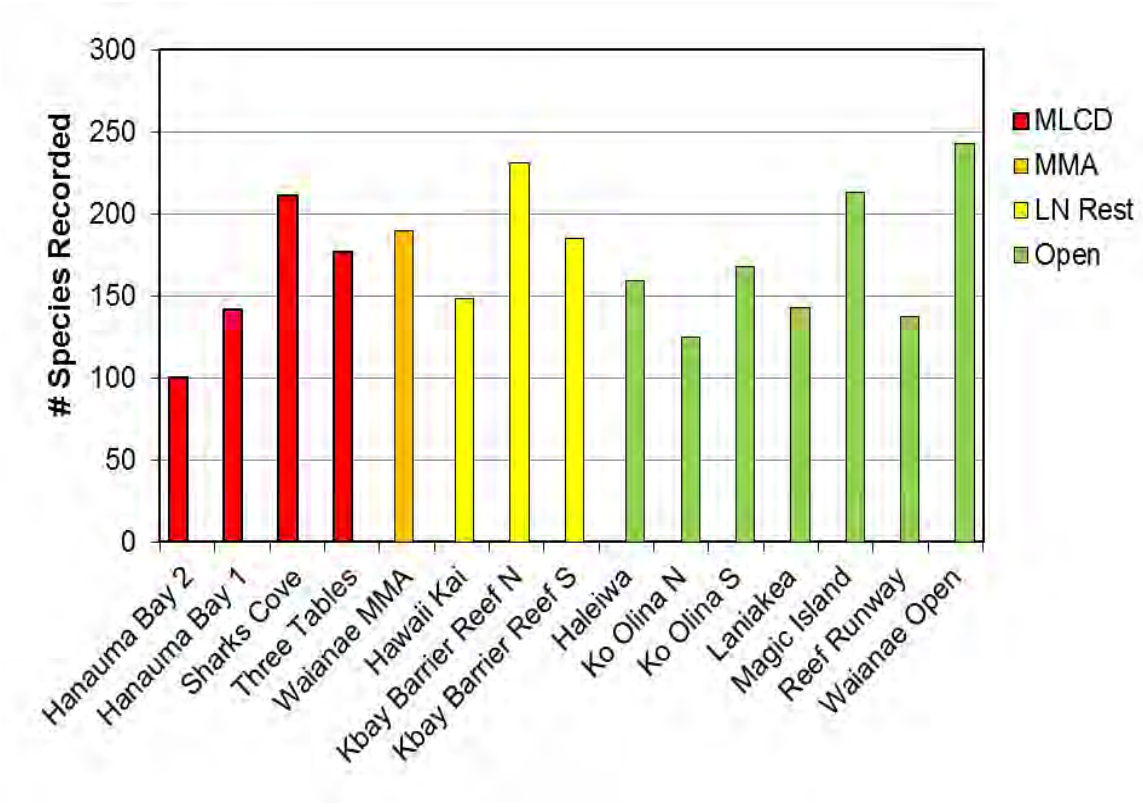


Figure 11. Cumulative number of species recorded from integrated survey sites on O'ahu by protection status.

Species richness does not appear to vary among protection status, though there is considerable variability between sites (Figure 11).

Surgeonfishes have the highest biomass of all families across sites of all protection levels, with triggerfishes, parrotfishes, wrasse, and goatfishes being the families with the next highest biomass (Figure 12). The only piscivorous family in the top eight most abundant fish families was the sea bass family, the only representative of which is the introduced grouper, *Cephalopholis argus.* No native piscivores were seen at any site in abundance, with herbivores (surgeonfish, parrotfish, damselfish) and invertivores (butterflyfish, wrasse, goatfish – though representatives of the latter can be piscivorous) predominating.

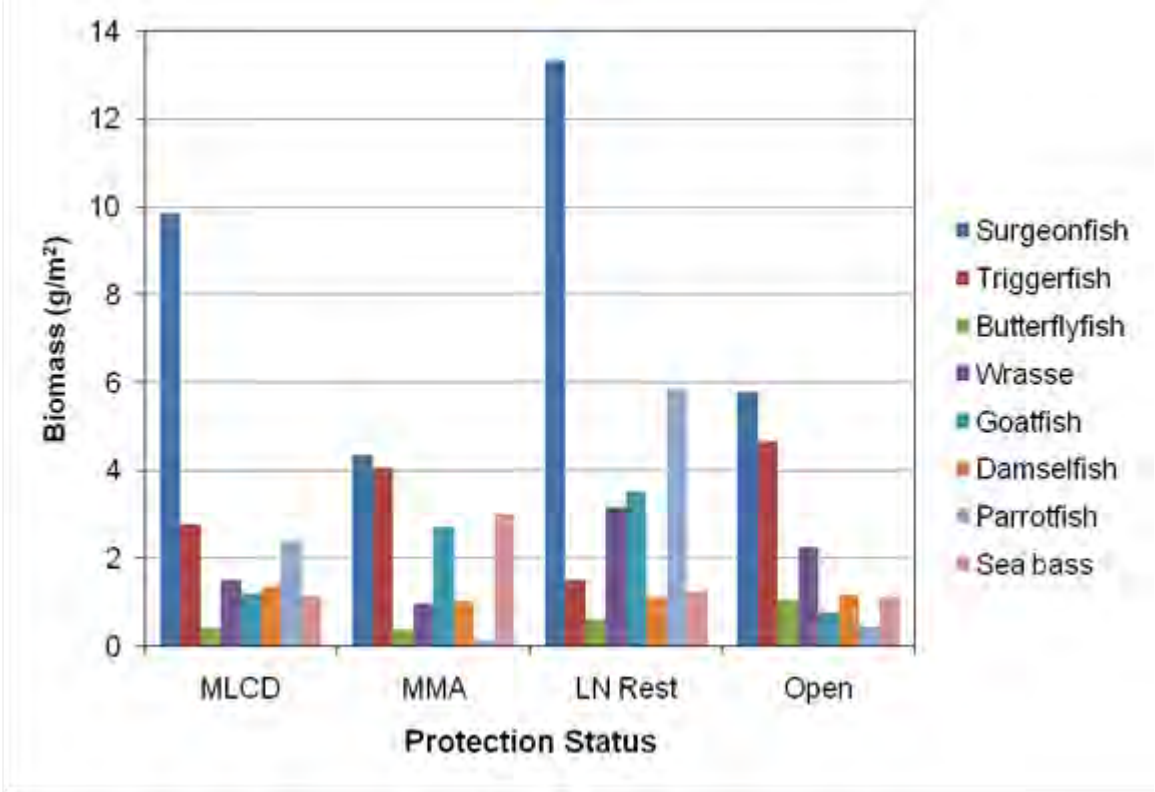


Figure 12. Mean biomass on O'ahu of the eight fish families most abundant by biomass against protection status of the survey sites.

With only three years of survey data, temporal trends in biomass are not apparent by family or protection status (Figure 13). There are suggestions of a few trends, however. The biomass of triggerfish and sea bass may be increasing in MLCD's, for instance. Lay Gill Net restricted areas show a possible trend in increasing surgeonfish biomass. Trends such as these, however, are reliant on a very small number of observations and will need to be borne out over future surveys.

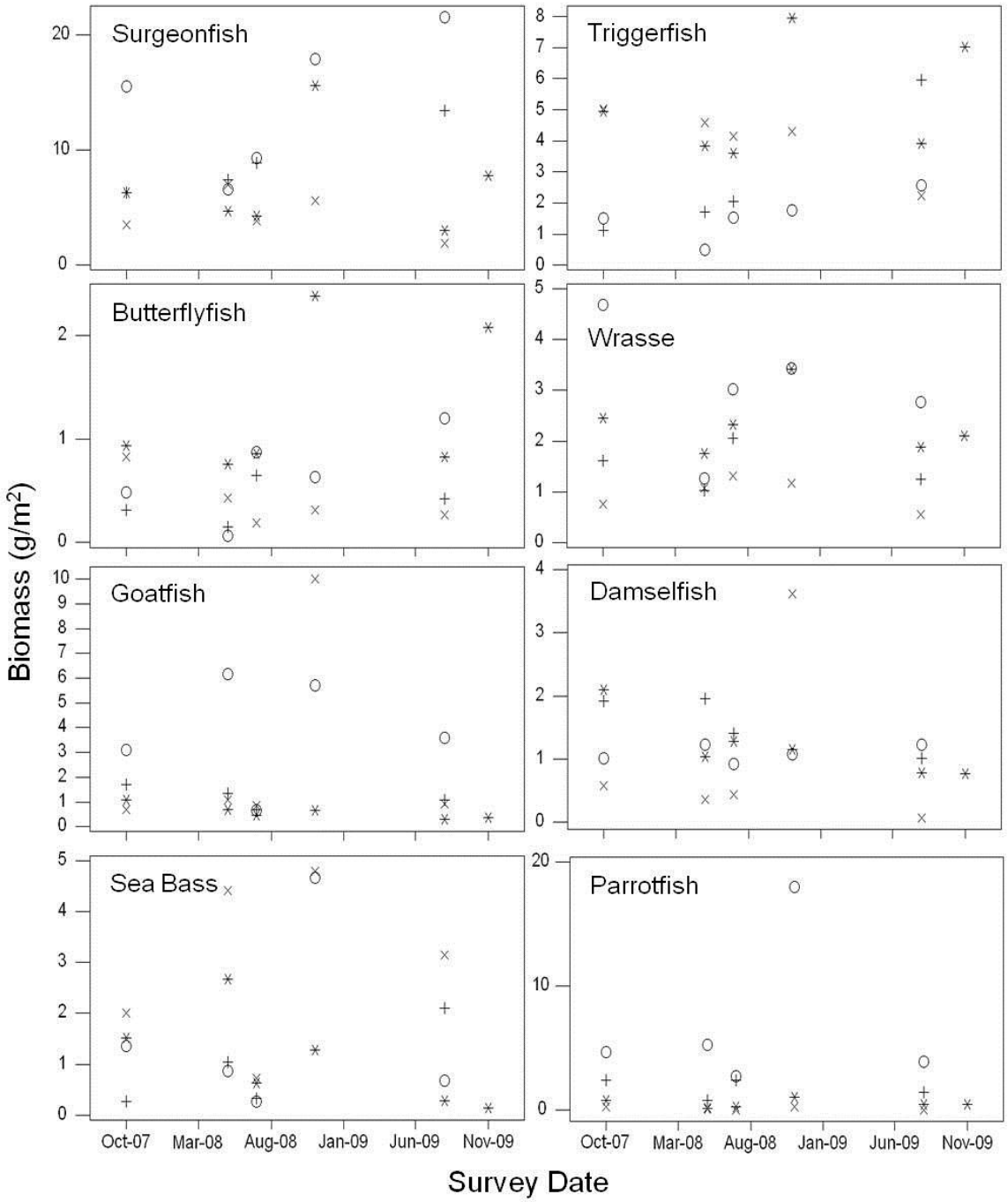


Figure 13. Mean biomass on O'ahu of the eight most abundant fish families by biomass over time. Symbols represent protection status: MLCD (+), MMA (X), LN Rest (O), and Open (*).

Maui Surveys

Benthic Survey Methods

Maui staff continue to work collaboratively with CRAMP (Coral Reef Assessment and Monitoring Program) to gather and analyze coral data and integrate it into the overall DAR and UH-CRAMP databases. CRAMP monitoring sites (Figure 14, Table 3) were selected on the basis of existing historical data, degree of perceived environmental degradation and/or recovery, level of management protection, and extent of wave exposure. A total of 10 sites are surveyed, with two reef area stations, a shallow (1-4m) and a deep (6-13m) station at each site (Table 3).

Each station consists of ten randomly chosen 10m permanent transects marked by small stainless steel stakes at both endpoints. Digital stills were taken every half meter perpendicular to the substrate at a height of 0.5m along the transect line. Approximately 24 overlapping still photos are acquired and approximately 11 non-overlapping images analyzed with Photo grid 1.0 software, for each 10 m long transect line. The analysis uses 25 randomly generated points per image with the analysis results calculated for percent benthic coverage.

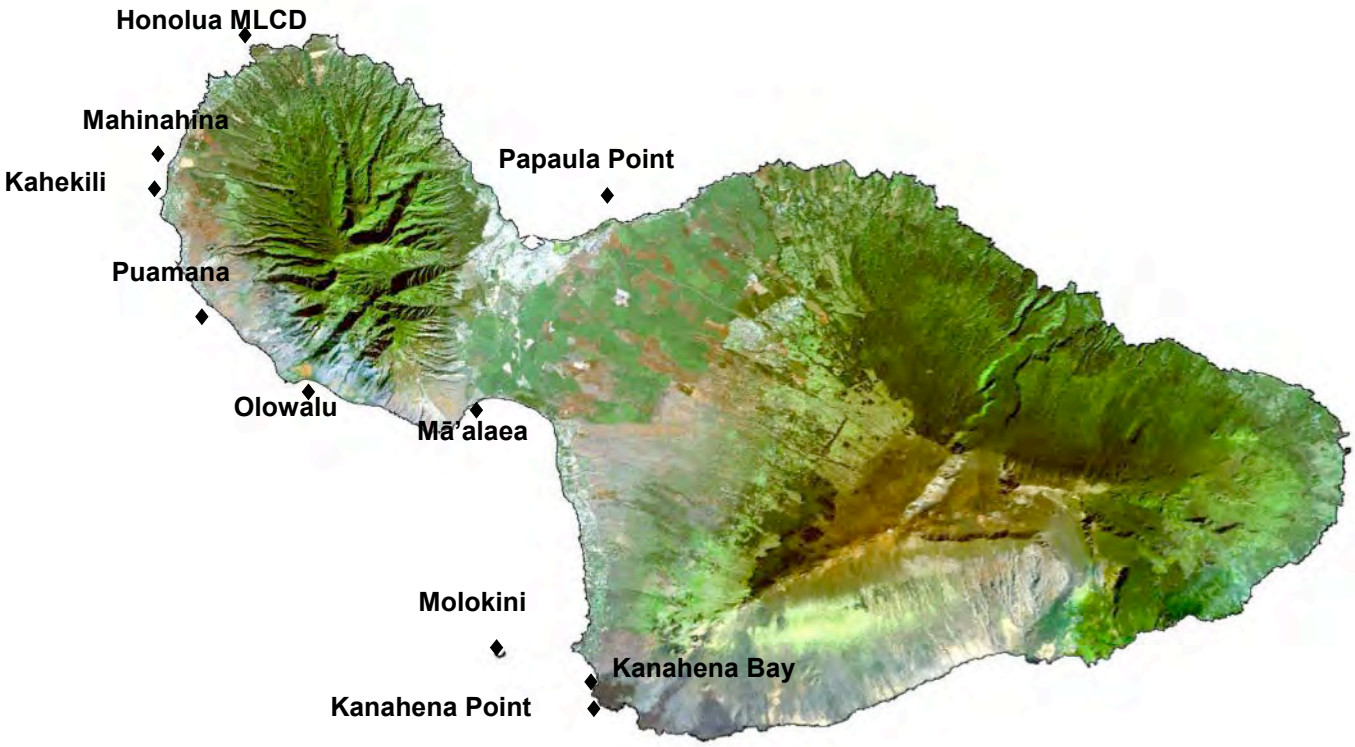


Figure 14. Maui Coral Reef Assessment Monitoring Sites.

Table 3. Maui Coral Reef Assessment Monitoring Sites listed with their corresponding depth, location, and management status. *Sites with temperature loggers deployed.

Island	Site Name	Depth (m)	Latitude	Longitude	Status
Maui	Honolua North	3	21.00.923	-156.38.343	MLCD
Maui	Honolua South	3	21.00.831	-156.38.380	MLCD
Maui	Kahekili	3	20.56.257	-156.41.595	OPEN
Maui	Kahekili	7	20.56.274	-156.41.623	OPEN
Maui	Kanahena Bay	1	20.37.049	-156.26.241	NARS
Maui	Kanahena Bay	3	20.37.015	-156.26.301	NARS
Maui	Kanahena Point	3	20.36.089	-156.26.214	NARS
Maui	Kanahena Point*	10	20.36.070	-156.26.280	NARS
Maui	Mā'alaea	3	20.47.378	-156.30.607	OPEN
Maui	Mā'alaea	6	20.47.332	-156.30.596	OPEN
Maui	Mahinahina	3	20.57.436	-156.41.252	OPEN
Maui	Mahinahina	10	20.57.461	-156.41.336	OPEN
Maui	Molokini	8	20.37.889	-156.29.795	MLCD
Maui	Molokini	13	20.37.940	-156.29.783	MLCD
Maui	Olowalu	3	20.48.505	-156.36.693	OPEN
Maui	Olowalu	7	20.48.363	-156.36.733	OPEN
Maui	Papaula Point	4	20.55.307	-156.25.571	OPEN
Maui	Papaula Point*	10	20.55.462	-156.25.571	OPEN
Maui	Puamana	3	20.51.369	-156.40.033	OPEN
Maui	Puamana*	13	20.51.322	-156.40.111	OPEN

Benthic Survey Results

In 1999 and 2000, the years Maui benthic surveys started, coral cover averaged 30.7% ± 5.4 SE for the 18 stations (9 sites) around Maui County. At the same 18 stations with the latest available data (2009 for most sites), coral cover was 25.8% ± 4.0 SE. This slight decline in living coral cover does not appear to be ecologically significant when viewed as a whole, but this approach tends to masks substantial changes that are occurring at the individual site level. Figure 2 shows the temporal changes at the 20 currently monitored reef sites. Nine of these 20 currently monitored reefs have experienced significant changes (paired t-tests of first survey year vs. most recent survey year, $p<0.05$). Coral cover has declined at 7 sites and increased at 2 of these sites. Of particular concern are the coral cover declines at Honolua Bay, Mā'alaea Bay,

and Papaula Point where the documented coral declines have been so severe that these individual reefs may have already experienced a total coral reef ecosystem collapse. All three of these locations appear to be effected by anthropogenic impacts (land based pollution, overfishing, etc.). Conversely, sites which have sustained high coral cover tend to be away from urban areas, are fairly remote or are located offshore (Kanahena Bay, Olowalu, and Molokini). The only sites showing significant increases are within Kanahena Bay. The increased coral cover documented in Kanahena Bay is likely the result of natural recovery from past physical disturbances in the mid 1990's. In addition, Kanahena Bay is within the ʻĀhihi Kīnaʻu Natural Area Reserve (NAR), and this area has recently undergone extensive on site management to prevent any extractive practices and to better control the potential impacts from recreational non-consumptive users.

The negative impacts of terrigenous sediments on coral reefs are considered a major contributing factor to reef degradation all over the world (Wilkinson 2004). The coral cover within the reef flats of Honolua Bay have been rapidly declining for several years. This decline appears, at least in part, to be the result of large, periodic, heavy sedimentation events. The most recent evidence occurred in January 2005 when heavy rainfall produced a large sediment plume within the bay. That same year a decline of nearly 50% of the coral cover on the Bay's south reef was documented (Figure 15 &16). The fact that this heavy sedimentation event coincided with relatively calm ocean conditions make it highly likely that the sedimentation was what caused the observed coral decline. Further evidence to this effect was that nearly all of the impacted coral were a shallow water species (Purple Rice Coral, *Montipora flabellata*) that is adapted to live in high wave energy environments and is not known to be very tolerant to sedimentation stress (Figure 16).

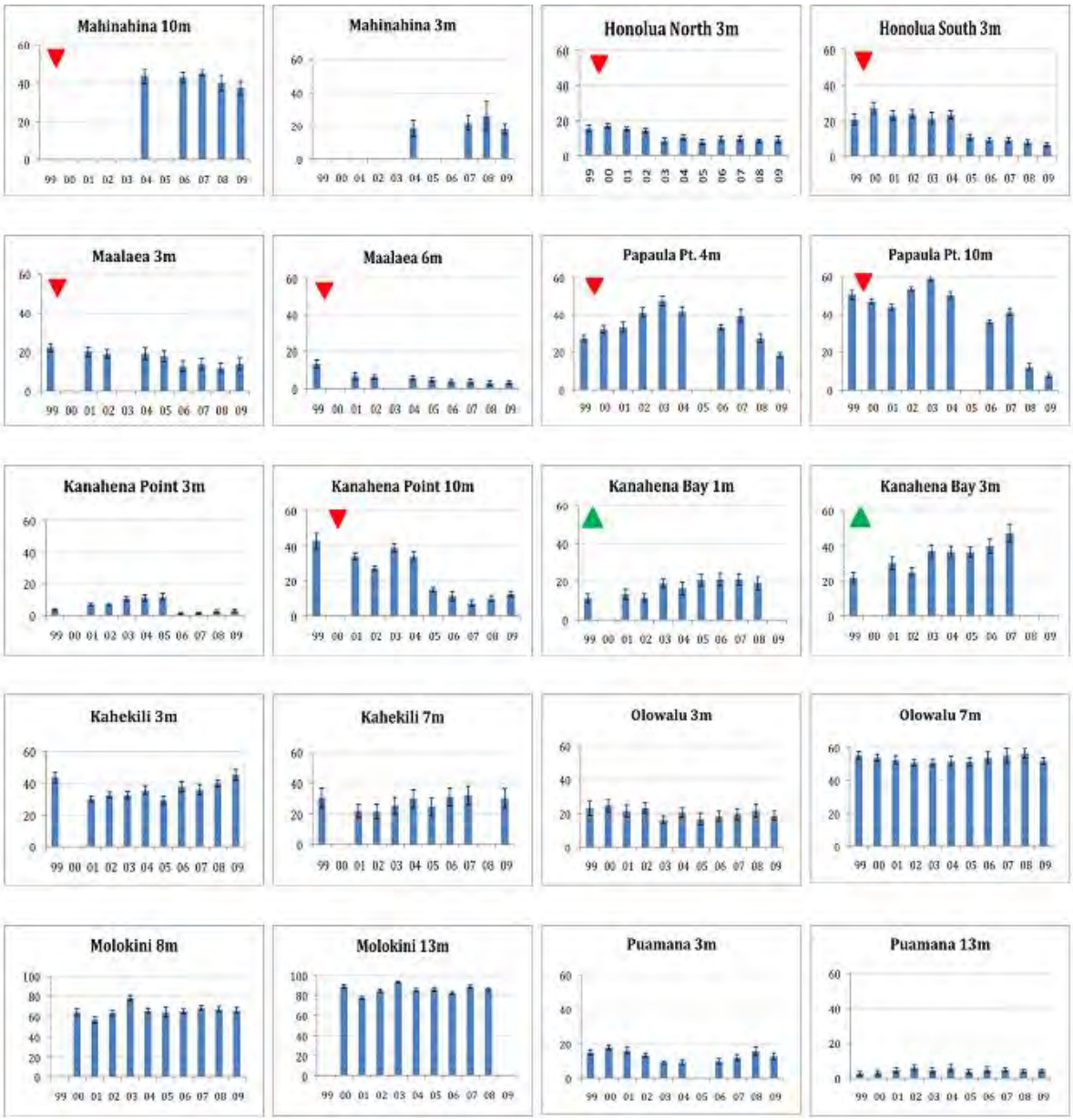


Figure 15. Temporal changes in percent coral cover at the 20 Maui monitoring stations. Significance tests (paired t-tests) compared the first and the last year's coverage. Solid red triangle represents significant decrease (p-value <0.05). Green triangle represents significant increase in coral cover.

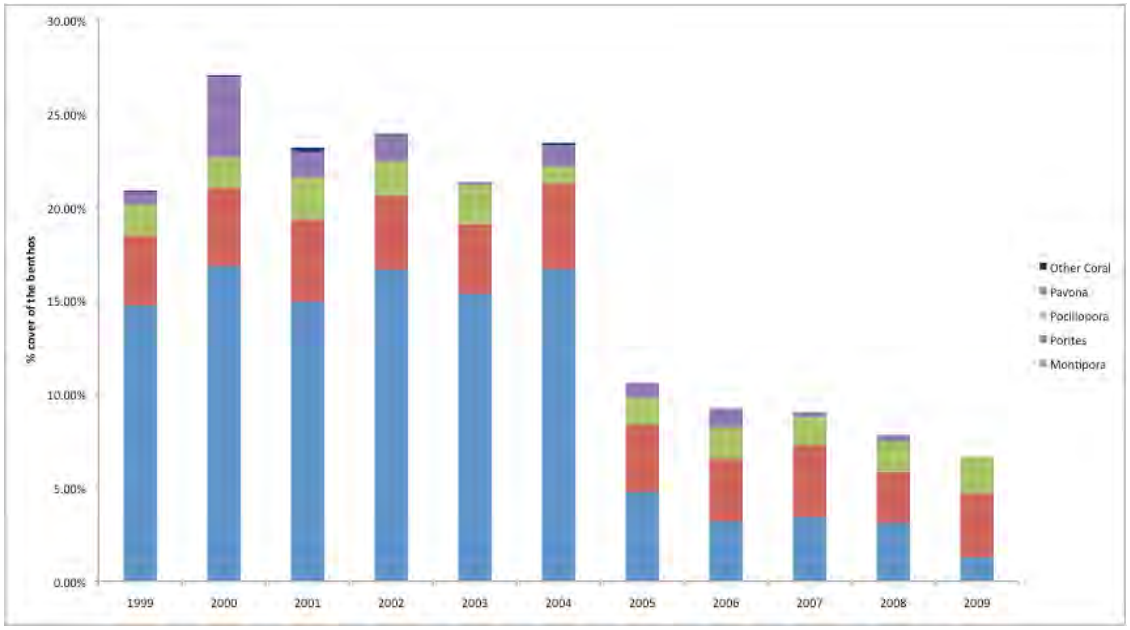


Figure 16. Honolua Bay South Reef percent coral cover plotted by coral genera.

Several of the monitored Maui reefs may be experiencing negative impacts from land-based nutrient pollution. This is of particular concern for reefs with declining coral cover accompanied by increases in macroalgae cover. Ma‘alae‘a Bay and Papa‘ula Point have experienced the most severe declines (Figures 15 & 17).

In 1972, the coral reefs within Ma‘alae‘a Bay were described as being “striking in their diversity and in the presence of rare corals species” (Kinzie, 1972). Similarly, a U.S. Fish and Wildlife environmental assessment in 1993 estimated coral cover in the vicinity of DAR’s survey sites to be between 50% and 75% (FWS 1994). These scientific assessments describe a once healthy and diverse reef ecosystem. The Mā’alaea reef is now extremely degraded and heavily overgrown by algae.

At Papaula Pt., coral cover on the 10m site has declined from around 60% in 2002 to less than 8% in 2009. Much of this decline has occurred in the last two years. Over this same time period a dramatic increases in macroalgae, particularly *Acanthophora spicifera* has occurred (Figure 17).

As a result of these rapid reef ecosystem collapses, fish stocks are suffering the double whammy of overfishing and lack of suitable habitat and are in very poor condition. These sites are now being dominated by small wrasses, triggerfish and puffers, with very few herbivorous species available to help control the explosive algal growth. Some combination of elevated nutrient levels and low herbivory are likely driving the observed increases in macroalgal cover, elevated nutrients have been implicated at other areas around Maui for *Hypnea* and *Ulva* blooms (Smith and Smith, 2006). However, in the case of *Acanthophora spicifera*, which is a highly preferred food for grazing fishes (Hunter, 1999), low grazing pressure might be a more fundamental causal factor. There appears to be a relationship between highly-depleted herbivore stocks (e.g. Mā’alaea) and abundant *Acanthophora*, and conversely, no or very limited *Acanthophora* growth at

sites where grazing fishes are abundant (e.g. Honolua Bay). This evidence has led to the recent management action at North Kā′anapali (see Kahekili Herbivore FMA Baseline Assessment).

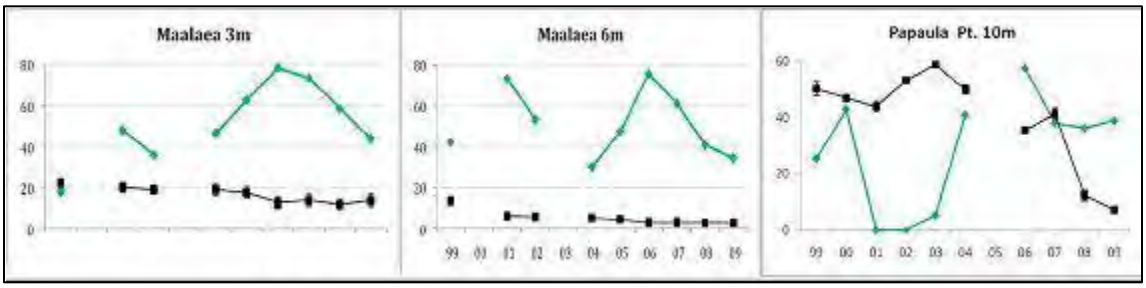


Figure 17. Long-term temporal changes in percent coral (black line) and macroalgae (green line) at both of the Ma‘alae‘a sites and at the offshore Papa‘ula Point site.

Finally, the dramatic decrease in live coral cover at one site (Kanahena Pt. 10m in 2005, and Kanahena Pt. 3m in 2006, Figure 15 &18) was attributable to a localized bloom of the crown of thorns starfish (COTS). Increased COTS densities were initially observed in areas just southeast of Kanahena Point in 2004, and at the time of one of our surveys in 2005, COTS density was roughly one starfish per 10 m^2 of reef at Kanahena Pt. Before the COTS outbreak, coral cover on the deep site was at 34% in 2004 and 12% on the shallow site in 2005. After the outbreak, the coral cover dropped to as low as 7% at the deep site in 2007 and 2% at the shallow site in 2006. The most affected coral genera was *Montipora*, whereas other genera, particularly *Porites*, appeared to be much less affected (Figure 18). Fortunately these reefs appear to be recovering. A comparison of the coral cover on the deep site from 2007 to 2009 showed a significant increase (paired t-test $p<0.01$). On the shallow site, comparisons between 2006 and 2009 show a similar recovery (paired t-test $P<0.06$). Although the COTS outbreak resulted in a rapid decline in coral cover the long-term effects of this event on the coral community and potential recovery will be monitored.

It is too early to determine if this localized coral predation event will result in changes in coral diversity, but it appears a trend from Montiporid towards more Poritid corals may have resulted. Overall increase in coral diversity within a reef system could help make the reef more resistant to future stressors and improve overall resilience (Carpenter 1997; Birkeland and Lucas 1990).

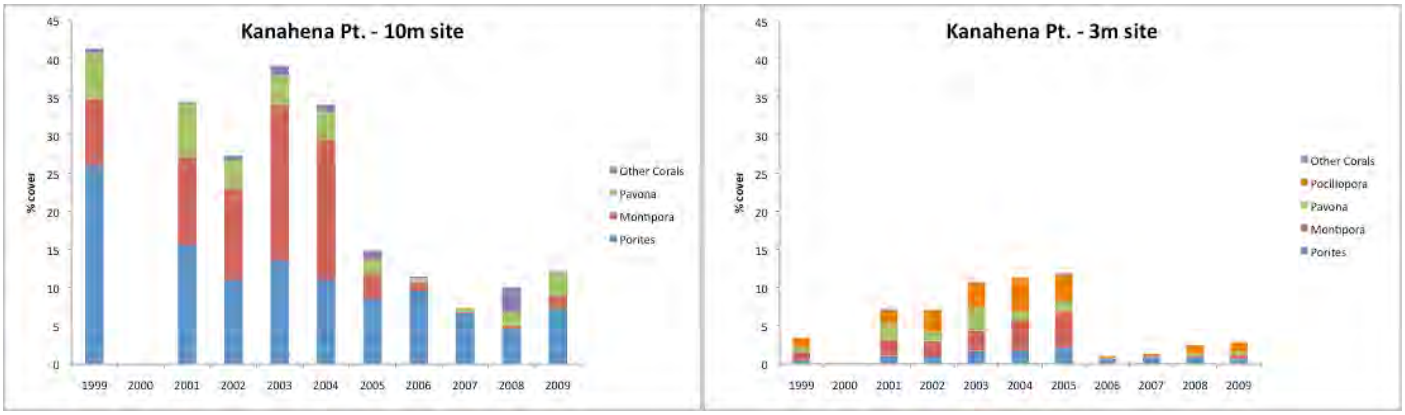


Figure 18. Coral percent cover for Kanahena Point 10 & 3m monitoring sites. Different color bars represent different coral genera.

Fish Survey Methods

Three types of fish surveys are conducted on Maui: (1) resource fish surveys, (2) "integrated" fish population and urchin surveys, and (3) nearshore habitat and fish assessments (HAFA).

Resource Fish Surveys

The resource fish surveys are conducted three times per year at eight sites (Figure 19). Four sites are within a reserve, where fishing is prohibited or severely restricted and four are within a 'control' area where fishing is permitted. Sites were selected to be in relative close proximity with relatively similar reef structure. The area pairs are:

Three marine reserves on Maui:

- 'Āhihi Kīna'u Natural Area Reserve (NAR), control at La Perouse Bay
- Molokini MLCD, controls at Makena and Keawakapu
- Honolua-Mokule`ia MLCD and control sites between Kapalua Bay and Lipoa Point

One marine reserve on Lāna'i

Manele-Hulopo'e MLCD and control area Lighthouse on southwest coast of Lāna'i.

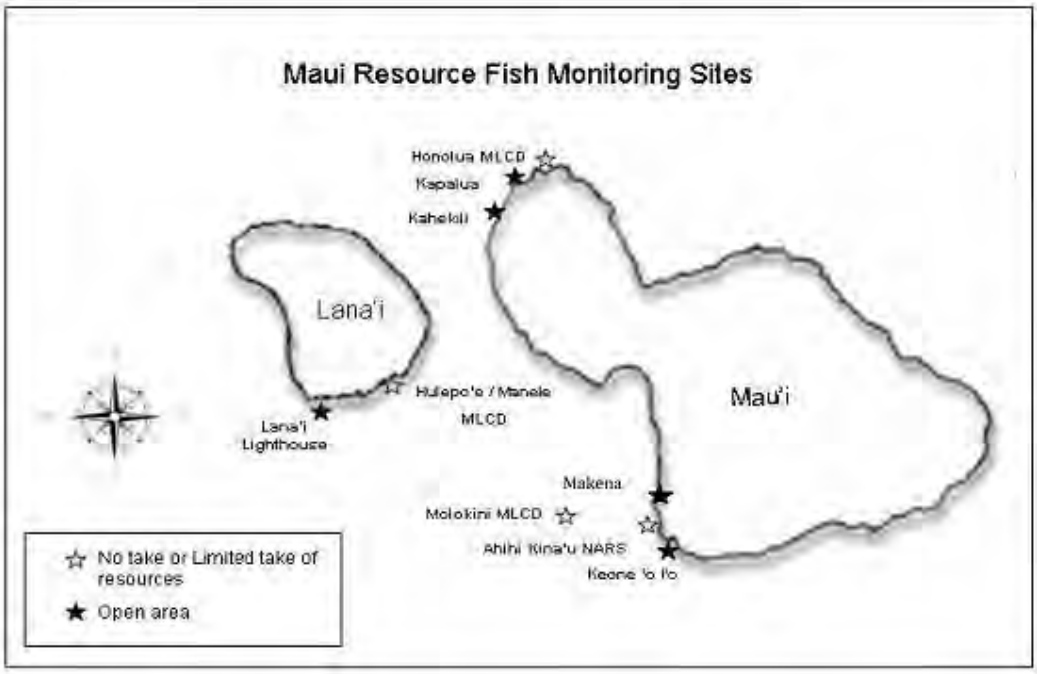


Figure 19. Maui resource fish survey areas.

All of the Maui closed areas are fully protected no-take reserves. Manele-Hulopo'e MLCD on Lāna'i permits pole and line fishing from shore. The Maui County survey areas were selected to allow pairwise comparisons between protected areas and controls, but it should be noted that differences in habitat and exposure exist between reserve and control areas, particularly between the Molokini MLCD and its control area. Therefore, although we attempt to draw conclusions about performance of individual reserves, we also look for broad patterns across all areas within each management strata (i.e. protected vs. open).

Five sub sites are surveyed per survey location (3 at 3-5m depth and 2 at 10m depth) using the 'resource fish' survey method. For this method, 2 pairs of divers start at a fixed center point and head in opposite directions. Each pair of divers swim parallel to each other, 10m apart, and follow a depth contour, for a five minute period. Each diver records all main fishery target species that ≥ 15cm and within a 5m wide belt. Dives are conducted using SCUBA. Abundance and biomass are then standardized for the area covered on each timed swim.

Starting points for each survey are based on the site coordinates for the center point. End points are determined by taking a GPS point from a Garmin handheld GPS that is attached to the dive float.

<u>'Integrated' Fish Surveys</u>

An 'integrated' fish survey, wherein all fish species and select invertebrates are assessed, was also conducted at each of the eight locations. Integrated survey sites used the same H transect design (Figure 2) as utilized on Hawai'i Island and O'ahu. This design is generally consistent with the fish survey methods in West Hawai'i and

O'ahu with several small differences. On Maui when the transects are being deployed fish >15cm TL are counted as the lines are rolled out. Additionally after completion of the fixed transect surveys, the dive pair swims back towards the end pin recording the number of large sea urchins within a 1 m swath on their side of the line. Each diver pair conducts surveys along two 25m lines that start at their central eyebolt. When finished with both lines, each diver then conducts a 5-minute present/absent survey of all fish species that were not seen on transect, but were in the general area of the survey site.

HAFA Surveys

The nearshore habitat and fish assessment or HAFA surveys are designed to record both the abundance and size of targeted fish species to establish the status and trends of specific reef fishes that were commonly taken by lay-gillnets prior to the lay-gillnet ban that went into effect in March of 2007 (HAR 13-75-12.4). Since several of the fish species potentially affected by gillnet fishing are herbivores, the surveys also assess relative sea urchin abundance, and benthic cover [e.g., coral, crustose coralline algae, macroalgae, sand, and substrate (rock, rubble, turf algae, etc.)].

HAFA Surveys are conducted three times per year at seven shallow water reef areas where lay-gillnets were previously used (Figure 20). Each survey location has eight sub-sites.

A HAFA survey is comprised of two parts: (1) an outward swim while counting fish followed by (2) an inward swim designed to qualitatively assess urchins and the benthic composition. Swimmers start their swim at a fixed GPS point. A five minute rapid assessment swim on a designated bearing is utilized with one pair of observers (snorkeling) at a depth contour of 2-4m. Within a 5m wide belt, each observer records all herbivorous fishes ≥ 10cm as well as, all other resource fish (wrasse, goatfishes, snappers, etc.) ≥ 15cm. The benthic assessments are conducted at each one-minute swim interval while returning to the starting location, and the end of the fish survey. The benthic assessment is conducted by looking at an estimated 5m-radius circle of benthos centered at the surveyor. When the five-minute fish survey is complete, the GPS location is marked and the surveyors begin the urchin and benthic composition assessments. This results in a total of six benthic assessments per transect. Upon completion of the return swim, the surveyors rank the urchin and general algae abundance using a DACOR scale (Dominant, Abundant, Common, Occasional, or Rare). In addition, the dominant algal species are identified and recorded.

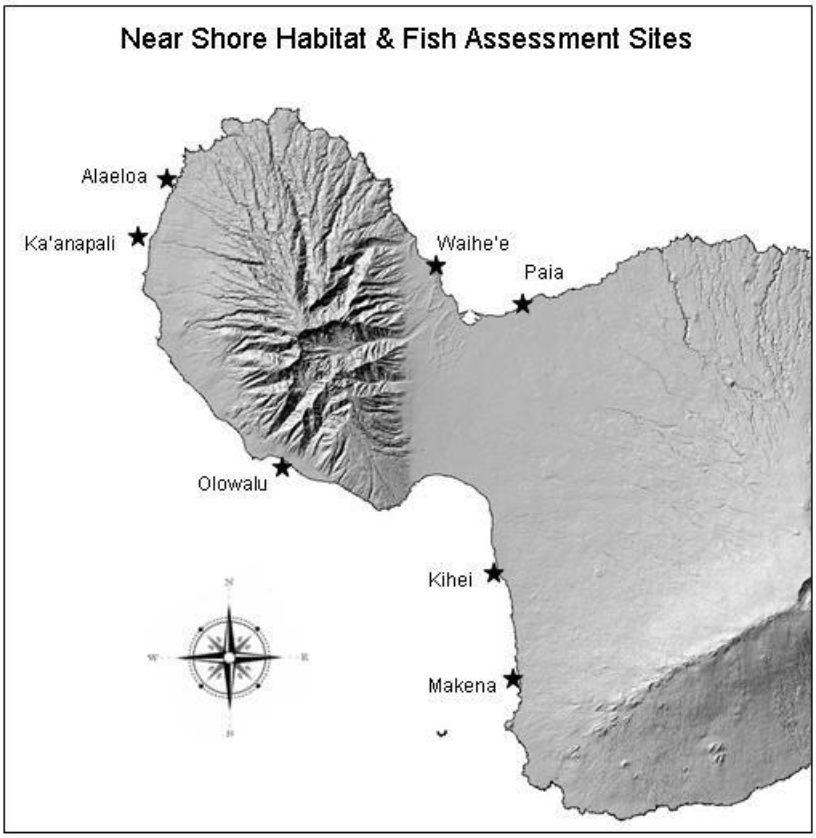


Figure 20. Maui HAFA survey sites.

Data Analysis

For all fish surveys the total length (TL) was estimated to the nearest centimeter. Length estimates of fishes from visual censuses were converted to weight using the following length-weight conversion: W = aSLb. The parameters a and b are constants for the allometric growth equation where SL is standard length in mm and W is weight in grams. Total length was converted to standard length (SL) by multiplying standard length to total length-fitting parameters obtained from FishBase (http://www.fishbase.org) and unpublished data on 150 species commonly observed on visual fish transects in Hawai‘i (Hawai‘i Cooperative Fishery Research Unit). In the cases where length-weight information did not exist for a given species, the parameters from similar bodied congeners were used. All biomass estimates were converted to grams per square meter (g m^{-2}) to facilitate comparisons with other studies in Hawai`i.

Fish Survey Results

<u>Resource Fish and Integrated Surveys</u>

Fish survey results indicate a positive effect of closure to fishing. Compared to their controls, the three fully closed reserves (Honolua-Mokule`ia MLCD, ‘Āhihi Kīna‘u NAR, and Molokini MLCD) had:

- Higher total food fish biomass (all ‘food fishes’ combined) (Figure 9). However, differences were only significant in two cases: between Molokini MLCD and its Makena control, and between Honolua Bay MLCD and its Kapalua control ($p<0.05$ paired t-tests of total biomass per survey round);
- A greater prevalence of apex predators (carangids and lethrinids) (Figure 21);
- Greater abundance and larger size target fishes (Figures 21 & 22); and
- Large schools of manini (the surgeonfish *Acanthurus triostegus*). Large manini schools were also observed at sites where fishing pressure was presumed to be low due to relative inaccessibility and low human population density (i.e. Lāna’i Lighthouse, Figure 24).

As previously noted, important differences in habitat and exposure exist between reserve and control areas, particularly between Molokini MLCD and its control. It is also noteworthy that the highest fish biomass at any surveyed area was at the Lāna’i Lighthouse control (a fished, but fairly remote location). It would therefore be overly simplistic to ascribe all differences among areas simply to management status (open or closed).

These observed size distribution trends were further investigated by independently looking at four relatively commonly-encountered and heavily-targeted fish species [*Caranx melampygus* (Bluefin Trevally), *Naso unicornis* (Bluespine Unicornfish), *Monotaxis grandoculis* (Bigeye Emperor), and *Scarus rubroviolaceus* (Redlip Parrotfish)]. For all four species, reserves contained more and larger fishes than open areas (Figure 22). The biological implication of these results is important because large individuals are an important component of most targeted species' breeding stock. They produce disproportionally more gametes than smaller fish, and those gametes tend to be more able to survive to become recruits (Birkeland & Dayton, 2005). Marine reserves make up less than 2% of nearshore waters in Maui County; therefore, their potential for substantially increasing spawning stocks is limited. Our results nevertheless indicate that these few marine reserves likely contribute disproportionately to total population spawning potential in Maui County.

The high fish biomass at the Lāna’i sites and the lack of a clear distinction between the partially closed (Manele-Hulopo`e MLCD) and the open area (Lighthouse) deserve further comment. Lāna’i has a small resident population, and as a result, sites are likely to have lower fishing pressure compared to most reefs on Maui. The Manele-Hulopo′e MLCD is the only Maui county reserve area that is not a complete no-take reserve. Fishing with pole and line from shore is permitted.

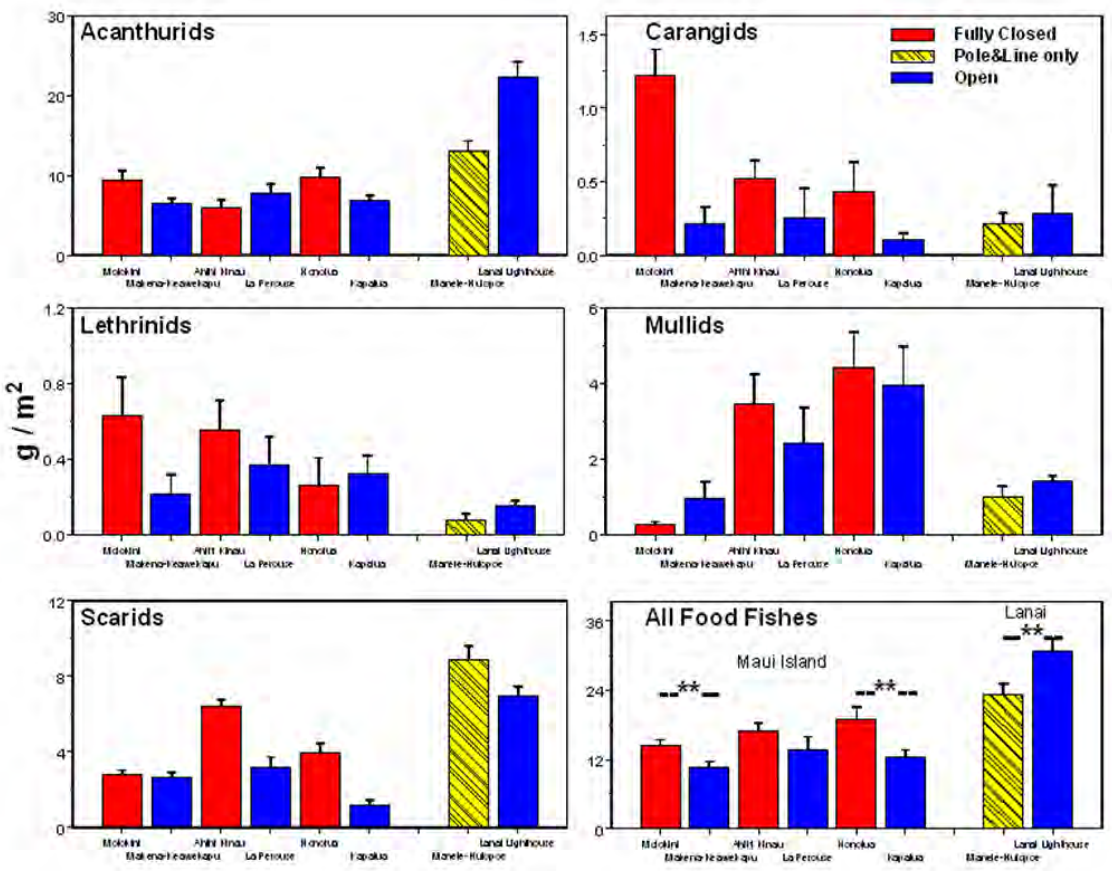


Figure 21. Mean and SE of biomass of 'resource fishes' at Maui County sites. Data are averages of all surveys in 2005-2009. Significant pair-wise differences indicated by ** (p<0.05).

The MLCD also has the most accessible section of coastline on the island, with a paved road leading down to the ocean and a public park with showers and bathroom facilities. Due to this easy access, it is likely that even though there is no spear fishing, netting, or vessel-based fishing allowed within the reserve, it still gets the majority of near-shore fishing activity in that vicinity. In contrast, the Lighthouse control area is located along the southwest coast of Lāna'i, where the shoreline is only accessible via a rough off-road jeep trail. Fish behavior and shore-based structures indicate that the Lighthouse area does get fished, but it seems likely that fishing pressure is relatively low. It is therefore reasonable to assume there is no clear distinction in absolute fishing pressure between the Lāna'i reserve and open area.

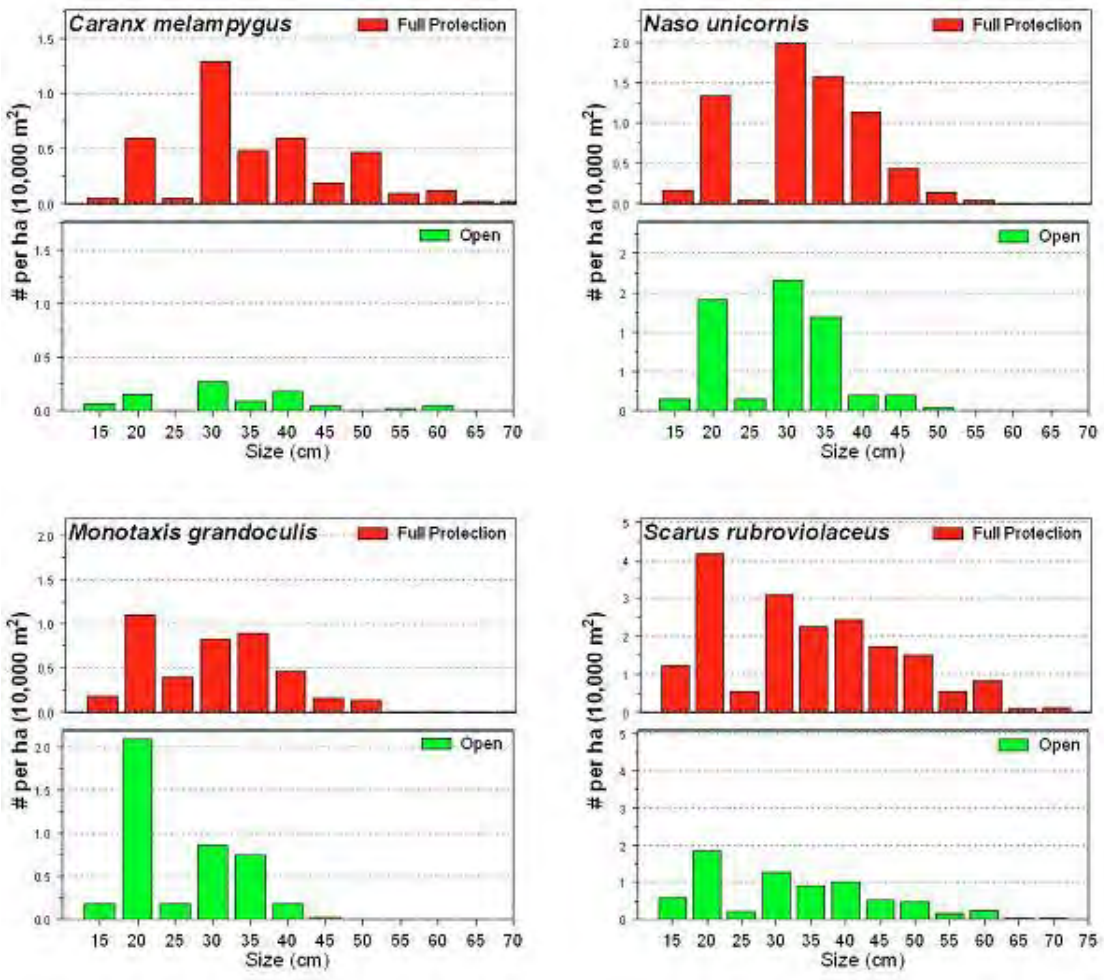


Figure 22. Number and sizes of key target fishes in protected and open areas on Maui. Data pooled into all protected monitoring stations (red) and all open sites (green).

Maui County fish surveys indicate that herbivore fish stocks are likely depleted at several of the survey locations. Several areas (Figure 21) had low acanthurid and scarid biomass. Large schools of manini (*Acanthurus triostegus*), a key shallow-water grazer, occurred only in reserves or in the relatively remote areas on Lāna'i (Figure 23). Both Lāna'i areas had large populations of manini, but the only survey sites on Maui Island with abundances greater than 125 manini/ha., were within the Honolua MLCD. In contrast, all of the Maui open access sites had manini densities < 5/ha. This observed distribution of large manini schools strongly suggests that fishing pressure is having an impact on this species.

Our growing concern about the spread of invasive algae on Maui, and the evidence that herbivore stocks are generally depleted on several Maui reefs suggest that additional management actions to protect or restore herbivore populations may be productive. Significantly, even a partially protected reserve such as Manele-Hulopo`e MLCD can

maintain large populations of herbivorous fishes (Figure 23), which suggests that partially-protected reserves, where only herbivores are protected, may have some utility while being more acceptable to fishers than fully protected areas.

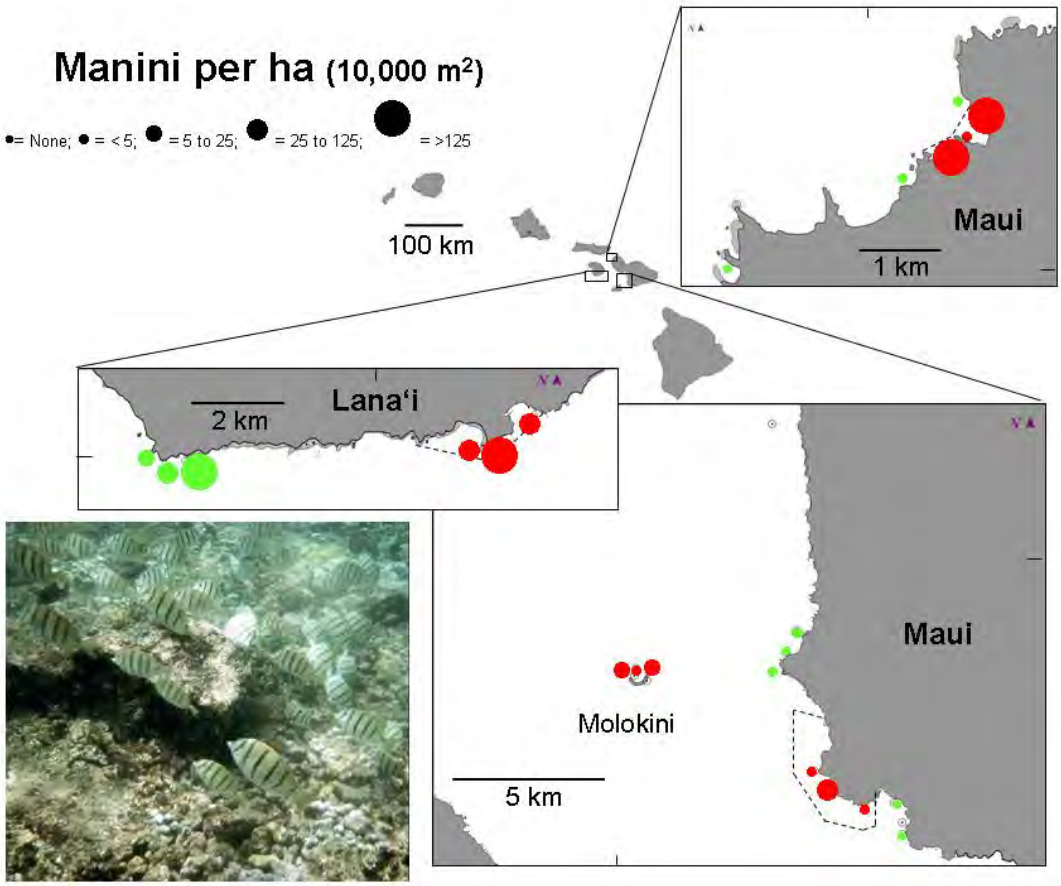


Figure 23. Manini abundance at Maui DAR monitoring stations. Density represented by size of circles. Red circles are areas where net fishing is prohibited, green circles are from open sites (no restrictions on net fishing).

HAFA Surveys

In March of 2007, new lay gill-net regulations went into effect (HAR 13-75-12.4). These new rules banned the use of lay gillnets in Maui waters. Previous to this law, there was concern that laynet fishing was indiscriminately catching and killing large numbers of nearshore reef fish. Many of these fish were herbivores, which provide important ecosystem services for maintaining healthy coral reefs. The new HAFA surveys were implemented in early 2007 in an effort to develop baseline information on shallow water reefs that tended to be heavily fished by laynets. These surveys looked at fish biomass levels, as well as, basic qualitative habitat characteristics. The seven sites on Maui were all rated by the intensity of past laynet fishing based on the observations by Maui resource managers. These ratings resulted in the following list of sites in order from highest laynet fishing intensity to lowest; Waihe′e, Pā'ia, Aealoa, Kihei, Makena, Kā'anapali, and Olowalu. Although not enough time has passed to look at trends in fish biomass, we can characterize the baseline fish and habitat on the surveyed sites in relation to the intensity of past laynet fishing. These results are displayed in Figures 24 and 25 below.

In general, there appears to be a trend towards higher fish biomass with lower past laynet fishing intensity (Figure 25). The Makena, Kā'anapali and Olowalu sites all had the highest overall fish biomass with primary and secondary consumer levels higher than the other sites. It appears, that both the Pā'ia and Aealoa sites had high herbivore densities, but much of these fish tended to be brown surgeonfish (*Acanthurus nigrofuscus*). Brown surgeonfish, although important herbivores are not very desirable as food fish and therefore are often avoided by fishers. It was also clear that the four highest laynet fished sites had very low levels of secondary consumers, much of which are targeted by net fishers (i.e. goatfish). Going hand in hand with the fish biomass levels is the overall health of the coral reef habitats at these survey sites. The Makena, Kā'anapali and Olowalu sites all had low levels of macroalgae and fairly healthy coral reefs (>30% coral cover). The four highest laynet fished sites, however, displayed macroalgae cover near 20% or higher (Figure 25). These results suggest that if the new laynet regulations are effective, we should be able to measure increasing reef fish biomass levels along with increases in overall coral reef ecosystem health.

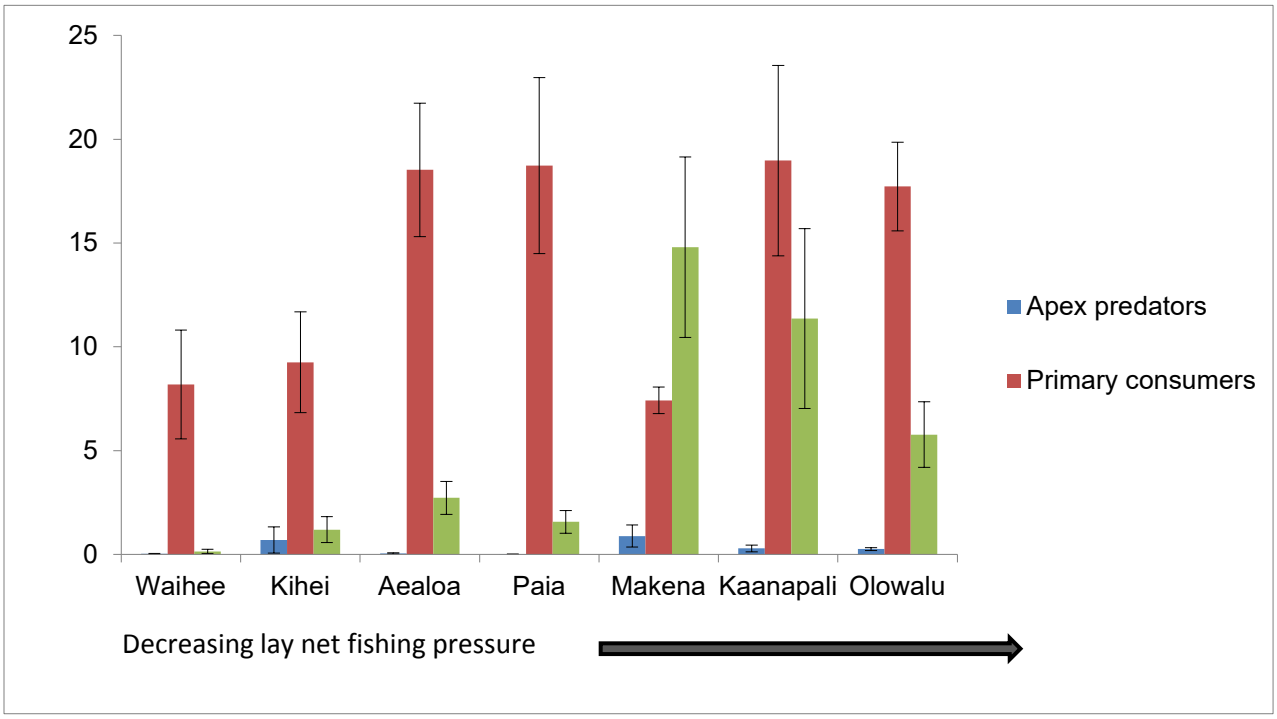


Figure 24. Fish Biomass plotted by trophic guild for 7 shallow water HAFA survey sites. Graphs organized by site in terms of decreasing lay gill-net fishing pressure.

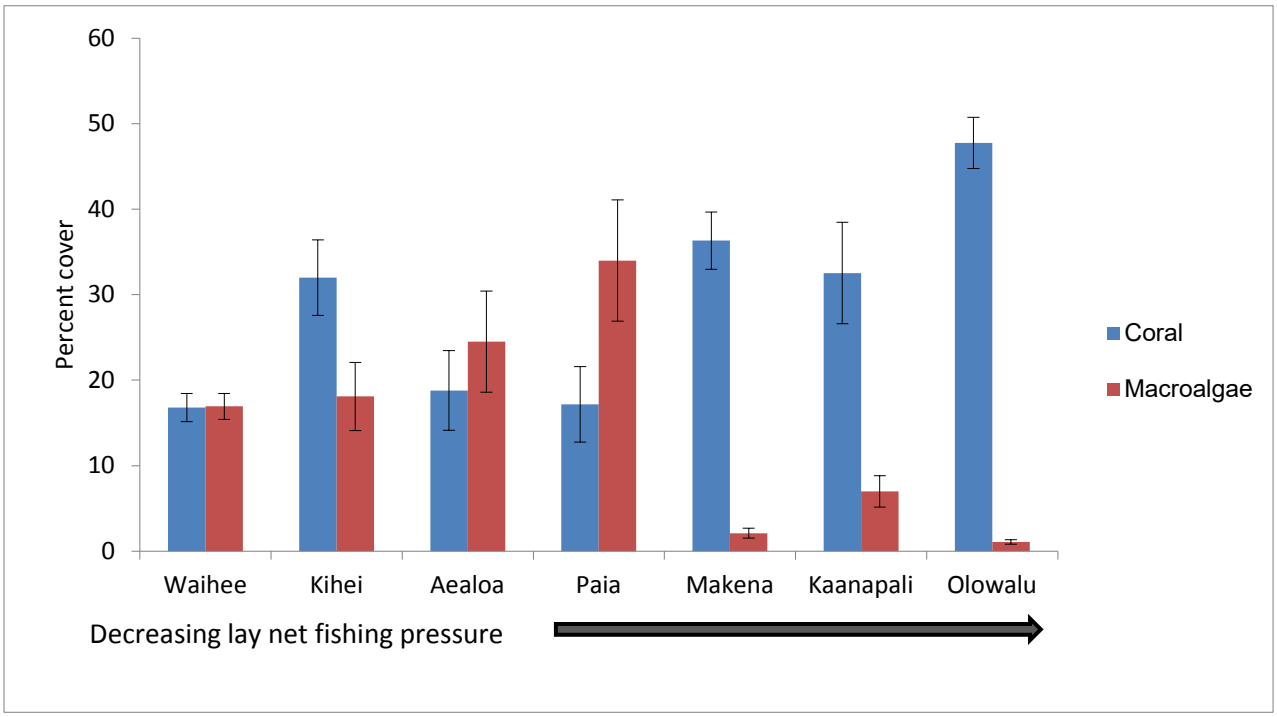


Figure 25. Habitat characteristics plotted by percent cover of coral and macroalgae for the 7 shallow water HAFA survey sites. Graphs organized by site in terms of decreasing lay gill-net fishing pressure.

Kahekili Herbivore FMA Baseline Assessment

In July 2009, the Hawai′i Division of Aquatic Resource (DAR) established the Kahekili Herbivore Fisheries Management Area (KHFMA). This new marine managed area encompassing coral reefs offshore of the Kahekili Beach Park in West Maui. The KHFMA was implemented in November 2009, with the installation of State rule signage at beach access points within the region. This reef tract was previously known for high coral cover, but recent degradation has led to significant increases in algal cover at the expense of corals. The goal of the HFMA is to increase the reef's capacity to resist this phase shift from coral to macroalgal domination by prohibiting the take of herbivorous fish and sea-urchins.

The aims of this assessment project were to: (1) design and implement a statistically and scientifically valid baseline of pre-KHFMA establishment conditions on the Kahekili reef; and (2) utilize new and existing data generated by DAR and partners, from survey programs in Maui and elsewhere, to draw broader conclusions about the relationships between local herbivore stocks and benthic algal communities (particularly in terms of reefs' vulnerability to macroalgal overgrowth).

DAR staff along with staff from the UH Botany Department, designed and implemented baseline surveys in 2008 and 2009. Fish and benthic communities were surveyed at a total of 242 sites within the HFMA in January and August of 2008 and September 2009. Starting in 2009, surveys were also conducted at Canoe Beach, a control site to the south of the KHFMA with no changes to fisheries management.

Survey sites were grouped into six broad habitat categories, with baseline benthic and fish community data analyzed for those different habitats.

Purpose

The reef in the KHFMA, while still in relatively good condition, has been intermittently stressed by the seasonal blooms of the invasive alga *Acanthophora spicifera*. The specific goal of the KHFMA is to restrict take of herbivorous fishes and sea-urchins to thereby restore the reef's capacity to prevent invasive algal blooms from occurring. The new management regulations were implemented on the KHFMA in November 2009, with public presentations and signage used to inform ocean users of the changes to management at Kahekili. The baseline assessment effort was designed to generate meaningful data against which eventual effectiveness of the HFMA can be assessed.

While the main spatial focus of this work was on the KHFMA, the problem of coral to algal phase shifts is a concern for many Hawai′i reef areas, particularly around heavily populated parts of the state. Therefore, this project was also designed to support wider-scale collaborative projects in the state related to herbivory and macroalgal domination of local reefs.

Methods and Results

Survey methods were established with previous work as reported by Ivor Williams, HCRI FY07, Project Title: KAHEKILI ECOSYSTEM RECOVERY AREA -Science Planning and Support; Grant Number: NA07NOS4000193; Date: May 23, 2008.

Surveys sites were haphazardly located on hard bottom areas within the KHFMA boundaries with the aim of broadly covering the full extent of the area and with adequate replication within different habitat categories (Figure 26).

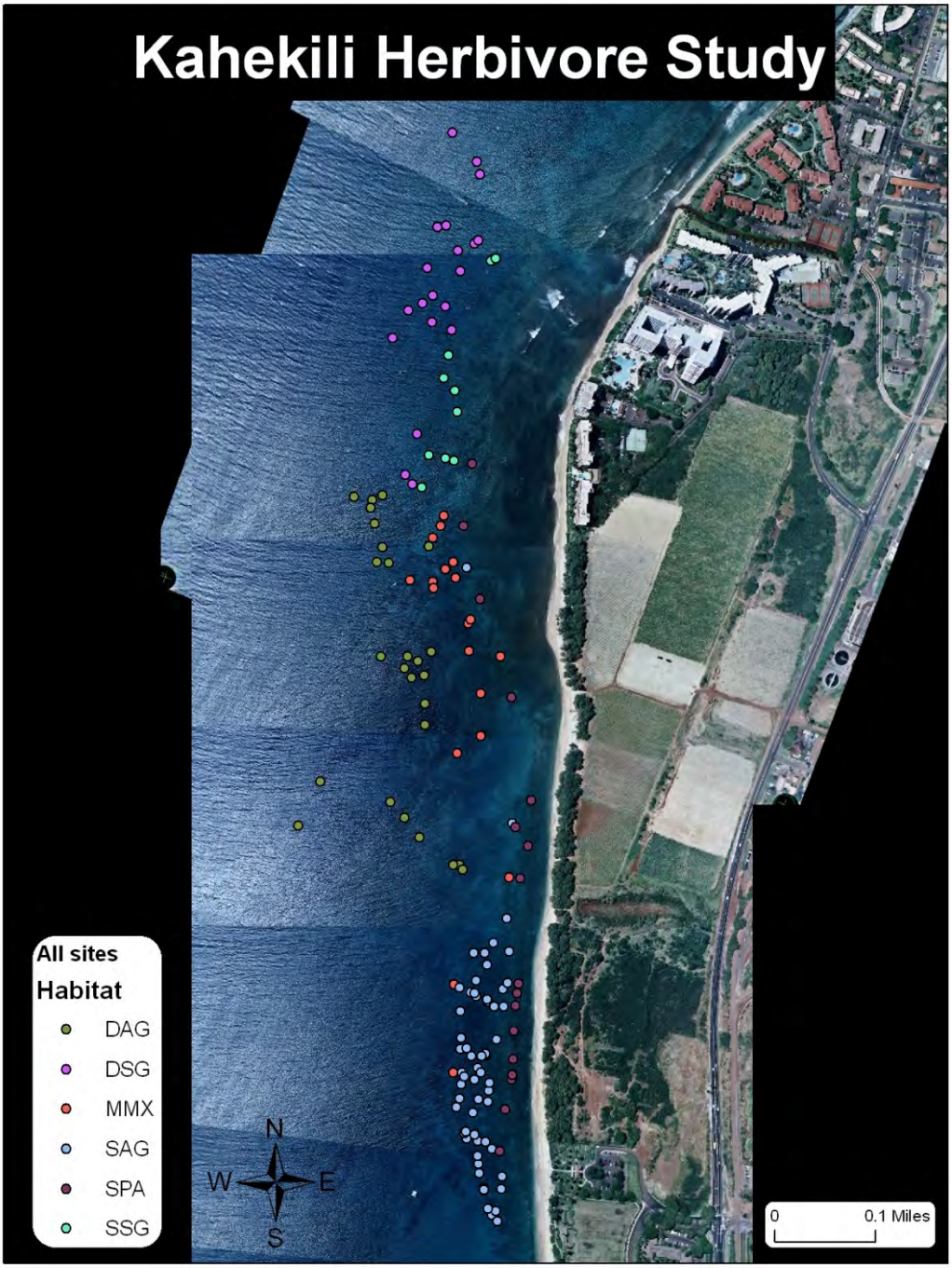


Figure 26. Location of 2008 Kahekili Baseline Surveys. January and August 2008 surveys combined. See Table 2 for a description of the six habitat types.

Reef habitats vary considerably within the KHFMA, and hence survey habitats were grouped into 6 broad classifications (Table 4) corresponding with distinct ecological

zones within the KHFMA. These habitats vary considerably in their fish and benthic communities, and therefore may have markedly different responses to the implementation of the KHFMA.

Table 4. Habitat classifications within the Kahekili HMFA.

Habitat	Depth Range (ft.)	Characteristics
Deep Aggregate Reef (DAG)	23 - 50	Some patches and sand, but substrate largely dominated by corals. Consequently, reef has moderate or high complexity.
Shallow Aggregate Reef (SAG)	5 - 23	As above (but shallower-largely corresponding with depth range of fringing reef in front of Kahekili Beach Park)
Mid-Deep Spur and Groove (DSG)	17 – 40	Spur and groove habitat – by around 15ft, physical structure is well established and by deeper portions of this habitat, spurs are up to about 15ft off the bottom
Shallow Spur and Groove (SSG)	10 – 13	Spur and groove (confined to northern edge of proposed HFMA). Shallow spur and groove begin to develop at around 10 ft deep, but do not develop substantial physical relief until 15ft deep or lower. Shallow spur-and-groove areas were also clearly more sedimented than deeper spur-and-groove
Mixed Mid-Depth (MMX)	10 – 25	Mixed medium depth and deeper habitat. Coral cover low and coral distribution patchy, abundant loose sediment and sand patches are common
Shallow Pavement (SPA)	4 – 8	Largely flat, low relief and low coral cover areas dominated by limestone pavement and loose sediment

Surveys were conducted from a small boat with survey teams of two divers. The divers entered the water over hard bottom habitat and swam straight down to the nearest suitable habitat (hard bottom large enough to lay a 25m survey transect in). One diver tied the starting point of the survey transect and the other recorded the transect start location using a GPS in a waterproof bag attached to a surface float. Compass bearings were taken for each transects, and whenever possible were run parallel to the shoreline running approximately northwards. In total, 242 surveys were conducted throughout the KHFMA prior to its implementation in November 2009 (Figure 26).

Survey transects were of 25m length, with one diver conducting fish surveys using

methods closely based on those used by NOAA-CRED throughout the state of Hawai'i: species, number and size (in 5cm slots) was recorded for all fishes larger 15 cm total length (TL) within a 4-m wide belt centered on the diver as they laid out the 25 m transect tape. The diver would then return along the transect, recording species, number and size of all fishes smaller than 15 cm TL in a 2m wide belt centered on the transect line.

The other diver followed the fish surveyor, and conducted a photo quadrat survey of the benthos under the transect line, and then recorded all sea-urchins within a 1m-wide belt, during the return swim along the transect line.

As expected, significant differences were found in the composition of the benthic communities in the different habitat types (Figure 27; two-factor ANOVA with survey date and habitat type as factors, Tukey's multiple comparisons for post hoc comparisons of means). Coral cover was significantly different across the habitats ($F_{5, 137} = 35.38$, $p < .001$), with cover in MMX and SPA significantly lower than the other habitats. Turf algae coverage also varied significantly with habitat type ($F_{5, 137} = 29.68$, $p < .001$), with SPA having significantly more turf algae than any other site, and MMX having significantly more turf than any of the remaining sites with the exception of DSG.

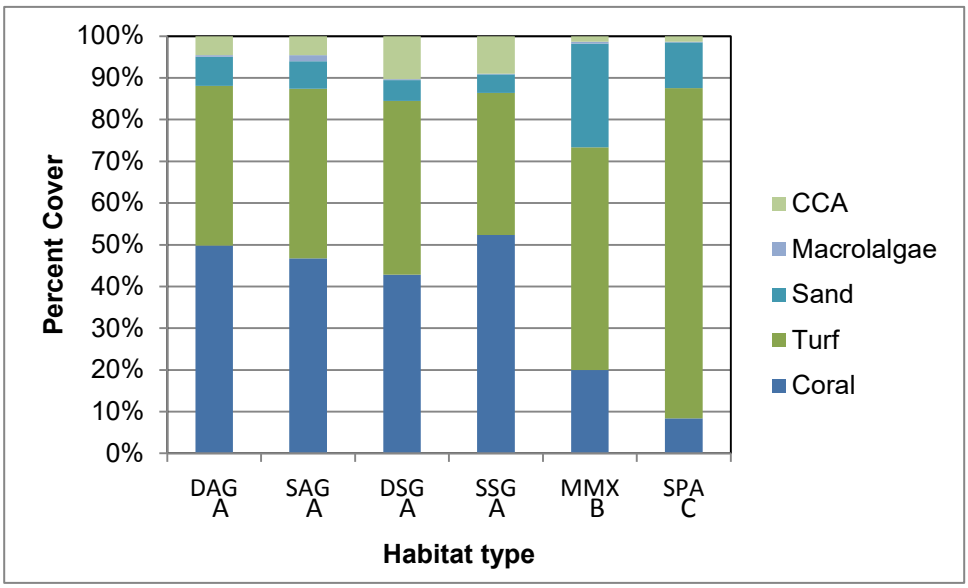


Figure 27. Benthic community composition (percent cover) by habitat type within the HFMA. Habitats with different letter designations have significant differences in coral cover.

Fish communities also showed marked variation in size and composition. (Figure 28) Total fish biomass was significantly different across the habitats ($F_{5, 240} = 3.97$, $p = .002$), with biomass in SAG and SPA significantly higher than in MMX (though SSG had the highest biomass, there was large variability in surveys from that habitat).. Total herbivore biomass also varied significantly with habitat type ($F_{5, 240} = 7.24$, $p < .001$), with SSG, SAG, SPA and DSG having the highest herbivore biomass numbers, and MMX significantly lower biomass (Figure 17).

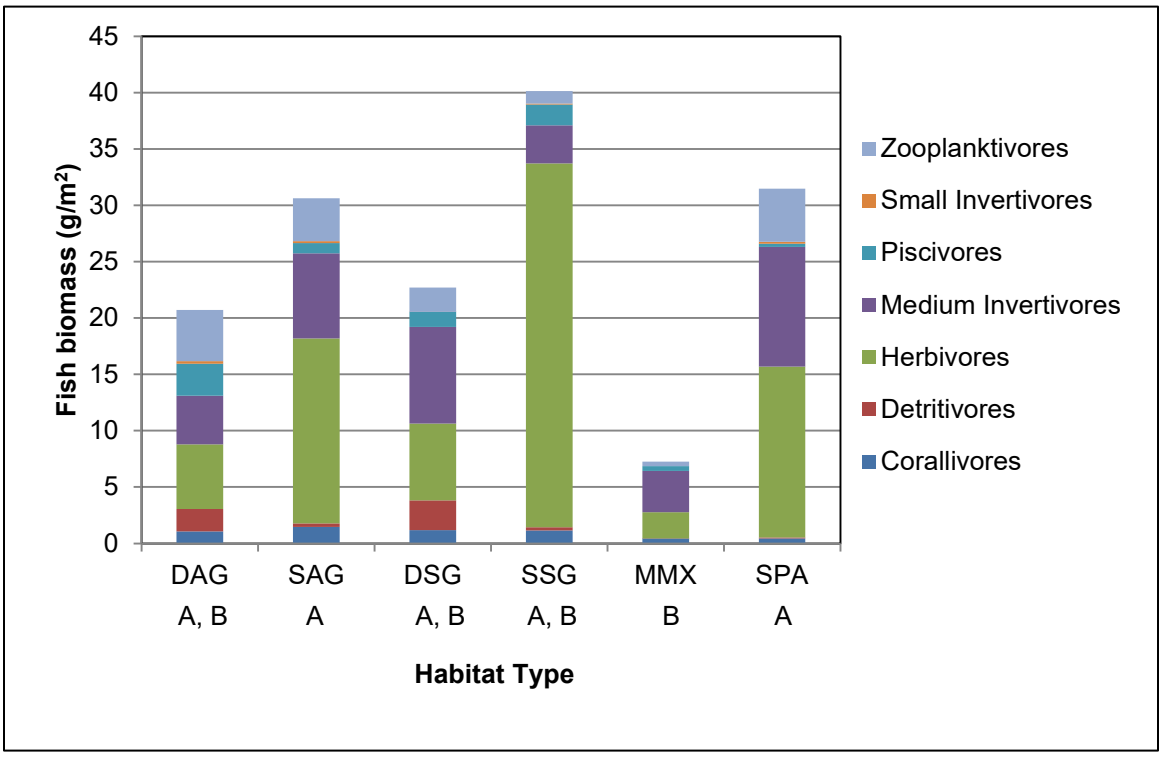


Figure 28. Fish biomass in grams per m^2 by habitat type and trophic group.

With 242 sites surveyed over three different dates, a firm baseline has been established to assess the effectiveness of the KHMFA both at protecting herbivores, and at affecting change to the structure of the benthic communities. Subsequent survey rounds (the next is planned for September 2010) will evaluate the success of this novel management strategy.

Citizen Science - Kahekili Herbivore Enhancement Area (HEA) Surveys

Citizen scientist surveys are an integral part of the overall assessment of the new KHFMA, and, just as importantly, have engaged the community stakeholders to learn, participate, and share their knowledge with others in the community. The community volunteers take part in data collection surveys, education, outreach, and frequently participate in helping develop public policy (e.g. public testimonies to EPA, County Council, and the Mayor's Wastewater Community Working Group, Makai Watch, etc.). Four different reef fish survey protocols were developed to enhance our knowledge base of the critical grazing fishes, and multiple community training workshops have been held that included a background of the science behind the establishment of the KHFMA, as well as protocols and goals of the surveys.

Over the course of 2008, eight training workshops for the KHFMA herbivore fish snorkel surveys were held, three public talks on the importance of herbivores on the reef were given, and 57 field survey days were coordinated. In 2009, there were four training

workshops, four public talks, four educational institution talks, eight field trainings, and 54 field survey days. More than 100 community members have participated, contributing over 2,400 hours of volunteer effort. Volunteer training workshops were advertised in local papers, facilitated by the local non-profit Project S.E.A.- Link, and held at the Lahaina Civic Center, the NOAA Humpback Whale Sanctuary in Kihei, the Jean-Michel Cousteau Ambassadors of the Environment Center, and Maui Community College.

Herbivore grazing pressure surveys were the first protocol implemented. These surveys were conducted to assess the contributions of individual species of grazers to overall levels of herbivory within the KHMFA and track how these levels change over time in response to the implementation of the KHMFA. The herbivore grazing pressure surveys were conducted by volunteers from the local community, as well as DAR staff.

Three additional survey protocols were introduced in March of 2009 to compliment the herbivore grazing pressure data and to attract new volunteers who may have found the herbivore grazing survey too challenging. The first was the behavior survey, where volunteers record the first behavior observed for each individual fish of a given species in a specific habitat. This survey was well received by volunteers and has become the most 'popular' of the four reef fish survey protocols.

A second timed grazing survey was designed as a quantitative measure of the total time an individual fish spent grazing. For this survey the same fish was followed for 5-10 minutes and the amount of time the fish engaged in actual grazing activity was recorded. This survey provided a higher resolution of grazing activity by species and size class. Lastly, a protocol was developed specifically to better characterize the composition and sizes of fishes in larger schools (> 50 individuals). The effects of these schools on the reef were not well-captured with the existing protocols, and this method should allow DAR to assess changes over time for these important grazers. Both of these surveys have proven too challenging for the majority of volunteers and will be taken over by DAR staff.

Volunteer Herbivore Grazing Survey and Results

In these surveys, individual fish of the various species of acanthurids (surgeonfish), scarids (parrotfish), and kyphosids (rudderfish) were observed, with the grazing rate (number of bites during a one minute observation period) by species, size class, behavior, and habitat recorded. All surveys from February 2008 through February 2009 were conducted from 9am until 11am, mainly for simplicity of scheduling volunteer observers. In order to explore grazing rates and behavior at different times of day, surveys from March through July 2009 were scheduled from noon until 2pm, and August data was collected between 2pm and 5pm. Thereafter, surveys were divided into three time slots, morning, mid-day, and afternoon, and selected randomly. Observations were made from within the HFMA and also from a number of appropriate control sites around the island. These areas included: Honolua Bay, Kapalua Bay, Olowalu, 'Āhihi Kīna'u Natural Area Reserve (NAR), and Maluaka. Data were only collected on individual fishes that exhibited natural (i.e. undisturbed) behavior and only in optimal water visibility conditions.

Data were collected from 14 species of acanthurids (n = 3127 observations) and seven species of scarids (n = 1083 observations). *Chlorurus perspicillatus* and *Calotomus zonarchus* are uncommon and the sample sizes were small, so these data were

excluded from the analysis. Similarly, only three kyphosids were observed during the observation time periods so data from those individuals was also removed from the analysis. Most fishes were observed while grazing, though all behaviors were recorded. It was common for the fish to have multiple behaviors over the observation time period leading to the development of new protocols to focus on the percent of time fishes spend grazing (see herbivore behavior survey results).

General grazing trends for both acanthurids and scarids were similar. A significant negative correlation (Pearson's, -0.276; P-value < 0.001) for grazing rate (bites per minute) versus fish size (total length) was observed, which is intuitive because smaller fishes require continuous energy for growth. Conversely, bite sizes increased with fish size.

Calculations based on bite size and grazing behavior of *Chlorurus* and *Scarus* species from Ong (2008) indicate the area of algae scraped by scarids over a year has a significant positive linear relationship to size (Pearson's, 0.925; P-value < 0.001), as illustrated in Figure 29. While *Scarus psittacus* was the smallest of the three species, they also had a significantly greater bite rate than the other parrotfish species (Figure 29 & Table 5).

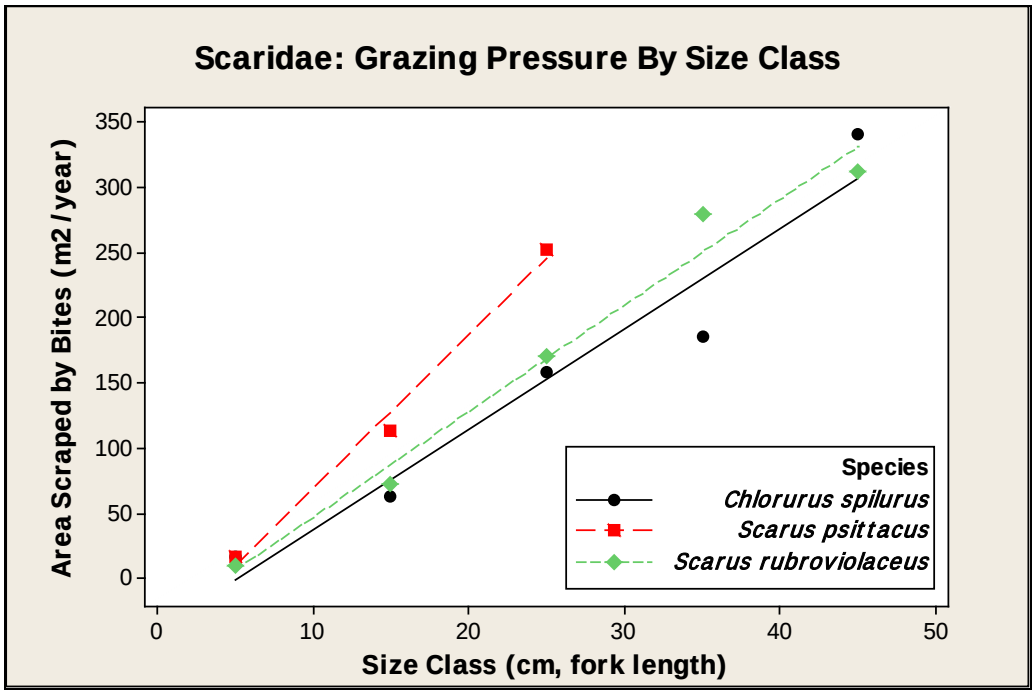


Figure 29. Parrotfish grazing pressure by size class calculated for area (m^2) scraped annually, based on bite data for *Chlorurus* and *Scarus* spp. by Ong (2008). Pearson's correlation for positive linear relationship is significant (0.925, P-value = 0.000).

Acanthurids overall had significantly greater grazing rates than scarids (ANOVA, n = 4210; P-value < 0.001). Acanthurids have greater overall species richness and population sizes, though not significantly so. Although no bite size data was available

for analysis, surgeonfishes in healthy abundances assuredly rival the grazing potential of parrotfishes. Both are critical grazers for controlling algae on the reefs.

Table 5 a-d. Parrotfish grazing pressure by size class calculated for area (m^2) scraped annually, based on bite data for *Chlorurus* and *Scarus* spp. by Ong (2008).

Table 3a.

Scarus rubroviolaceus	Size Classes (cm) 5	15	25	35	45
Total n	7	62	28	54	38
Bites per Minute +/- SE	14 ± 3	16 ± 2	16 ± 2	15 ± 1	11 ± 1
Bites per day	10626	12144	12144	11385	8349
Area m² per year	10	72	170	280	313
Aggregate n	4	39	22	48	27
Bites per Minute +/- SE	12 ± 3	12 ± 1	15 ± 3	14 ± 2	10 ± 1
Bites per day	9108	9108	11385	10626	7590
Area m² per year	9	54	159	261	284
Pavement n	3	23	6	6	11
Bites per Minute +/- SE	17 ± 5	22 ± 3	22 ± 5	18 ± 1	15 ± 3
Bites per day	12903	16698	16698	13662	11385
Area m² per year	12	99	233	336	427

Table 3b.

Chlorurus spilurus	Size Classes (cm) 5	15	25	35	45
Total n	10	43	38	20	4
Bites per Minute +/- SE	24± 4	14 ± 2	15 ± 2	10 ± 2	12 ± 3
Bites per day	18216	10626	11385	7590	9108
Area m² per year	17	63	159	186	341
Aggregate n	8	33	30	16	4
Bites per Minute +/- SE	22 ± 4	12 ± 2	16 ± 2	9 ± 2	12 ± 3
Bites per day	16698	9108	12144	6831	9108
Area m² per year	16	54	170	168	341
Pavement n	2	10	8	4	0
Bites per Minute +/- SE	33 ± 5	20 ± 6	11 ± 3	14 ± 4	0
Bites per day	25047	15180	8349	10626	0
Area m² per year	23	90	117	261	0

Table 3c.

Calotomus carolinus	Size Classes (cm) 5	15	25	35	45
Total n	6	36	55	40	16
Bites per Minute +/- SE	13 ± 5	13 ± 2	11 ± 1	7 ± 1	7 ± 1
Bites per day	9867	9867	8349	5313	5313
Aggregate n	4	19	40	12	14
Bites per Minute +/- SE	16 ± 7	12 ± 2	11 ± 2	8 ± 2	7 ± 2
Bites per day	12144	9108	8349	6072	5313
Pavement n	2	17	15	28	2
Bites per Minute +/- SE	8 ± 4	14 ± 3	10 ± 2	7 ± 1	10 ± 6
Bites per day	6072	10626	7590	5313	7590

Table 3d.

Scarus psittacus	Size Classes (cm) 5	15	25
Total n	27	86	24
Bites per Minute +/- SE	26 ± 4	26 ± 2	24 ± 3
Bites per day	19734	19734	18216
Area m² per year	17	114	253
Aggregate n	16	67	19
Bites per Minute +/- SE	27 ± 4	25 ± 2	22 ± 3
Bites per day	20493	18975	16698
Area m² per year	18	110	232
Pavement n	11	19	5
Bites per Minute +/- SE	23 ± 6	28 ± 4	28 ± 8
Bites per day	17457	21252	21252
Area m² per year	15	123	295

Herbivore Behavior Survey and Results

The herbivore behavior survey provides an estimate of how fish allocate their time between grazing and other behaviors throughout the day. Snorkelers swam in a set direction within a specific habitat type and noted the behavior of an individual of the target species at first sight, pausing only a few seconds to confirm the behavior. Fish species are chosen by the observer *in situ* and choices were usually based on their experience level. The behavior categories are grazing (including foraging), swimming (travelling), "hanging out" (semi-stationary), and interaction (with another organism).

A total of 7327 individuals from 18 species of acanthurids and scarids have been observed at six different sites and in several different habitats (Table 6). Observations were made between the hours of 9:00 am and 5:00 pm, with the bulk of the survey effort allocated between 9:00 am and 2:00 pm.

Table 6. Behavior Survey. Data collected on fish behavior along a roaming swim. The behavior recorded is the first behavior observed for a given individual.

Species	Total n	% Grazing	% Swimming	% Interaction	% HangingOut	% Other
Acanthuridae						
Acanthurus blochii	**86**	76	21	2	1	0
A. dussumieri	**36**	81	8	6	6	0
A. leucopareius	**153**	50	36	3	8	3
A. nigrofuscus	**1580**	76	22	2	1	0
A. olivaceus	**701**	78	18	3	2	0
A. triostegus	**1920**	73	21	1	3	1
Ctenochaetus strigosus	**52**	69	29	0	2	0
Naso brevirostris	**546**	40	55	1	3	1
N. lituratus	**273**	59	34	4	2	0
N. unicornis	**292**	57	40	1	2	0
Zebrasoma flavissimus	**1123**	77	20	1	3	0
Z. veliferum	**27**	52	37	0	11	0
Scaridae						
Calotomus carolinus	**56**	61	30	7	2	0
Chlorurus spilurus	**49**	73	24	2	0	0
Scarus psittacus	**282**	72	26	1	1	0
S. rubroviolaceus	**201**	59	37	1	1	1

Overall, both acanthurids and scarids spent the majority of their time grazing (70% and 66% respectively), followed by swimming, with little time devoted to other activities (Figure 30). Both families show relatively constant grazing activity, regardless of time of day (Figure 31), but there is a suggestion of higher feeing rates in the afternoon, which has been hypothesized to be an optimal time for concentrated grazing activity due to the accumulation of photosynthate over the course of the day. However, the small sample sizes for these time periods makes it difficult to draw any concrete conclusions.

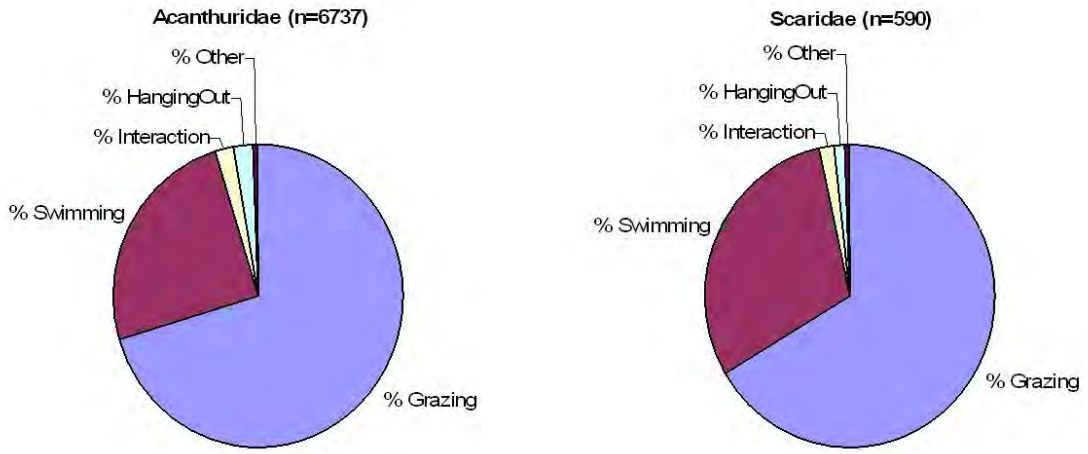


Figure 30. Percentage of time spent in the six behavior categories for acanthurids (surgeonfishes) and scarids (parrotfishes).

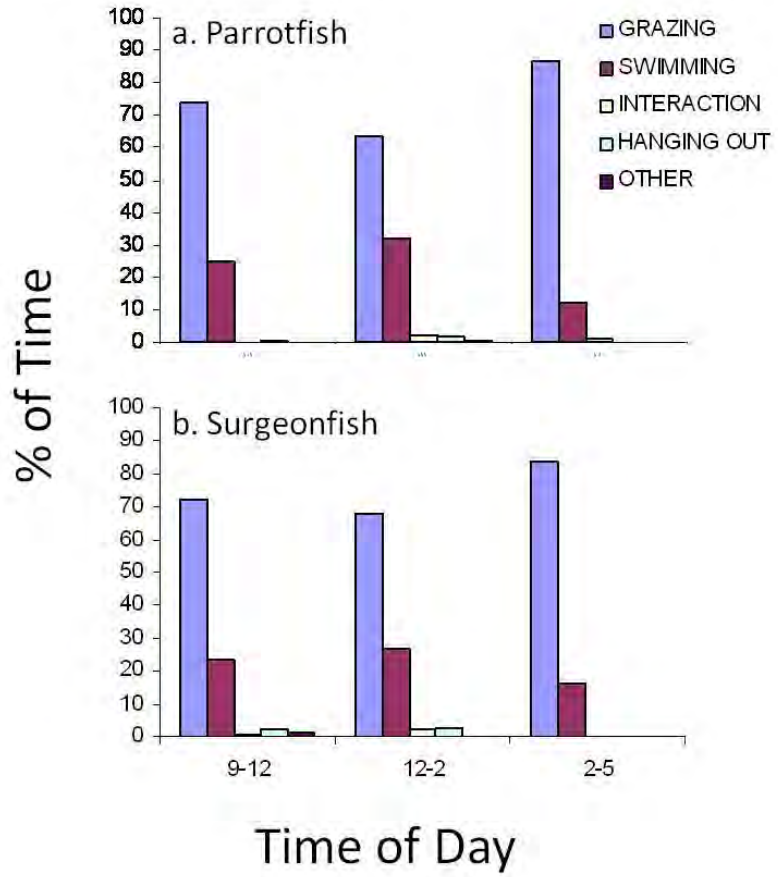


Figure 31. Diel patterns in observed behavior for acanthurids and scarids.

These observations (herbivore grazing and behavior surveys) were collected by trained volunteer citizen scientists who contributed their time and skills to help DAR develop a better understanding of the importance of herbivore fishes in the coral reef ecosystem. More than 100 community members participated in the 532 surveys (through February 2010) for greater than 2400 volunteer hours. Through their involvement in these surveys, volunteers have become more informed about the status of Maui's reefs, and they have helped to begin to fill in some knowledge gaps in the state's overall understanding of how to best manage Maui's coral reef ecosystems.

Introduced Species

Roi were intentionally introduced as food fish to Hawai'i in the 1950s in response to declines in commercial catches of native food fish. Assessments of the composition of Hawai'i's fish communities at the time determined that "many of the important shallow water game and food fishes such as the snappers and groupers abounding in the central and western Pacific are conspicuously missing in the Hawaiian Fauna." It was thought that introducing several mid-size predatory fish into Hawaiian waters that fit this "empty niche" would enhance fish catches (Division of Fish and Game, 1956). Species were selected for introduction based on their ecological characteristics and popularity as food fishes in their native ranges. Almost 16,000 fishes of 12 species were introduced in the late 1950s and 1960s with only Roi (peacock grouper, *Cephalopholis argus*), ta'ape (*Lutjanus kasmira*) and to'au (*Lutjanus fulvus*) becoming established.

However, due to the prevalence of ciguatera fish poisoning in roi, they are infrequently targeted and eaten by fishers. In the absence of sustained fishing pressure, roi populations have increased on some reefs around the state in recent years, leading to concerns amongst fishers and managers that roi may be a detriment to Hawai'i's reefs rather than a boon to fishers. The results of research to date have been mixed, with roi having been demonstrated to consume large numbers of native reef fishes especially in the smaller size ranges, but without documented impact on the size and composition of those fish communities (Dierking 2007, 2008; DAR unpublished data, also see pg. 87 of this report).

Although there is little scientific evidence to suggest that roi are having an overall deleterious impact on Hawai'i's reef fish communities there is strong sentiment amongst some members of the fishing community that roi is decimating Hawai'i's native reef fish populations. Multiple roi removal initiatives have been organized at the grass-roots level since 2008 as a proactive step by fishers to combat the perceived threat (Wood, 2010). "Roi Roundup" fishing tournaments are touted to be an environmental conservation movement with the aim of restoring Hawai'i's native reef fish populations (D. Tanaka, pers. comm.). These tournaments were founded on the island of Maui, and are now being held on the islands of Maui, O'ahu, Moloka'i, and Hawai'i.

Community assisted roi removal efforts were first conducted in West Hawai'i in 1999 by DAR in an effort to obtain information on roi feeding habits and ciguatoxicity. Such removals were undertaken in the same locale (Kūki'o, North Kona) for four years (1999, 2002, 2003 and 20046). Some of the key findings from this work were: 1) the degree of ciguatoxicity of the roi population at Kūki'o could vary dramatically between years 2) there was no significant relationship between the size of a roi and ciguatoxicity and 3) a substantial portion (67%) of the roi captured had empty stomachs even though efforts were made to reduce the loss of prey items by regurgitation during capture. A similar high number of empty guts have been found in other studies around the world.

DAR's original attempt to partner with and learn from these Roi Roundup events on Maui involved the establishment of a new integrated fish monitoring site at Canoe Beach (in front of the Hyatt at the southern end of Honokaoʻo Beach, Lahaina). This site serves as a control site for Kahekili, and the hope was to collect data from an area where roi are heavily targeted (Canoe Beach) and from the adjacent area at Kahekili, where DAR asked that fisherman not target roi so as not to confound the results of the KHMFA regulations. However, many fishermen did continue to target roi in the KHFMA, and as a result it is unlikely DAR will be able to measure any roi eradication impacts with in-water visual census assessment methods.

Figure 32. 'Kill Roi Day' event on April 18th at Olowalu, Maui. Mayor Charmaine Tavares and local fishers support community management of roi populations.

Subsequently, DAR has shifted research emphasis on Maui to opportunistically collecting data on the impact of this grassroots roi control efforts on roi populations. Data on the number and size of invasive fishes seen and caught at three Roi Roundup tournaments and, more recently, monthly 'Kill Roi Days' (KRD) were collected on-site. Tournaments can be either open to fishing from all sites on Maui or a discreet stretch of coastline, but the monthly KRD efforts have been focused primarily on one site, Olowalu. Fishers have removed well over 1000 introduced fishes including roi (*Cephalopholis*

argus), ta‘ape (*Lutjanus kasmira*), and to‘au (*Lutjanus fulvus*) from Olowalu alone (Figure 32). Fish weighing greater than one pound were sent to Dr. Paul Bienfang’s lab at UH Mānoa for ciguatera analysis. Fish weighing less than one pound were sold to a public aquarium for fish food or donated to organic farmers for composting.

At Olowalu, we have the best time series of data on roi removal, with data for roi removals conducted in July, August and November of 2009 and January and February of 2010. The following analyses use only the data from experienced fisherman present at these events (defined as fisherman who’s catch per unit effort exceeded 0.5 roi caught/hour), as their efforts yielded the most consistent data on roi abundance and catch.

Over this seven month time period the catch per unit effort (CPUE) for roi is trending downward (Figure 33), as are the total number of roi per hour that escape fishermen (Figure 34). The CPUE may be showing signs of leveling out at 0.5 roi per hour, though the trend is not significant. The number of roi seen that escape capture by fisherman has declined significantly from the initial Roi Roundup events. Taken together, these data suggest that overall abundance of roi has been reduced at these sites.

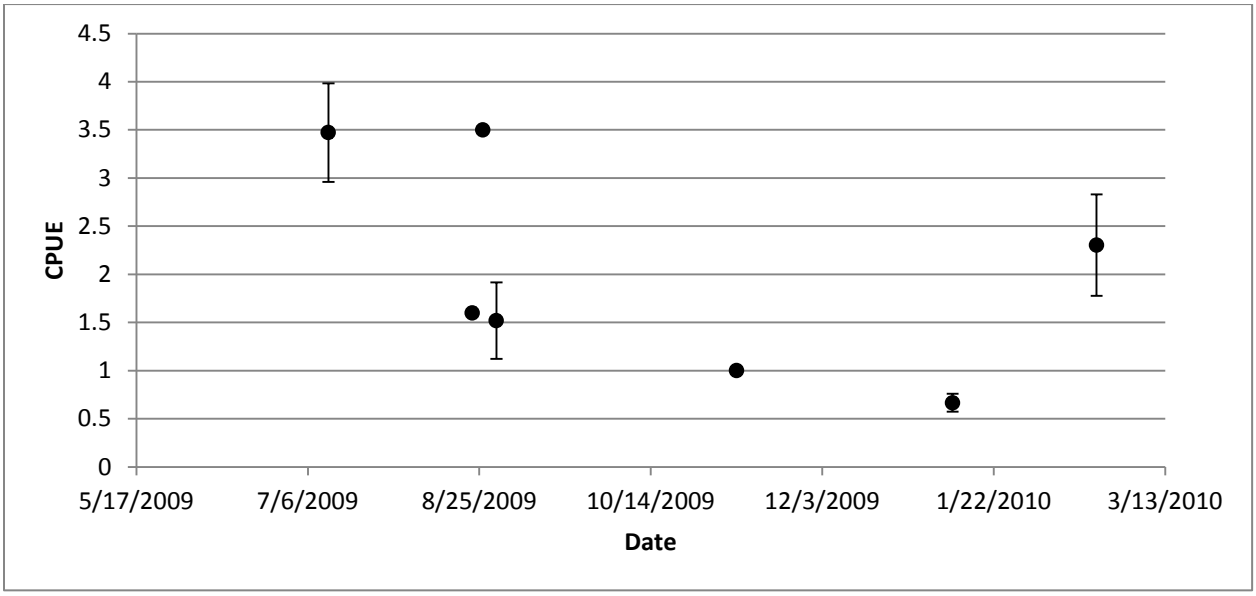


Figure 33. Average number of roi caught per hour by experienced fisherman (CPUE) at Olowalu, Maui. The CPUE trends downward but is not significant due to the rise in the CPUE in 2/21/2010. Error bars are standard error of the mean.

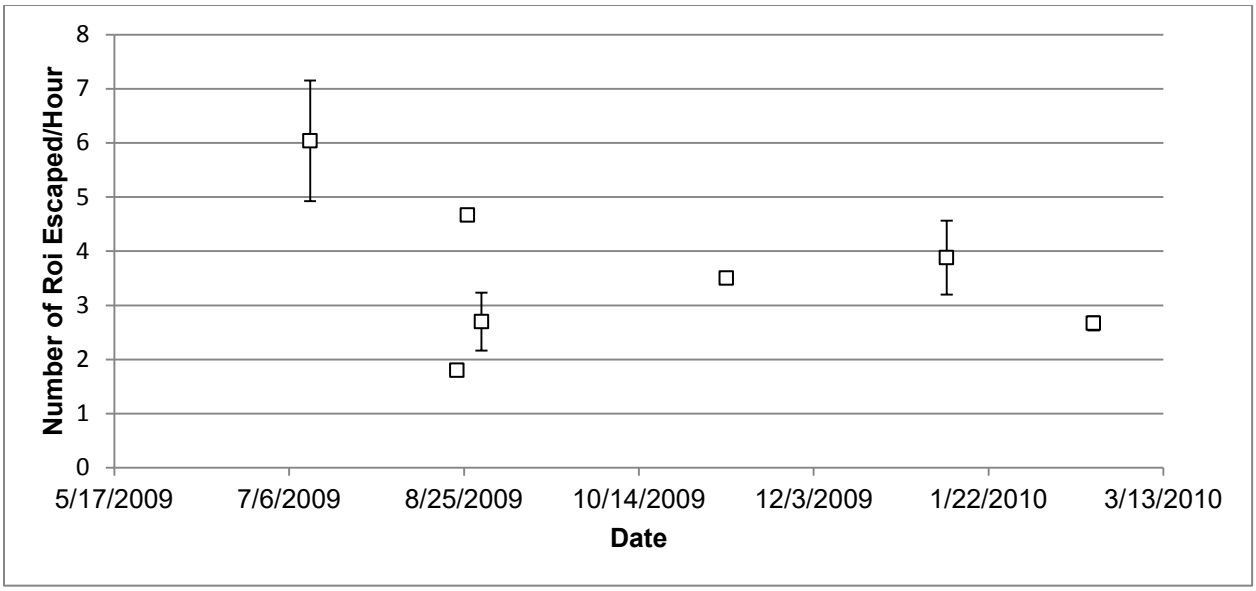


Figure 34. Average number of roi per hour that escaped catch by experienced fisherman at Olowalu, Maui. The downward trend is marginally significant (p=0.052). Error bars are standard error of the mean.

When data on both CPUE and the number of roi escaped are combined, a significant decline in roi abundance can be seen (Figure 35), with the average number of roi seen per hour declining by almost a factor of four. This indicates that these events are significantly decreasing the abundance of roi at Olowalu. However, it also suggests that, while roi have been substantially reduced, they are still present in moderate densities despite months of removal effort.

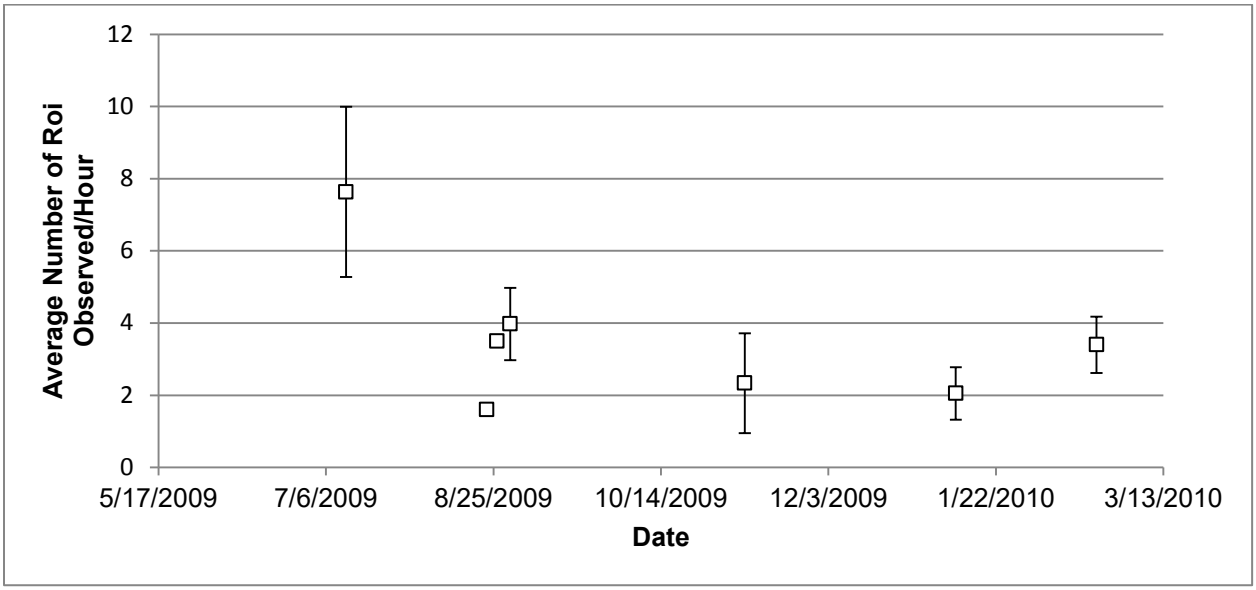


Figure 35. Average number of roi observed per hour (total of "roi caught" and "roi left") at Olowalu, Maui has significantly decreased since July 2009 (p=0.001). Error bars are standard error of the mean.

Based on the results from Dr. Paul Bienfang's lab, there were a total of 551 roi from Maui caught between July 20, 2008 and November 8, 2009, with the majority of fish coming from the leeward side of island. 414 of these roi have been tested for ciguatera (137 remain untested). Of these, 287 roi tested positive (69%) and 127 tested negative (31%). The relative toxicity rank assigned to the positive Maui fish ranged from 2.19 to 170.89. This is in contrast to positive Oahu fish, whose rank ranged from 35.26 to 60.85. Maui roi body weights versus relative toxicity rank shows no correlation of weight with ciguatoxicity and thus larger fish are not necessarily more toxic. The average body weight of roi received from Maui is 990.04g. The average weight of the negative fish from Maui is 946.35g, and the positive fish average weight is 1052.2g.

Coral Disease

'Āhihi Outbreak

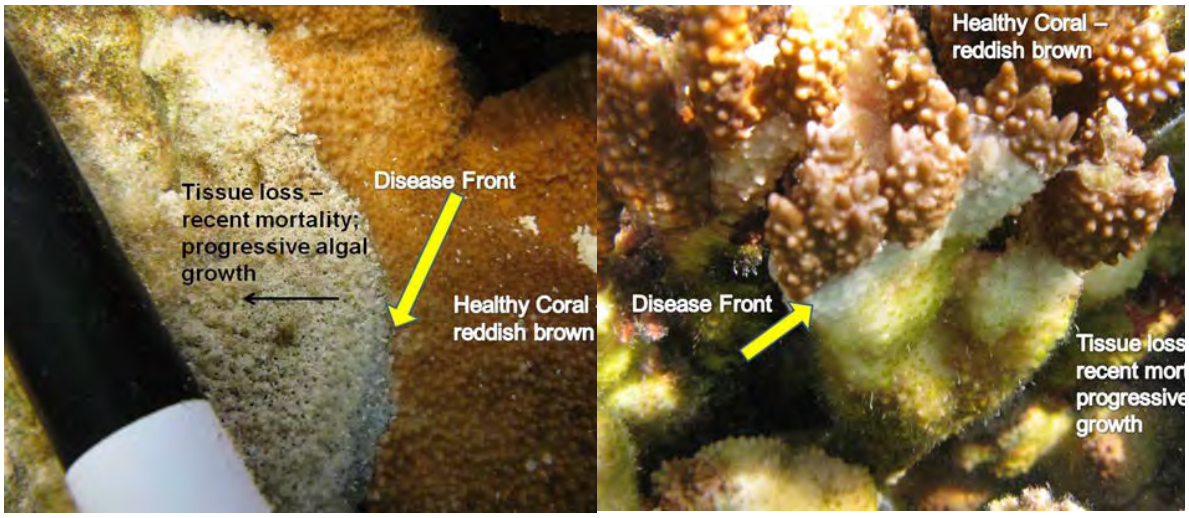


Figure 36. White Syndrome (tissue loss) outbreak at 'Ahīhī Kīna'u Natural Area Reserve, in a semi-enclosed 'pond' adjacent La Perouse Bay. Monitoring is ongoing.

In January, 2010, researchers from the University of Hawai'i at Mānoa (UHM) and Hawai'i Institute of Marine Biology (HIMB) were performing their research within the 'Āhihi Kina'u NAR, when they reported a coral disease (white syndrome) outbreak (Figure 36). This outbreak had been ongoing for approximately one year when DAR learned of it. Percent cover data from Yuko Stender's research indicated a 47% decline in coral cover over that time frame. Dr. Greta Aeby visited the site with the Maui DAR team to coordinate monitoring and sampling of the outbreak. Monthly or bi-monthly surveys of ten marked colonies using photographs and semi quantitative estimates of live, diseased, and old dead are ongoing. Samples for histology and micro work have been collected and sent out for analysis to Dr Thierry Work and Dr Sean Callahan, respectively, as is consistent with the Rapid Response Contingency Plan. Additionally, an inventory of the area (diseases and associated species) is planned for later this fall, utilizing the extra manpower of visiting coral disease biologists and Eyes of the Reef volunteers.

NOAA DZ Surveys

The NOAA Coral Reef Watch and NOAA/NMFS Coral Reef Ecosystems Division (CRED) have partnered with DAR on each island to collect coral disease (DZ) data to feed into a computer model for the development of a satellite prediction tool. This tool utilizes sea surface temperature (SST) data as an indicator of potential disease outbreaks, and has been thus far successful on the Great Barrier Reef. Hawai‘i poses new challenges to this tool, given that the reefs are very close to the shoreline, increasing the need for finer resolution imagery.

Surveys are performed three times a year (April, July, and late September), and the four priority sites for this project include established fish survey and CRAMP sites at Molokini, Keawakapu, Kahekili, and Honolua Bay. Additionally, all of the CRAMP sites will be surveyed in July. Dr. Bernardo Vargas-Angel is the project PI, and Dr. Greta Aeby is the survey advisor. Megan Ross from UHM/HIMB is a participant in the Maui surveys, and CRED is also sending biologists to assist with the field work. All data are sent back to CRED for analysis, and a copy will be housed at DAR Maui as well.

Internships and Community Education Programs

The Kahekili volunteer surveys and projects relating to the research and management of the KHFMA have become a focus for community groups and student learning. The Kahekili project and associated research has been incorporated into the Ka Ipu Kukui Fellowship Program (www.kaipukukui.org) which trains future leaders of the community. The fellows of 2008 and 2009 participated in presentations relating to the importance of herbivores and the history of the issues surrounding the project, field survey training, and engaged in discussion about the challenges of managing stressors to the reef.

The Marine Option Program at Maui Community College, led by Donna Brown, has provided students with multiple opportunities to give presentations and trainings to classes and encouraged them to participate in volunteer surveys. In addition, Derek Masaki of USGS, an instructor in Geographic Information Systems (GIS) at MCC, brought his students to Kahekili to learn about collecting field data and created a GIS by focusing on the stressors to the reef.

In 2009, two students from Kamehameha School’s KA`IMI internship program (http://maui.ksbe.edu//faculty/prmikell/Ka%60imiHome.html) gained valuable skills while aiding the project by mapping freshwater seeps (point sources of freshwater intrusion) and ‘dead zones’ (obvious death of *Porites compressa* beds) out on the reef. The ‘dead zone’ map led to a NOAA Hawai′i Coral Program funded grant to investigate these anomalies beginning late 2010.

Additionally, Carrie DeMott, an herbivore survey volunteer, is a science teacher at Maui Preparatory Academy. She has taken the initiative to integrate the herbivore surveys and related science into her class curriculum. Students are graded on their knowledge and skills relating to the Kahekili herbivore surveys.

Partnerships

The Division of Aquatic Resources (DAR) has been working collaboratively with the Coral Reef Alliance’s (CORAL; www.coral.org) Hawai‘i Manager, Liz Foote, to help create a web platform for the data collected from community-based volunteer surveys (http://monitoring.coral.org). This will enable DAR managers to broaden the scope and

efficiencies of monitoring and data collection by enabling broader volunteer involvement. Other organizations that have contributed toward this partnership effort in the online Web Portal include the NOAA Humpback Whale Marine National Monument and Robin Knox, junior researcher in Celia Smith's lab at the University of Hawai'i Botany Department. Both of these groups focus on water quality monitoring for part of their activities.

The data web portal was developed to allow volunteer citizen scientist to independently collect and enter data (http://monitoring.coral.org). Additionally, basic information collection regarding special resource issues has also been incorporated to allow recreational users to enter data any time they go snorkeling or spearfishing. The type of information collected on this web portal includes catch data and the total observed number of the alien fish roi (*Cephalopholis argus*), the number of large parrotfish observed (>45cm), and the number of large grazing fish schools observed (large schools are defined as having > 300 individuals). With contributions from the NOAA Humpback Whale National Sanctuary office, other community-based data will also be available at this site for managers including water quality data. Managers will have access to these data, and volunteers can see reports and access information that is important to them. Currently the portal is active but is still under construction.

In addition to the web portal project, CORAL has been an integral partner by helping educating the community stakeholders to raise awareness regarding the new KHFMA, sustainable tourism, the 'Take a Bite out Of Fish Feeding' Campaign, responsible stewardship, and coral reef etiquette.

Project S.E.A.-Link (Science, Education, Awareness), a local non-profit directed by Liz Foote, has also been an invaluable partner through initiating press releases, assisting in securing facilities for public talks and trainings, and list serve communications to the greater Maui community. Project S.E.A. Link specializes in providing links between agencies, organizations, and the community with an emphasis on assisting community based efforts that benefit managers.

The NOAA Hawaiian Islands Humpback Whale National Marine Sanctuary and the Jean-Michel Cousteau Ambassadors of the Environment Center have both been gracious hosts on numerous occasions providing free facilities for public volunteer training workshops. These groups have been true partners in our efforts to educate and engage the local community in the research and management efforts on Maui's coral reef habitats.

Hawai'i Island Surveys

Benthic Monitoring

Methods

Benthic surveys were initially conducted in West Hawai'i in 1999 and then again in 2003. More recently, surveys were conducted at 26 monitoring sites in 2007 (Figure 47). Three additional sites were surveyed in either 2005 or 2009. The images used for analysis in 1999 were captured by digital video. The resolution of the video images was very poor however compared to the subsequent surveys which used much higher resolution digital still images (Olympus 5060 in 2003 and Olympus 7070 in 2007). Specifically, octocoral was not detectable in the 1999 video capture images, nor was it possible to distinguish live finger coral from dead finger coral. It was therefore determined that it was not valid to compare data taken with these two different techniques.

To obtain images of consistent size and quality, a 75cm clear Plexiglas® spacer rod is attached to the underwater housing and used as a guide to steady the camera at a fixed height (0.75m) above the benthos. A white balance feature was used to compensate for loss of red light at depth, giving the images a more natural appearance without artificial lighting. Four transects 25m in length were photographed at each site. Images were taken at 1m intervals from a standard height of 0.75cm starting at the 0 point and ending at the 25m mark, producing 26 images per transect.

Images were analyzed using the Coral Point Count with Excel extensions software program (CPCe Kohler and Gill 2006). Data was pooled by transect. The resulting configuration was 4 transects per site, 26 frames per transect, 20 stratified random points per image (4 rows, 5 columns), 520 individual data points per transect, and 2080 points per site. Proportion of each benthic category was determined for each image and percent cover was calculated for each transect, Total percent cover was obtained by calculating the mean percent cover of the 4 transects.

Results

Complete benthic data for the 2003 and 2007 surveys, presented as percent coverage, are contained in Appendices B-E. Comparisons of total coral cover (paired two-sample T tests) were performed on the percent total coral cover mean values for individual transects (1-4) (Table 7).

Between Lapakahi, the northernmost site, and Keahole Point, a distance of approximately 37 coastal miles, there are 9 survey sites. One site, Unualoha, was added in 2007 and therefore no comparative data is available. Of the 8 "northern" sites (north of Keāhole Point) that were compared, 6 showed statistically significant declines in total coral cover between 2003 and 2007. Lapakahi, Kamilo Gulch and Waiaka'ilio Bay (the three northernmost sites), Keawaiki, 'Anaeho'omalu and Ka'upulehu all declined significantly. Only Puakō and Makalawena showed no significant change (Figure 37).

A severe storm with large swells caused extensive coral damage along the West Hawai'i coast north of Keāhole Point in January 2004. This damage was noted during surveys

soon after the storms occurred. The declines at Kamilo Gulch and Waiaka'ilio Bay may also have been influenced by a major sediment runoff event caused by heavy rainfall in October 2006. A reconnaissance was conducted offshore of several intermittent streams near these sites soon after the event. Thick layers of sediment covering large amounts of coral were observed and sediment was recorded at water depths of 90 feet. Numerous dead coral were observed during subsequent reconnaissance.

South of Keāhole Point 15 sites were compared. Three sites, Wawaloli Beach, Papawai Bay and South Oneo Bay showed statistically significant increases in total coral cover between 2003 and 2007. All other sites showed no change.

Table 7. 2003 and 2007 coral cover at West Hawai'i sites.

Site (N to S)	2003	2007	Δ	P=	
Lapakahi	19.50%	11.40%	-8.10%	0.004	Decline
Kamilo	49.50%	38.20%	-11.30%	0.020	Decline
Waiaka'ilio Bay	54.40%	42.50%	-11.90%	0.047	Decline
Puakō	49.90%	47.80%	-2.10%	0.604	No Change
'Anaeho'omalu	41.20%	31.50%	-9.70%	0.038	Decline
Keawaiki	29.90%	16.70%	-13.20%	0.006	Decline
Ka'upulehu	40.90%	31.20%	-9.70%	0.033	Decline
Makalawena	45.20%	47.60%	2.40%	0.553	No Change
Wawaloli Beach	33.32%	42.25%	8.93%	0.015	Increase
Wawaloli	37.21%	37.51%	0.31%	0.859	No Change
Honokōhau	48.29%	48.74%	0.45%	0.894	No Change
Papawai	32.21%	38.31%	6.10%	0.044	Increase
S. Oneo Bay	56.09%	61.86%	5.77%	0.025	Increase
N. Keauhou	31.92%	31.10%	-0.81%	0.356	No Change
Kualani	52.81%	59.78%	6.97%	0.124	No Change
Red Hill	30.68%	33.22%	2.54%	0.511	No Change
Keopuka	15.98%	15.59%	-0.39%	0.602	No Change
Kealakekua Bay	27.10%	28.64%	1.54%	0.595	No Change
Ke'ei	31.20%	28.67%	-2.54%	0.424	No Change
Ho'okena (Kalahiki)	36.53%	39.62%	3.09%	0.263	No Change
Ho'okena (Auau)	28.18%	28.44%	0.26%	0.925	No Change
Miloli'i (Omaka'a)	29.76%	27.08%	-2.68%	0.491	No Change
Miloli'i (Manukā)	30.35%	33.17%	2.82%	0.488	No Change
Lapakahi	19.50%	11.40%	-8.10%	0.004	Decline
Kamilo	49.50%	38.20%	-11.30%	0.020	Decline

Octocoral Distribution

Benthic surveys revealed a most interesting distribution of one or more species of octocorals centered on the urbanized areas of Kailua-Kona (Figure x). The Bishop Museum checklist (http://www2.bishopmuseum.org/HBS/invert/results.asp) lists 11

species of shallow water octocorals occurring in Hawai‘i. At least one of the species in question appears to be the blue octocoral *Sarcothelia (Anthelia) edmondsoni* -Figure 38)

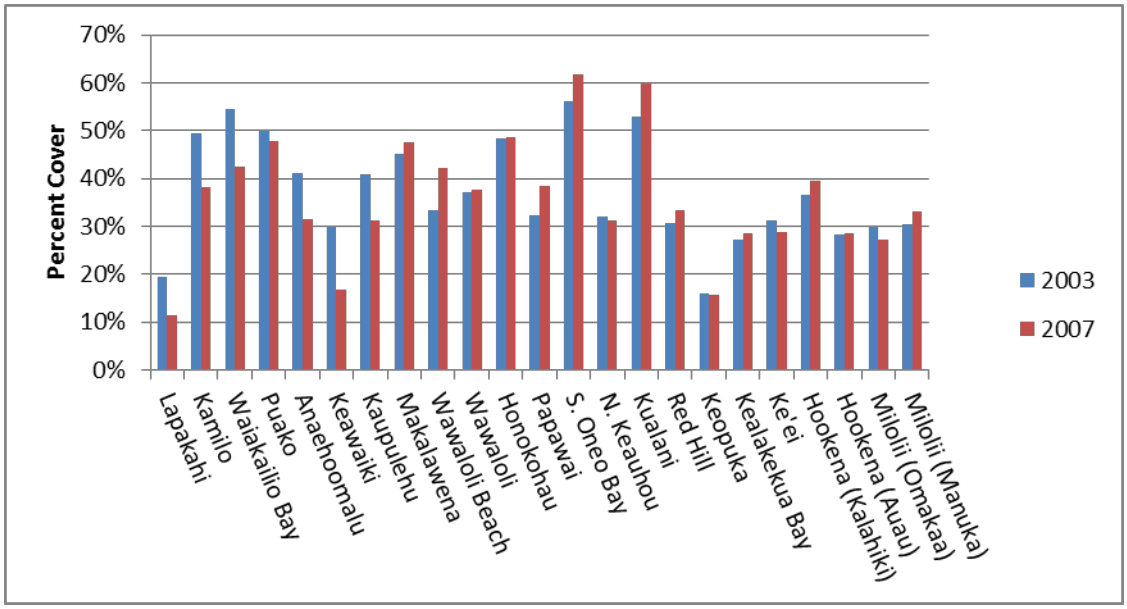


Figure 37. Comparison between survey years of percent coral cover across West Hawai‘i monitoring sites.

although the taxonomy of the group is somewhat confused. The original taxonomic description for S. *edmondsoni* is actually a brown morph common in calm lagoons on the windward side. The blue morph is more abundant in fore reef areas with heavy wave surge and is most likely a separate species. Both varieties have long histories in Hawai’i and are presumably native and/or endemic (S. Kahng, pers. comm.)

The apparent concentration of *Sarcothelia edmondsoni* (Figure 39) in the vicinity of Honokōhau Harbor and Kailua Bay (Figure #) may suggest anthropogenic influence on the distribution of octocoral in West Hawai’i. Published studies have suggested that octocorals may be indicators of pollution (Baker and Webster 2010, Hernandez-Munoz et al. 2008). With the planned increase in development in these areas and the possible associated rise in point source pollution further investigation into octocoral distribution and its potential as a pollution indicator is suggested.

An analysis of octocoral percent cover changes between 2003 and 2007 showed no statistically significant change in all but one of the West Hawai’i sites where octocoral has been recorded. Papawai Bay declined from 18.2% to 10.9% (P=.018).
The next benthic surveys to be conducted in early 2011 will permit octocoral percent cover comparisons of the 6 sites that were added after 2003.

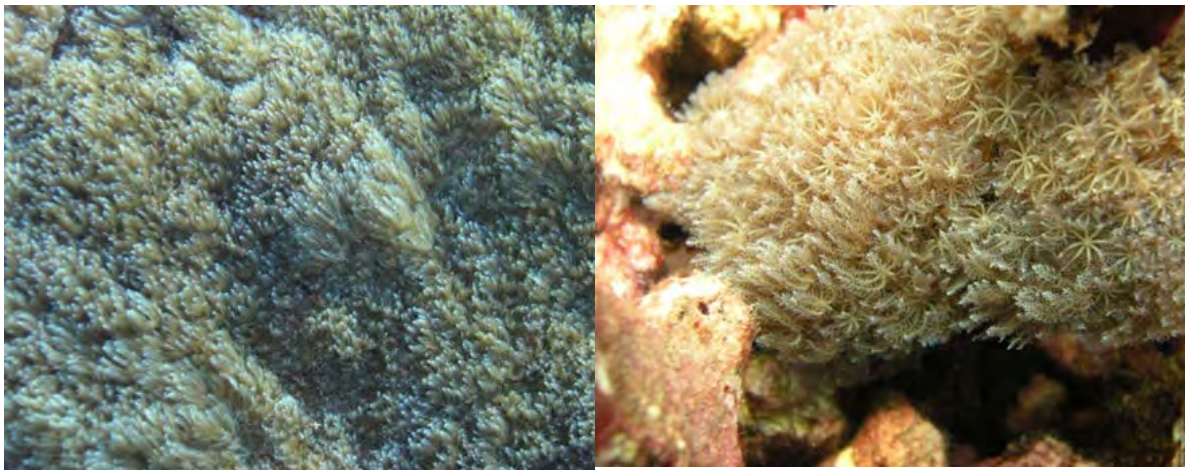


Figure 38. *Sarcothelia edmonsoni* (left) and another unidentified octocoral found on West Hawai'i reefs.

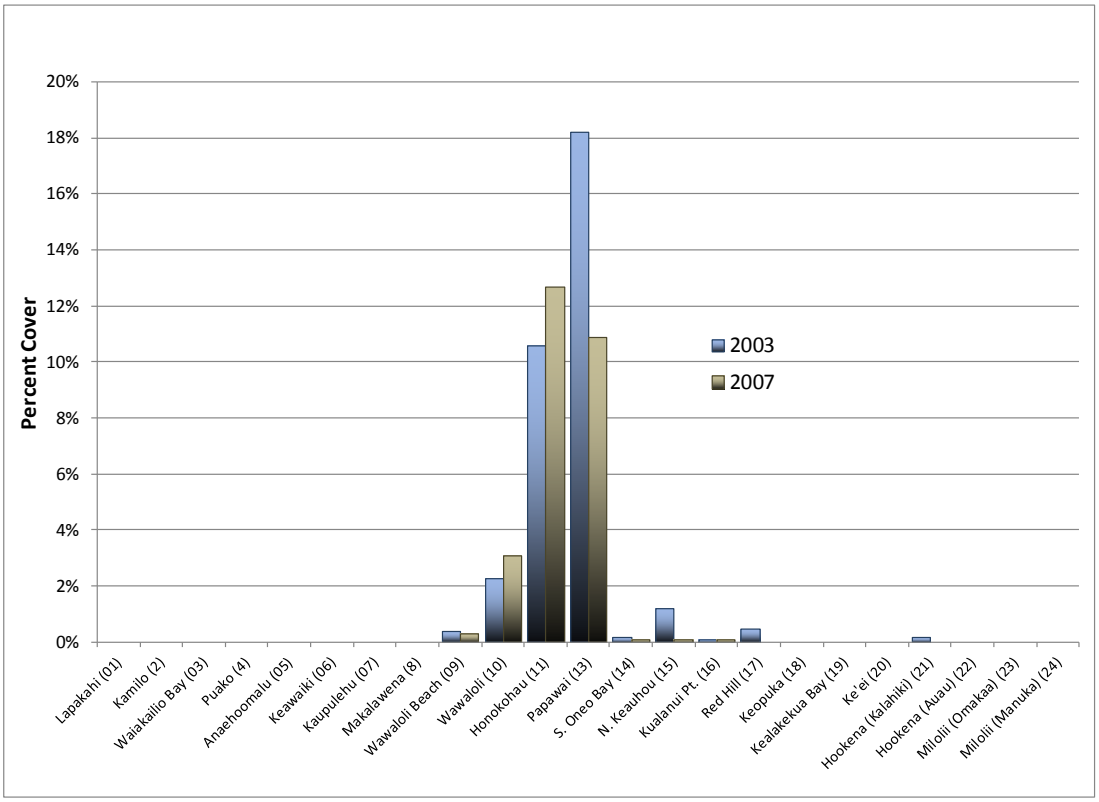


Figure 39. Comparison between survey years of percent cover of octocoral across West Hawai'i monitoring sites.

Coral Disease

Methodology

Coral disease surveys were conducted at 28 West Hawai'i sites, and at Okoe and Hōnaunau Bays. Surveys were conducted from March to July 2010 by four survey divers: Courtney Couch (Cornell University), Camille Barnett (DAR), Kara Osada-D'Avella (DAR), and Linda B. Preskitt (DAR). Two permanent transects were surveyed at each site.

Field surveys

An area of 1 x 25 meters was surveyed for coral disease along each transect. Larger areas were surveyed at sites with low occurrences of disease, while (due to time constraints) the full 25 m^2 was not surveyed at several sites with high disease frequency. Disease assessment included all corals within the survey area inspected for signs of trematodiasis, growth anomalies, tissue loss syndrome, multifocal tissue loss, hypermycosis, and other progressive conditions. When disease was present, colony size and species were recorded along with the number, size, shape and color of the lesion(s) observed. All diseased colonies were photographed and described, excluding colonies with only *Porites* trematodiasis. In addition, 1-2cm fragments from diseased coral colonies were sampled for histological analyses, helping to further differentiate between tissue loss and biological interactions (e.g. predation).

Colony assessment

Colony counts were conducted in conjunction with coral disease surveys. For each transect line, a 1 x 10 meter area was surveyed with the aid of a 1m square quadrat. Each coral colony within the survey area was recorded to species level and assigned to one of seven size classes; 0-5cm, 5.1-10cm, 10.1-20cm, 21.1-40cm, 41.1-80cm, 81.1-160cm and >160cm.

Calculations and Analyses

We calculated mean colony density (colonies/m^2) for each site by averaging the number of colonies of each genus on both transects and dividing by the average area surveyed for each site. Mean colony density was then multiplied by the area surveyed for disease to obtain estimated number of colonies. At each site we calculated total estimated disease prevalence for each disease as follows: (total no. cases of a specific disease for the genus) ÷ (estimated number of colonies for the genus). Total disease prevalence for each site was calculated using the method described above using total number of colonies and total number of diseased cases for each site (all genera combined).

In 2007, Dr. Greta Aeby and Steve Cotton (DAR) conducted initial coral disease surveys at 10 WHAP sites (Table 8) (DAR 2007). This dataset was compared with data collected in 2010 to assess changes in coral disease frequencies. Prevalence (% of diseased colonies per site) data between the two surveys were not comparable due to substantial differences in colony counts between 2007 and 2010, with significantly more small colonies (colonies <10cm) counted in 2010 than 2007. This difference was believed to be due to observer changes rather than biological changes. Therefore, data were compared using disease abundance per m^2 rather than disease prevalence.

Coral disease prevalence data were non-parametric; therefore Spearman rank correlation analyses were employed. Paired t-tests were used for comparisons of disease per m^2 between 2007 and 2010 surveys at ten WHAP sites (JMP® v8.0.2.2, ©2009 SAS Institute Inc.)

Results

Coral disease by size class

Coral diseases were observed across all colony size classes, with the greatest percentages of disease cases occurring in the larger size categories (Figure 40). Coral colonies less < 5cm accounted for 18% of total colonies (18.3% of *Porites* spp.) recorded in count surveys, yet accounted for only 1% of the total cases of diseased colonies (1.1 % of *Porites* spp.). These findings imply West Hawaii's small corals (<5 cm) are less susceptible to disease than the larger and subsequently older colonies. Linear growth rates of coral colonies are both species and size specific, and are affected by a suite of environmental factors such as depth, temperature, light irradiation and latitude.

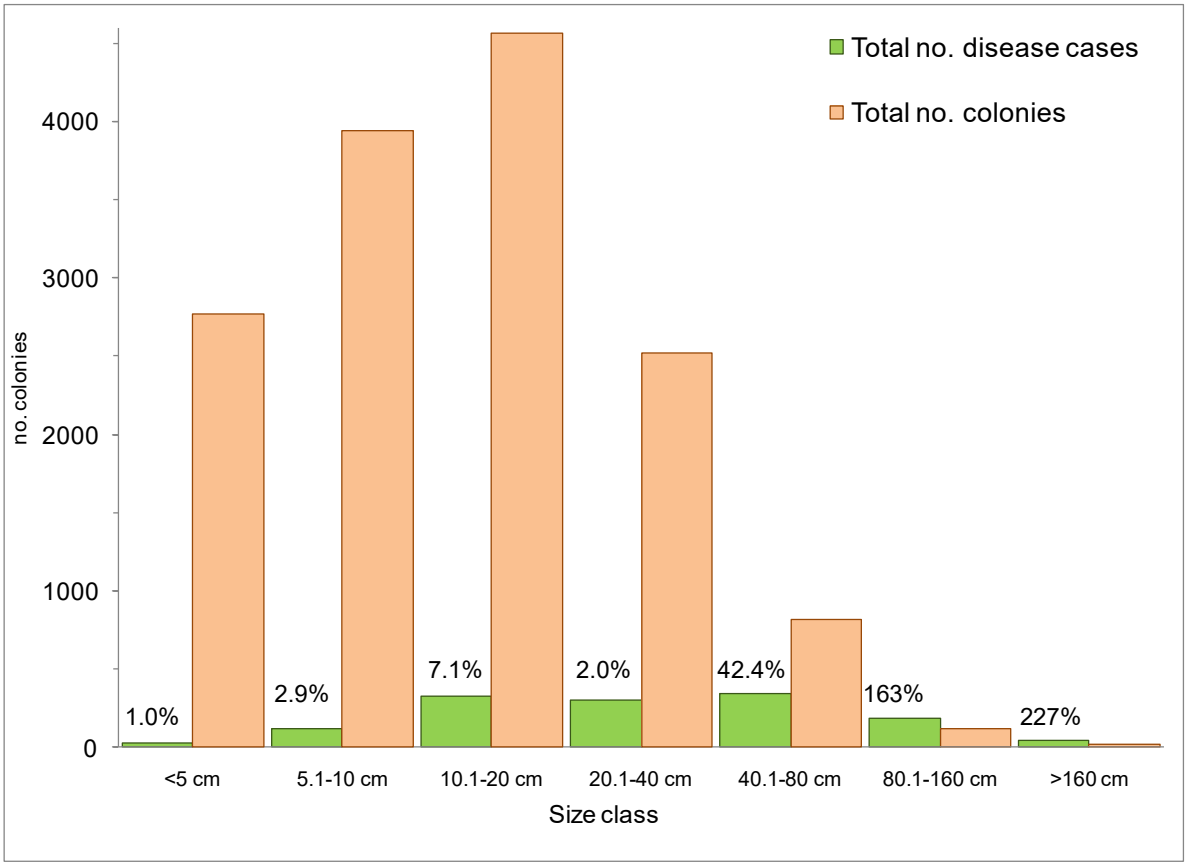


Figure 40. Size structure of coral colonies recorded in West Hawai'i during surveys conducted in 2010. Percentages reflect % of diseased colonies recorded within each size class.

Therefore it is difficult to age colonies based on size. Given an overall slow growth rate (ranging from 7.4 – 16.7 mm/yr.) of the dominant reef builder *Porites* and the relative contribution of gametes that large colonies provide, it is important to continue monitoring coral disease prevalence as they may have long-term effects on coral populations and community structure (Rodgers & Cox 2003; Forsman et al. 2006, Richmond 1987; Grigg & Maragos 1974, Lough & Barnes 2000).

Why more diseased colonies than total colonies recorded?
Larger colonies tended to occur near the end of survey lines, therefore the number of diseased colonies are greater than total colonies counted due to the methodology employed; coral colonies were counted and sized for the first 10m of each transect, while disease assessments were made along the full 25m line.

Coral community structure

Percent coral cover varied across surveyed sites, ranging from 11.5% at Site 1 (Lapakahi) to 62.0% at Site 14 (South Oneo Bay) (Appendix C). Within all monitoring sites, Poritids were the most abundant corals, while densities of other coral genera were variable across sites. Coral colony density was not significantly related to percent coral cover (Spearman $p = -0.2626$, $p > 0.1$). Rather, high coral density reflects an abundance of small colonies (Figure 40).

Spearman rank correlations revealed significant negative relationships between overall colony density and total disease prevalence ($\rho = -0.5276$, $p = 0.0033$). However, total disease prevalence was positively related to percent coral cover ($\rho = 0.4291$, $p = 0.0202$). In other words, higher disease prevalence was observed on reefs with high coral cover and lower colony density, which is likely due to the increase in disease susceptibility with colony size.

When relationships were analyzed by genus, *Porites* followed the same trend as described above. *Porites* growth anomalies and *Porites* tissue loss syndrome were positively correlated with percent cover of *Porites sp.* ($\rho = 0.4444$, $p = 0.0178$ and $\rho = 0.3804$, $p = 0.0458$) and negatively related to Poritid density ($\rho = -0.7200$, $p < 0.001$ and $\rho = -0.5600$, $p = 0.0016$). Frequency of *Porites* diseases may be attributed to the dominance of Poritid corals in West Hawai‘i reef communities possibly allowing the spread of pathogens or creating a susceptibility to disease within the genus.

Diseases in West Hawai‘i

At 30 sites surveyed in West Hawai‘i, the following diseases were recorded within each specified genus: growth anomalies (GA) of Poritids and Montiporids, *Porites* trematodiasis (TRE), tissue loss syndrome (TLS) within *Porites* and *Pocillopora*, *Porites* multifocal tissue loss (MFTL), and hypermycosis (HYP) of *Pavona* (Figure 41).

The above diseases have been previously described (Coral Disease Working Group 2007, Williams et al. 2010), however we observed a number of cases of a distinct type of tissue loss in *Pocillopora meandrina*. The lesion was characterized by progressive tissue loss from one side of the colony with old algae-covered skeleton grading into recently denuded skeleton to sloughing and into apparently healthy tissue. The tissue loss appears to originate and progress from the base of each branch, with a clear band of freshly denuded skeleton at the lesion margin. We also recorded cases of possible

Pocillopora senescence. This condition is common along West (C. Couch pers. obs.) and East Hawai‘i (B. Vargas-Angel pers. comm.) In most cases colony death originates on one side of the colony and progresses across the colony. Algal covered skeleton is adjacent to paled/bleached tissue, which grades into “normally” pigmented tissue. Samples sent to United States Geological Survey (USGS) Biological Resources Division for analyses revealed atrophy, appearing to be a senescence reaction (or progressive death of the colony, perhaps due to age) (Figure 41).

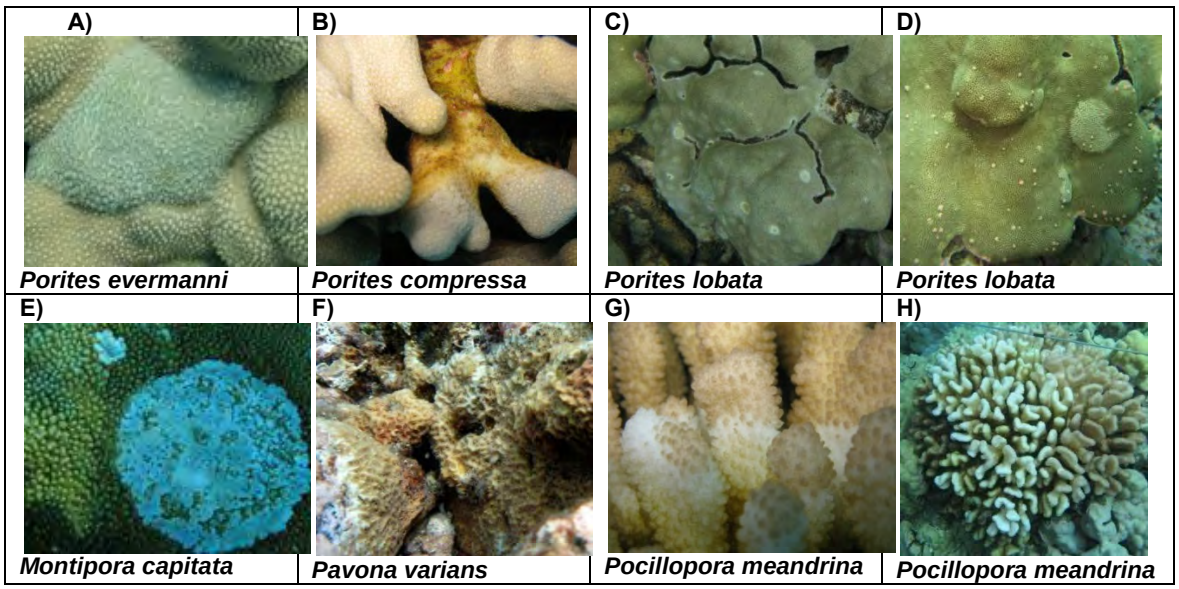


Figure 41. Examples of coral diseases observed in West Hawai‘i during 2010 baseline surveys: A) *Porites* growth anomaly, B) *Porites* tissue loss syndrome, C) *Porites* multifocal tissue loss, D) *Porites* trematodiasis, E) *Montipora* growth anomaly, F) *Pavona varians* hypermycosis, G) *Pocillopora* tissue loss, H) possible senescence reaction.

Disease distribution and prevalence

Consistent with previous coral disease assessments in the Main Hawaiian Islands (Aeby and Cotton 2007, Williams et. al 2010), *Porites* was the most susceptible genus to disease, having the highest disease prevalence (3.76 ± 3.58 %) and most types of diseases compared to other genera. The most widespread diseases observed were growth anomalies, trematodiasis, and tissue loss of *Porites spp*. (Table 8 Figure 42, Appendix A)

Table 8. Occurrence of diseases across ten monitoring stations in survey years 2007 and 2010 in West Hawai'i. Presence during only one survey year is noted by the year when it was observed, with "X" denoting presence for both survey years.

Disease	SITE 3	SITE 4	SITE 5	SITE 8	SITE 97	SITE 11	SITE 15	SITE 17	SITE 19	SITE 20
Porites trematodiasis	2007	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Porites tissue loss	**X**	2010	2010	**X**	2007	**X**	**X**	2007	**X**	**X**
Porites multifocal tissue loss		X	2007							2010
Porites growth anomaly	2010	**X**	**X**	**X**	2007	**X**	**X**	**X**	**X**	**X**
Pavona hypermycosis		2010		2010					2010	
Montipora white syndrome				2007						
Montipora growth anomaly			2007	**X**	2010					
Pocillopora senescence reaction					2010					
Pocillopora tissue loss										

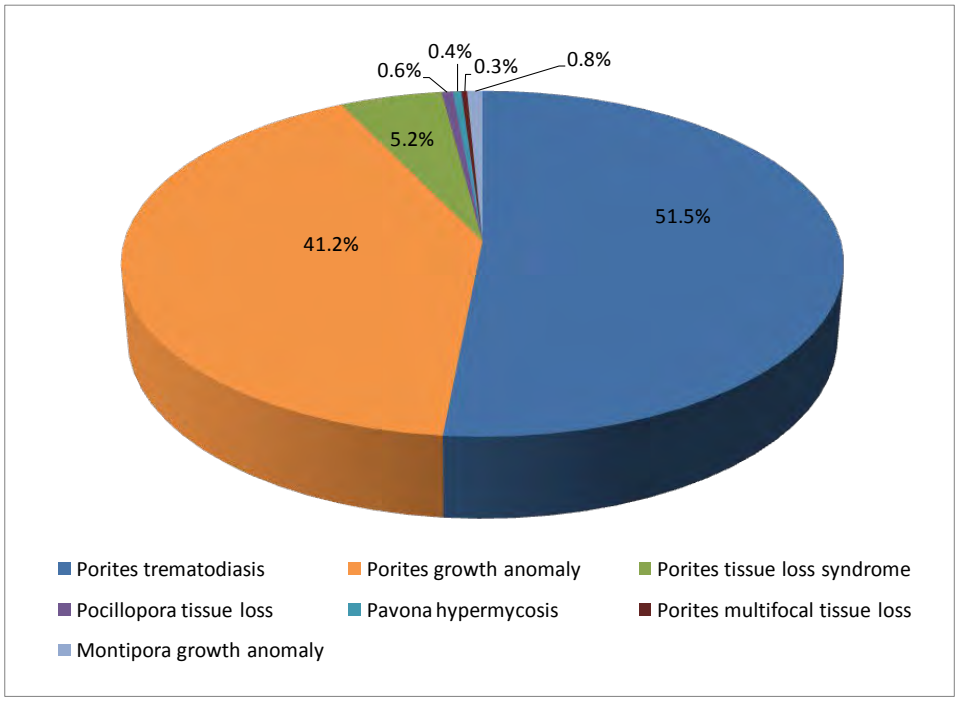


Figure 42. Relative abundance of coral diseases recorded for DAR monitoring sites in West Hawai'i during surveys conducted in 2010.

Although *Porites* growth anomalies were found at all but two sites (Sites 6, Keawaiki and Site 97, Unualoha Pt.), mean prevalence across all sites was low (1.83 ± 2.15 %),

ranging from 0.02 % at Site 10 (Wawaloli Beach) to 7.81% at Site 11 (Honokōhau) (Figure 43).

Porites trematodiasis, the second most common disease, was found at all but the following four sites: Site 2 (Kamilo Gulch), Site 3 (Waiakaʻilio), Site 18 (Keopuka), and Site 21 (Kalahiki Beach). Mean prevalence across all sites was low (1.71 ± 2.17%), ranging from 0.05 % at Site 1 (Lapakahi) to 9.03% at Site 8 (Makalawena) (Figure 43). Porites tissue loss syndrome occurred at all but the following sites: Site 1 (Lapakahi), Site 6 (Keawaiki), Site 7 (Kaʻupulehu), Site 97 (Unualoha Pt.), and Site 17 (Red Hill). Mean prevalence across all sites was low (0.21 ± 0.18 %), ranging from 0.02 at Site 10 (Wawaloli Beach) to 0.65 % at Site 23 (Omakaʻa Bay) (Figure 43).

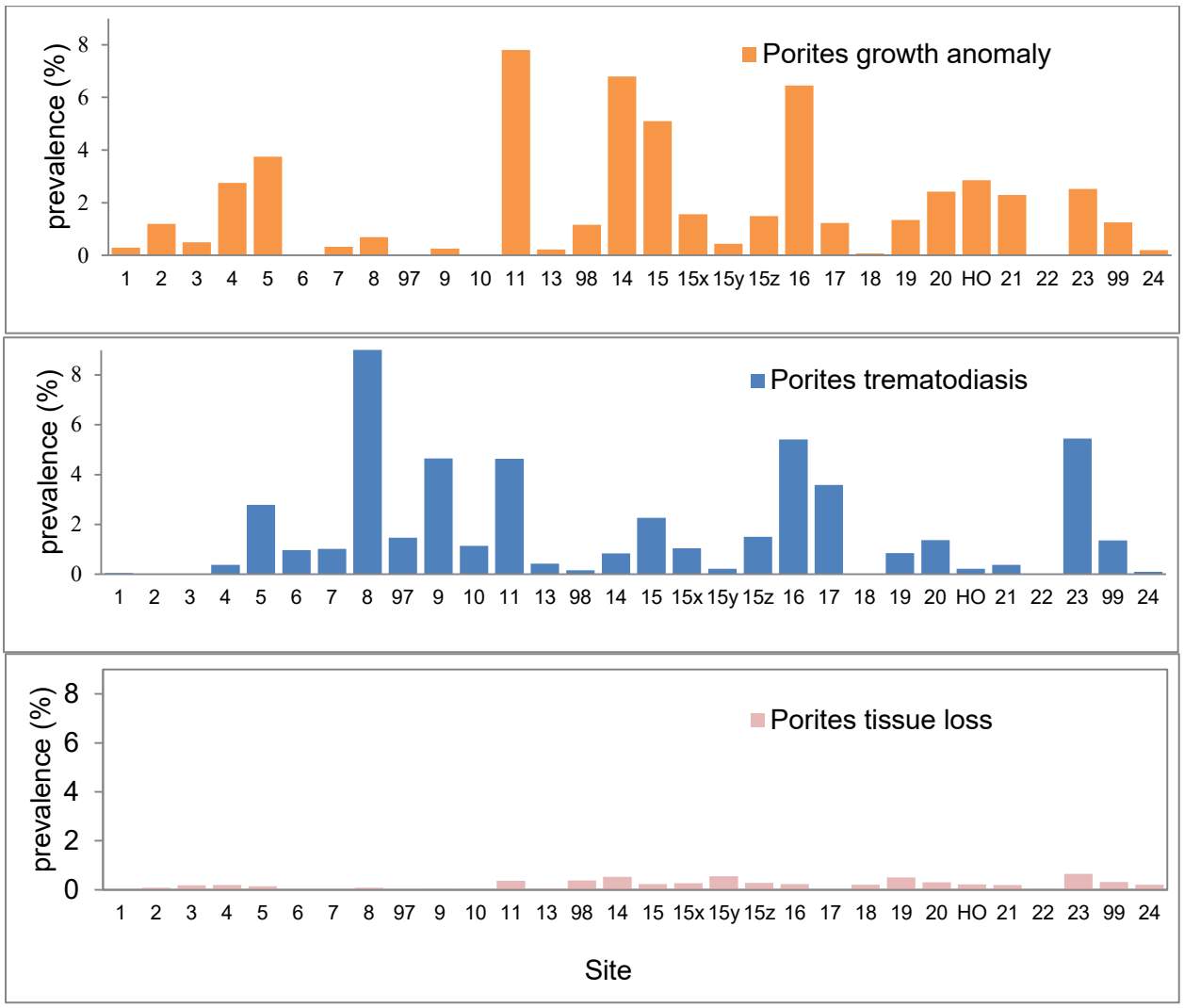


Figure 43. Prevalence of Poritid diseases at each West Hawaiʻi site surveyed in 2010.

Although possible senescence reaction of *Pocillopora meandrina* appears commonly in West Hawai‘i (see section entitled Diseases in West Hawai‘i), this condition was observed at only two sites: 97 (Unualoha Pt.) and 22 (Ho‘okena). This infrequent documentation of cases is likely attributed to the low number of Pocilloporids occurring at DAR monitoring sites, as *P. meandrina* accounts for an average of 0.83% of total coral cover at WHAP sites

Spatial Patterns

Anthropogenic impacts such as coastal pollution are hypothesized to result in physiological stress and altered host-pathogen interactions, leading to changes in coral health and coral reef community structure (Harvell et al. 2007). While the mechanisms underlying the link between coral disease and water quality are poorly understood, diseases such as growth anomalies have been positively associated with high human use and impaired water quality in the Pacific (Yamashiro et al. 2000, Kaczmarsky 2009, Aeby et al. in review).

Due to Hawai’i’s highly porous basaltic rock, terrestrial inputs are transported rapidly through submarine groundwater (Knee et al. 2010). Data collected by Johnson (2008) documented areas with submarine groundwater discharge (SGD) “plumes” between Kawaihae and Hōnaunau. Disease prevalence at DAR monitoring sites was analyzed in relation to these SGD plumes (data were available for a total of 14 monitoring sites within the region documented).

Overall disease prevalence and prevalence of *Porites* growth anomalies were positively correlated with total estimated size of SGD plumes (total prevalence $r = 0.460$, $p = 0.098$, *Porites* GA $r = 0.586$, $p = 0.028$) and number of SGD plumes (total prevalence $r = 0.612$, $p = 0.020$, *Porites* GA $r = 0.744$, $p = 0.002$) located within the vicinity of each site (<1.5 km). These results show high nutrient loading may be affecting West Hawai’i’s coral health.

Additionally, sites surveyed in West Hawai‘i show a significant negative relationship between disease prevalence and distance from harbors/boat ramps (overall disease prevalence: $r = -0.402$, $p = 0.028$) (Figure 44). The most frequently occurring diseases, *Porites* growth anomalies and *Porites* tissue loss syndrome showed decreased prevalence with greater distance to these usage areas (*Porites* GA $r = -0.701$, $p = 0.0001$, *Porites* TLS $r = -0.658$, $p = 0.0001$). Similar to previous findings, the distribution of *Porites* trematodiasis, a disease known to be transmitted by fishes, particularly corallivores, was not associated with these locations (Aeby 2007).

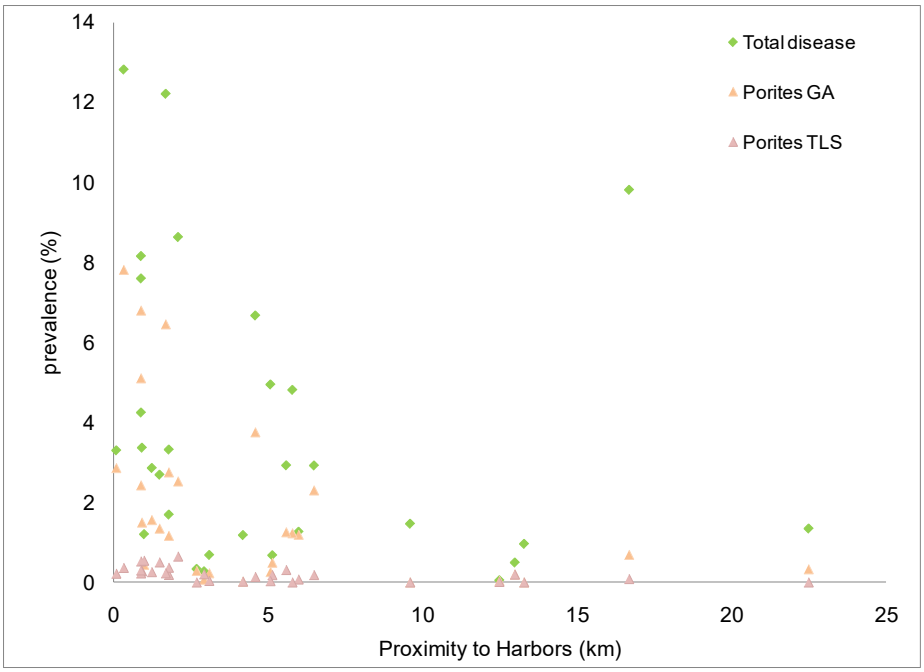


Figure 44. Disease prevalence in relation to site distance from harbors/boat ramps in West Hawai'i for overall disease prevalence (r = -0.402, p = 0.028), *Porites* growth anomalies (GA) (r = -0.658, p = 0.000) and *Porites* tissue loss syndrome (TLS) (r = -0.701, p = 0.000).

Prior studies have also found relationships between abundances of reef fish and prevalence of particular coral diseases. Various fishes are known to impact corals directly (such as the grazing of parrotfish) as well as transmit diseases (such as corallivorous butterflyfish) (Williams et al. 2010). Aeby et al. 1998 also found the highest trematodiasis at sites with intermediate percent coral cover. Using fish abundance data from WHAP surveys, sites were compared for Poritid disease prevalence to corallivorous butterflyfish and parrotfish abundances. However, no statistically significant relationships were found between these fish groups and coral disease prevalence for West Hawai'i's reefs.

Temporal comparisons

Comparisons of disease density (instances per square meter) between 2007 data and 2010 revealed no significant changes in disease densities between survey years (t = -1.46, p = 0.18). Though changes were not significant, *Porites* trematodiasis slightly increased at most sites (Figure 45).

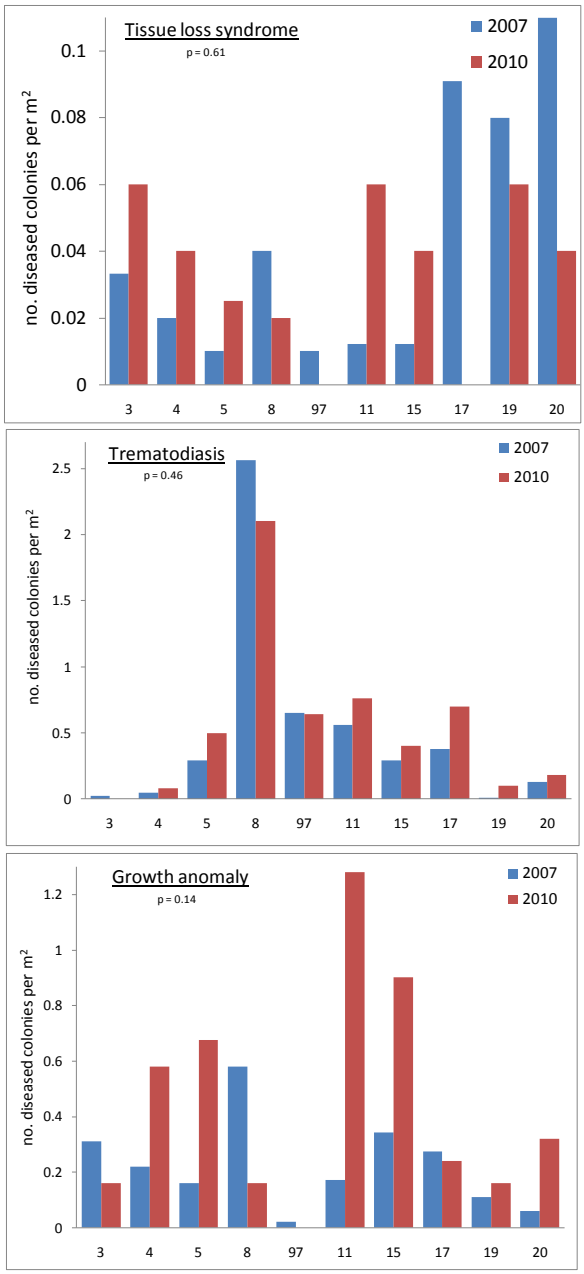


Figure 45. Comparison between survey years (2007 vs. 2010) of diseased colony densities for three types of Poritid conditions at 10 sites in West Hawai'i.

Instances of *Porites* growth anomalies and *Porites* tissue loss syndrome increased (though not significantly) at four sites: Sites 4 (Puakō), 5 (Mauna Lani), 11 (Honokōhau) and 15 (Keauhou). Each of these sites is located in close proximity to harbors and boat ramps. As described in the previous section, diseases have been positively associated with high human use.

Although no significant change in disease frequency was found, the change in presence or absence of two diseases was noted. *Montipora* white syndrome was not recorded in surveys in 2010, though one case was recorded in 2007. *Pocillopora* tissue loss

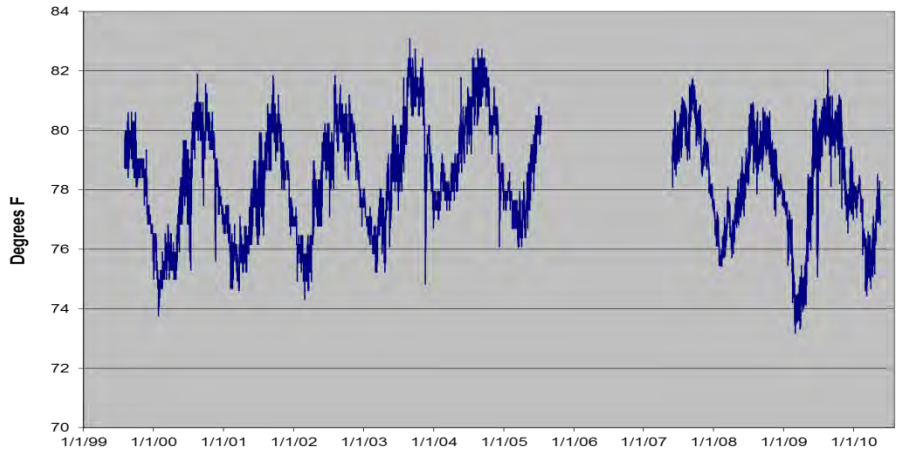
(including senescence reaction) and *Pavona varians* hypermycosis were not recorded in 2007 surveys, but occurred at multiple sites in 2010. For *Pavona varians* hypermycosis, this includes some sites previously surveyed (Table 8).

Temperature data

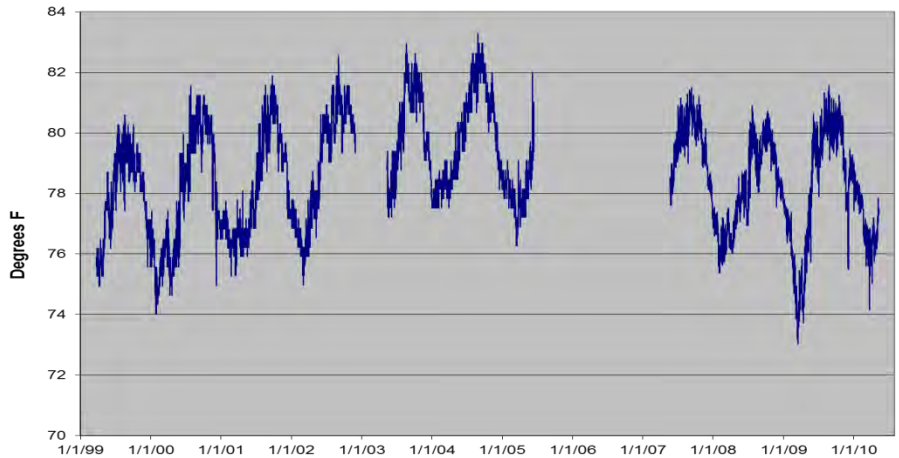
Hobo® temperature loggers (Onset Computer Corporation) were initially deployed at all West Hawai'i Fish Replenishment Area (FRA) sites (Figure 46). They were attached via cable tie to a coral head in the immediate vicinity of the center transect pin. Due to various circumstances including loss and flooding (i.e. multiple Hobo® Water Tem Pro units) a complete temperature record over the last decade is not available for any site. Fortunately fairly comprehensive temperature data exists for several West Hawai'i sites including a northerly site (Waiaka'ilio), a southerly site (Miloli'i) and a central site (Ke'ei) (Figure 47).

Examination of the temperature data reveals a marked similarity in water temperatures along coastal sites separated by considerable distances. From 1999 to 2005 there was a clear trend of increasing water temperatures along the West Hawai'i coastline. Over this 6 year period water temperatures increased by 1.8-2.7°F. For comparison, surface water temperate records at Koko Head, O'ahu indicated an increase of 1.4°F over a 50 year period (NMFS + IGLOSS corrected data provided by Paul Jokiel). Trend analysis suggested that if West Hawai'i water temperatures continued to increase unabated, the lethal thermal limit for corals (i.e. 30 day exposure to mean water temperature of 29.6°C) would likely be reached within a decade. The good news is that waters have not continued to increase and actually have decreased over the past several years.

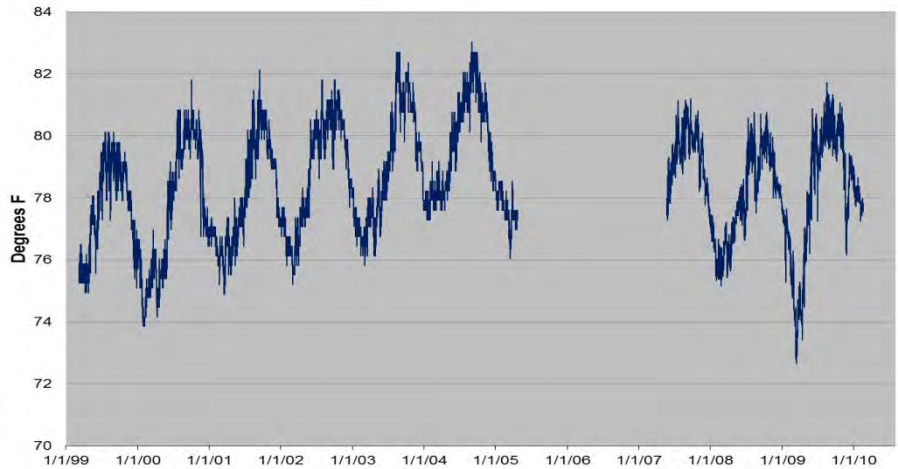
The most recent El Niño event to occur began in June 2009, peaked in November and December of the same year and waned in March 2010. It was effectively over by June 2010 (Jet Propulsion Laboratory http://sealevel.jpl.nasa.gov/science/elninopdo/elnino/). Although El Niño periods are characterized by warmer than usual equatorial waters, West Hawai'i coastal waters were only marginally warmer than the preceding two years. Mean water temperatures for the four month period of Oct 09-Jan10 was 78.9°F which was only 0.4 - 0.5°F warmer than the previous periods (Oct-07-Jan 08 = 78.5°F; Oct 08-Jan 09 = 78.6°F). Examination of the temperature records also shows that water temperatures in several of the previous years (e.g. 2004/2005) were generally higher than during the recent El Niño event.



Waiaka'ilio FRA



Ke'ei FRA



Miloli'i FRA

Figure 46. Temperature (°F) records for three West Hawai'i FRAs.

Fish Survey Methodology

Although the DAR fish survey protocol for West Hawai'i was initially designed to focus primarily on species which are the principal targets of the aquarium fishery it has proven to be a highly useful methodology for general coral reef monitoring and has been adopted by DAR for monitoring on other islands. It's important to note that all fishes are censused, whether they're aquarium species or not. While the protocol is particularly effective for assessing recruits, smaller site-oriented species and those not wary of divers; it also provides highly useful information on other groups including predators, invertebrates and "food" fishes. The specifics of the methodology are detailed in the O'ahu section (pg. 13).

DAR monitored 23 sites in West Hawai'i (Figure 2) bi-monthly, for a total of six surveys per year (five in 2000 due to logistic problems) until Jan. 2005 when the project was revamped at which time surveys became quarterly.

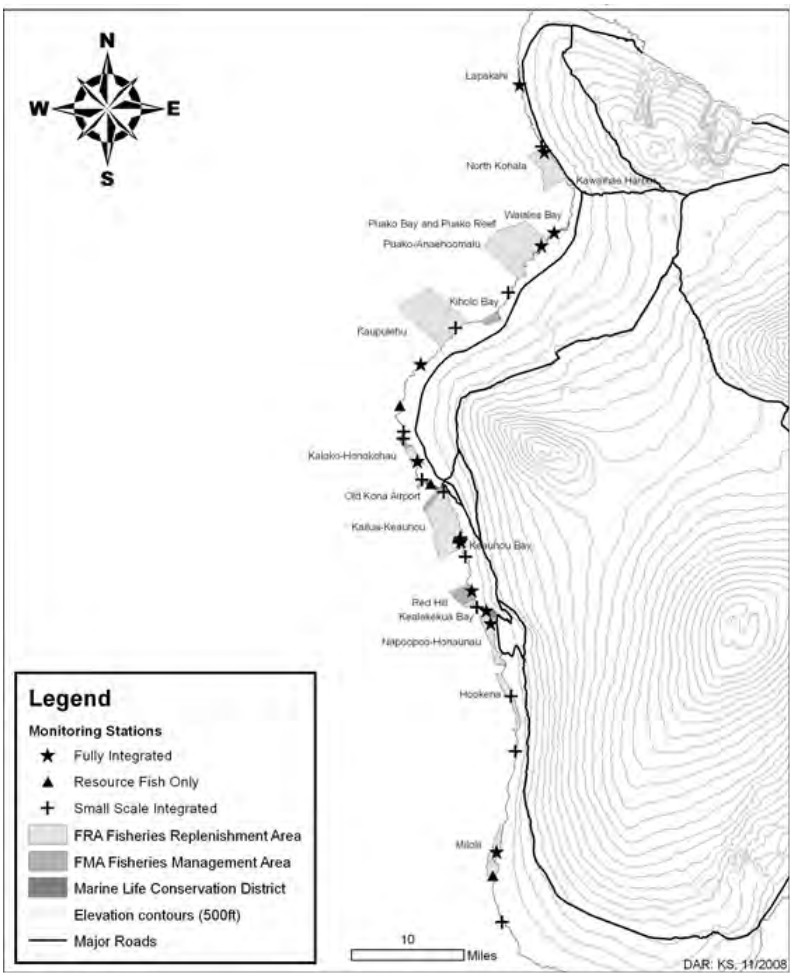


Figure 47. West Hawai'i monitoring sites.

These fixed transect surveys are noted as 'small scale' surveys in Table 9. Similar monitoring has also been conducted at three sites in East Hawai'i although on a less systematic schedule.

In addition to the transect surveys, a 10 minute 'free-swim' survey is also conducted by two divers in the areas surrounding the fixed transects. The purpose of this survey is to increase the ability to census uncommon or rare species and species of particular ecological interest such as cleaner wrasse (*Labroides phthirophagus*), ta'ape (*Lutjanus kasmira*), roi (*Cephalopholis argus*), crown-of-thorns (*Acanthaster planci*) and all species of terminal phase parrotfishes. Recording of species during the timed free-swim survey that were not observed on the transect surveys augments a site-specific species list.

In order to obtain better data on fish species that are heavily harvested and in demand for both subsistence, recreational and commercial food fisheries (i.e. 'resource fish') an enhanced monitoring protocol was newly implemented in 2005 at all new survey sites and at a number of existing monitoring sites (Table 9). 'Resource fish' are surveyed by a pair of divers swimming in parallel (10m apart), following a depth contour, for a five minute period. Each diver records all 'resource fishes' (main fishery target species) >15cm within a 5m wide belt. Rare, skittish or uncommon fishes such as sharks, rays or carangids which are observed any time throughout the survey dive are noted. Starting points for this survey are based on existing center pin site coordinates. End points are delimited by a diver deploying a surface float at the completion of the 5 minute survey. Sites which include all three types of monitoring are termed "Integrated" (Table 9).

Table 9. West Hawai'i monitoring sites with corresponding coordinates, status and survey type (INT=Integrated monitoring, SS=Small scale, RF=Resource fish only)

Site	District	Latitude	Longitude	Mean Depth (m)	Status	Type
Lapakahi	N. Kohala	20.1600000	-155.9001833	12.1	MLCD	INT
Kamilo Gulch	N. Kohala	20.0810167	-155.8680833	12.8	Open	SS
Waiaka′ilio	N. Kohala	20.0739167	-155.8645167	13.4	FRA	INT
Puakō	S. Kohala	19.9698833	-155.8488000	9.2	FMA	INT
'Anaeho′omalu Bay	S. Kohala	19.9527500	-155.8661667	10.0	FRA	INT
Keawaiki	N. Kona	19.8911167	-155.9100667	13.3	FRA	SS
Ka′upulehu	N. Kona	19.8439500	-155.9809667	11.4	Open	SS
Makalawena	N. Kona	19.7965000	-156.0328833	10.2	FMA	INT
Ho′ona / Unualoha Pt.	N. Kona	19.7425100	-156.0557500	12.4	Open	INT
Wawaloli Beach	N. Kona	19.7088833	-156.0494951	9.8	Open	SS
Wawaloli	N. Kona	19.7000100	-156.0499100	13.6	Open	SS
Kaloko-Honokōhau	N. Kona	19.6709833	-156.0303333	13.1	FRA	INT
Papawai	N. Kona	19.6472500	-156.0229833	10.4	FMA	SS
Old Kona Airport	N. Kona	19.6421200	-156.0121000	12.2	MLCD	RF
S. Oneo Bay	N. Kona	19.6312000	-155.9930000	12.0	FRA	SS
Keauhou	N. Kona	19.5683833	-155.9693500	12.0	FRA	INT
Keauhou X	N. Kona	19.5733666	-155.9694666	11.6	FRA	SS

Keauhou Y	N. Kona	19.5698000	-155.9703666	15.2	FRA	SS
Keauhou Z	N. Kona	19.5670166	-155.9712666	16.5	FRA	SS
Kualanui Pt. (Red Hill)	N. Kona	19.5482667	-155.9623000	11.3	Open	SS
Red Hill	S. Kona	19.5052833	-155.9528833	13.9	FRA	INT
Keopuka	S. Kona	19.4829167	-155.9460000	10.3	Open	SS
Kealakekua Bay	S. Kona	19.4793000	-155.9327833	8.0	MLCD	INT
Ke′ei	S. Kona	19.4628167	-155.9268000	11.5	FRA	INT
Ho′okena (Kalahiki)	S. Kona	19.3691500	-155.8974000	11.1	FRA	SS
Ho′okena (Auau)	S. Kona	19.2978833	-155.8898833	13.6	Open	SS
Miloli′i/Honomalino	S. Kona	19.1673000	-155.9132500	12.3	FRA	INT
Okoe Bay	Ka'u	19.6421200	-156.0121000	16.5	FRA	RF
Manukā	Ka'u	19.0767167	-155.9039667	12.0	Open	SS

Shallow Water Resource Fish Surveys

Shallow water resource fish surveys collect data on the abundance of resource (desired) fish species in shallow water habitats where they are typically most abundant during the day in West Hawai′i. These surveys were designed to be comparable with our standard

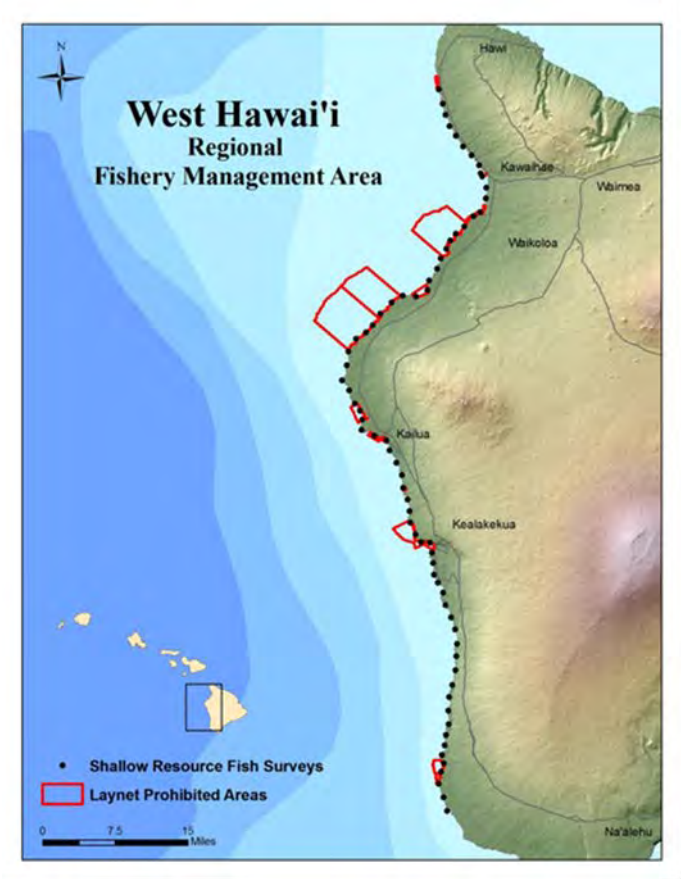


Figure 48. Map showing locations of West Hawai'i shallow water resource fish surveys and laynet prohibited areas.

resource fish surveys occurring in mid-depth habitats, and thus the methodology is very similar. As with the other resource fish surveys, distance covered is measured for every survey so that data can be analyzed on a per unit area basis. Initially 72 sites were selected evenly distributed along the coastline in 2-6m of water between our northern and southernmost permanent study sites (Figure 48). Using a GIS (ArcGIS 9.2), the 72 points were overlaid on a NOAA habitat map for the purpose of adjusting any sites that did not fall on hard-bottom habitat. Direction taken for the survey was predetermined when habitat was an issue. Otherwise survey direction (north or south) from the start point was determined in the field. Each site is surveyed only once.

The survey consists of a timed 10min swim along the coastline with divers being careful to remain in the target depth of 2-6m. When the survey is finished, the boat captain records an end point so that the distance covered can be later calculated. The dive team consists of two divers both surveying a single 5m wide belt. One diver is counting surgeonfish, goatfish, and introduced species above 15cm except for *Acanthurus achilles* and *A. triostegus* for which individuals above 10cm are recorded. The other diver counts parrotfish, wrasses, other resource fish, and selected rare butterflyfish of interest. Large predatory fish appearing off transect are also recorded.

Adult Yellow Tang surveys

To supplement data from the long-term monitoring program and to investigate the possibility of ‘spillover’ of adult fish from existing protected areas, we survey adult yellow tang populations in their prime daytime habitat, i.e. the deep edge of the shallow pavement zone around 3 to 6 m deep. Along the West Hawai′i coast, shallow pavement areas generally have a distinct deep boundary where the main reef slope begins and where coral cover increases rapidly, and therefore the target habitat zone for our surveys was mostly well defined. Recognizing that adult yellow tang have highly clumped distributions, we developed a survey approach which allows divers to count yellow tang over long transects running approximately parallel to shore through the prime adult habitat.

There are 4 AYT sites within FRAs, 4 within long-term protected areas (LTP); and 8 in open, i.e. fished, areas. As adults have daily movements between diel and night time areas of up to at least 800 m we assumed that there could be spillover across protected area boundaries over at least that scale. We therefore established 4 open sites as ‘boundary’ sites, centered < 1 km from the nearest protected area boundary, and 4 as ‘open’ sites with mid-points > 2 km from the nearest boundary. Each area was surveyed 5 times in 2006 and 6 times in 2010 and analysis of the latest data will commence in the new year. The survey technique and initial findings of significant spillover of yellow tang from protected to open areas is contained in Williams et al. 2009.

Depth Stratified Random Surveys

In response to a long standing conflict between aquarium fish collectors and the local community at Ka′ohe (Pebble Beach), South Kona, a DLNR community advisory group, the West Hawai′i Fisheries Council (WHFC) recently recommended that the area at Ka′ohe be closed to aquarium collecting. To maintain the existing balance of open and closed areas the WHFC also recommended that a similarly sized protected area be opened at to collecting Keauhou which is presently in an FRA. Considerable

disagreement ensued however surrounding the nature and abundance of the resources within the proposed open area so DAR embarked on an effort to accurately assess the populations of a number of species of interest. 72 random, depth stratified, surveys were conducted at Keauhou (Figure 49) in July 2008 to derive area population estimates. Survey methodology closely follows the methodology described above for 25m fixed transects but with two rather than four 25mX4m transects at each random point. The Keauhou survey was repeated in August 2010 and similar surveys have been conducted at Ka'upulehu (August 2009) and Red Hill (April 2009).

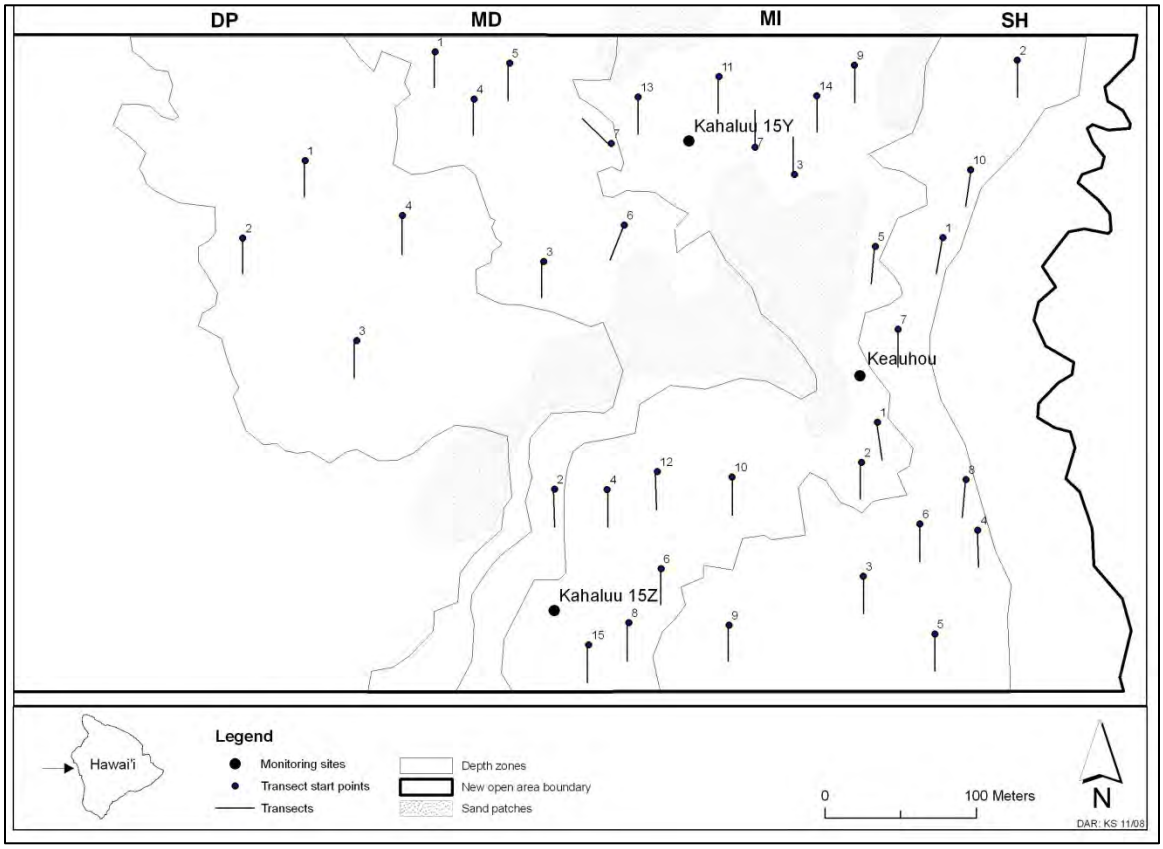


Figure 49. Map showing the locations of Keauhou stratified random fish population survey sites. The stratified depth zones are as follows: DP=24-30m, MD=18-24m, MI=9-18m, SH=3-9m.

Retrospective Surveys

Several long-term retrospective surveys, primarily directed at fish populations, are being conducted at 3 West Hawai'i sites. The sites and the date of the initiation of the original surveys are as follows: Puako, South Kohala (1979), Ke'ei, South Kona (1978) and Honaunau, South Kona (1975). So that new data is comparable with historical data, the same transect locations and survey methodologies are employed as in the original studies. Methods vary by locations, but all are based on standard dimension belts or search areas. Additional benthic data are also being collected. This work is presently under analysis.

Fish Surveys Results

West Hawai'i

Fishes on West Hawai'i reefs may be regarded as falling into three groups based upon human utilization. Resource or 'food' fish such as jacks (Carangidae), goatfishes (mullidae) and parrotfishes (Scaridae) are those targeted for food by recreational and commercial fishers. Aquarium fish are those which are harvested, usually in the smaller size classes, by commercial aquarium collectors Although there are some species which fall into both groups (e.g. kole, *Ctenochaetus strigosus* and Achilles tang, *Acanthurus achilles*) for the present study these are classified solely as aquarium fishes. The third group ('other') is species which are harvested neither for food nor for aquaria.

The overall number of 'other' fishes, those which are not substantially harvested for either food or for the aquarium trade, did not change significantly at West Hawai'i sites over the last 11 years although individual species within this group may have. In contrast, the abundance of both aquarium and food fishes increased significantly over the same time period (Figure 50). For aquarium fishes it is clear that a substantial part of the increase in overall numbers is due to the implementation in 2000 of a network of

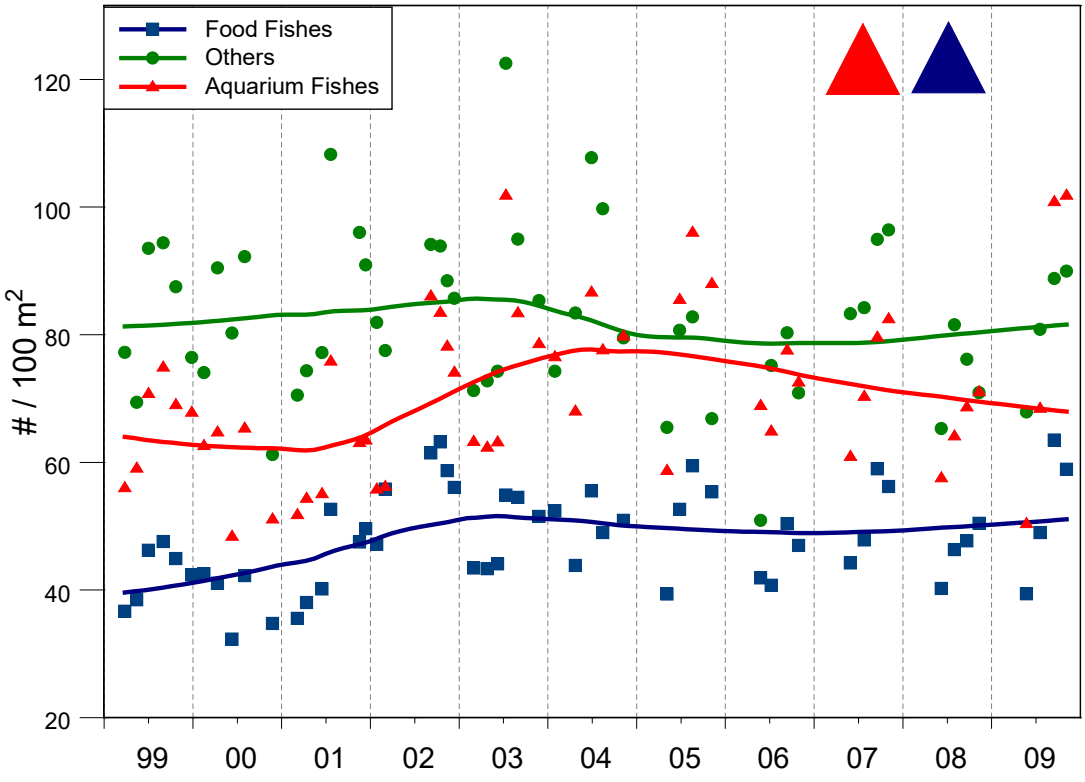
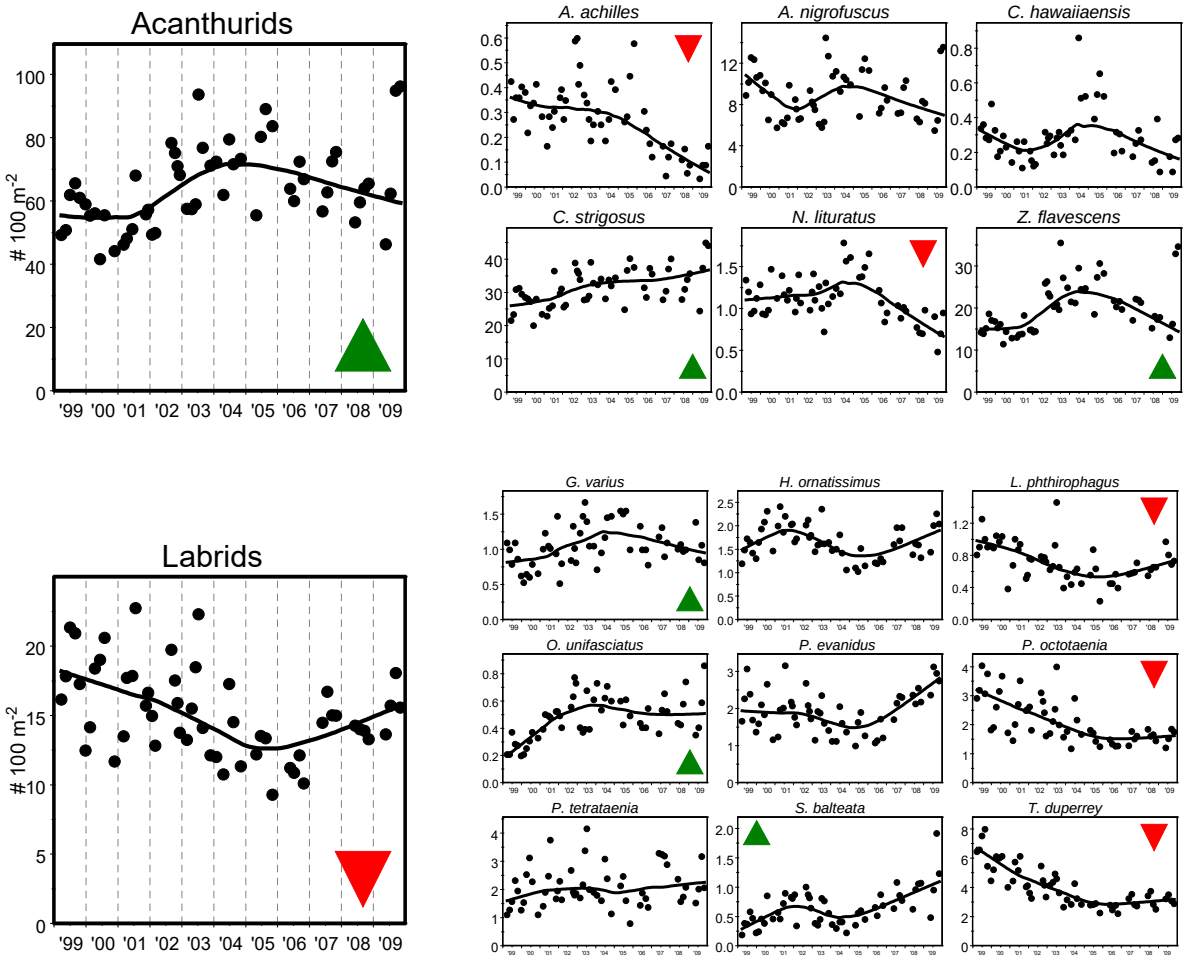


Figure 50. Overall temporal trend in mean fish density of three major fish utilization groups at West Hawai'i sites. Aquarium Fishes represents top 20 collected species. Trend line represents LOESS (locally weighted polynomial regression) smoothing procedure applied to data. Closed triangle = p<0.05 (Spearman rank test).

Fish Replenishment Areas (FRAs) along the West Hawai'i coast. The aquarium fishery in Hawai'i is economically the largest inshore fishery in the state and certainly the most conflict filled. The management importance of comprehensive and extensive monitoring such as has been underway in West Hawai'i for over a decade cannot be underestimated when addressing the issue of this highly controversial fishery. In depth analysis of aquarium collecting impacts is contained in a later section (pg. 84).

Examination of the temporal trends of some of the most common reef fish families indicates that acanthurids have been increasing over the past eleven years while labrids have decreased (Figure 51). Overall, chaetodontids and pomacentrids have been relatively stable although some species within the family have either increased or declined.



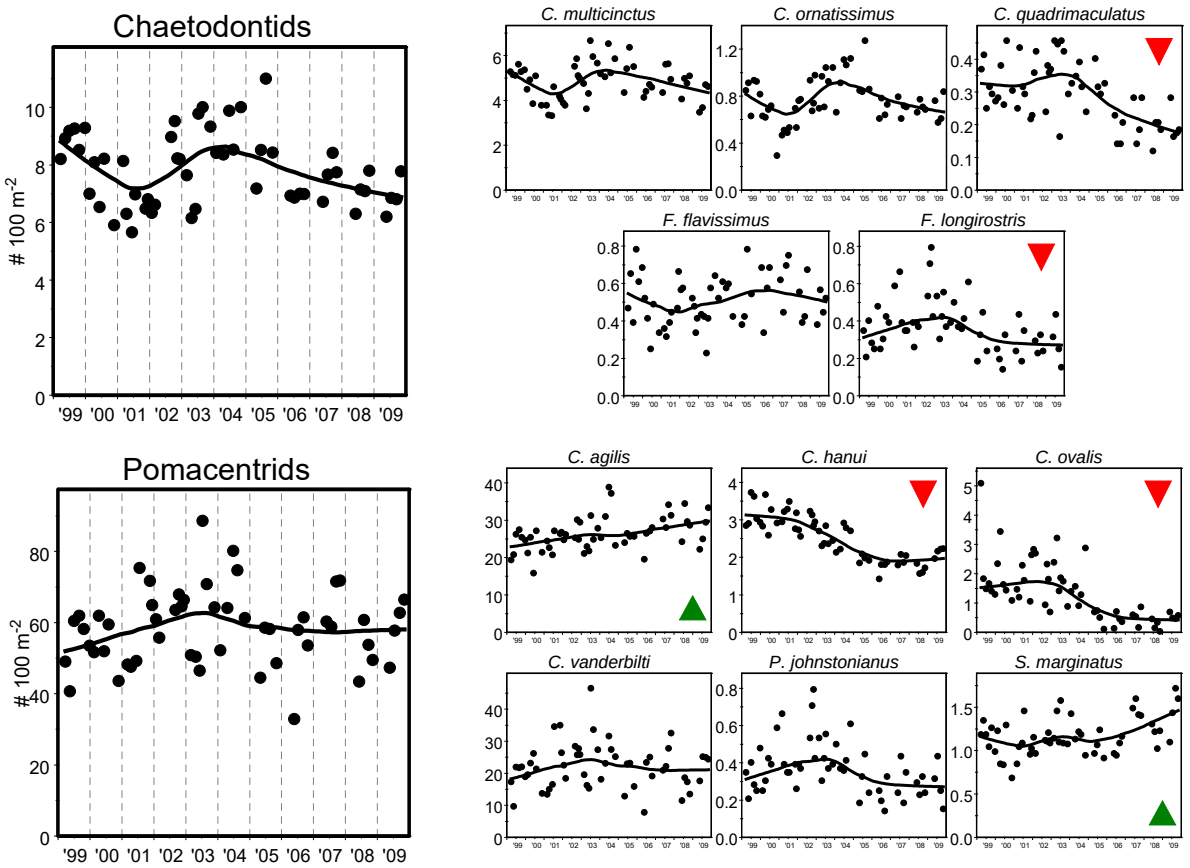


Figure 51. Temporal trend in mean fish density for four families on West Hawai'i sites. Trend line represents LOESS (locally weighted polynomial regression) smoothing procedure applied to data. Open triangle = p<0.1, Closed triangle = p<0.05 (Spearman rank test).

As noted, the species within each family can vary substantially in temporal trends as exemplified by the wrasses where three species increased, two decreased and three remained stable. The reasons for such differences are not clear but it does appear that with only a single exception (*Stethojulis balteata*) most wrasses are in a period of decreasing abundance, undoubtedly influenced by low levels of recent recruitment. Among the acanthurids the two species exhibiting the most substantial increases (*Zebrasoma flavescens* and *Ctenochaetus strigosus*) are also the most heavily collected aquarium species comprising approximately 91% of the total catch. It is also apparent however that a number of less abundant aquarium-targeted species such as the moorish Idol (*Zanclus cornutus*) and lei triggerfish (*Sufflamen bursa*) have not responded to the increase in protected areas and have actually decreased in West Hawai'i since 1999 (Figure 52).

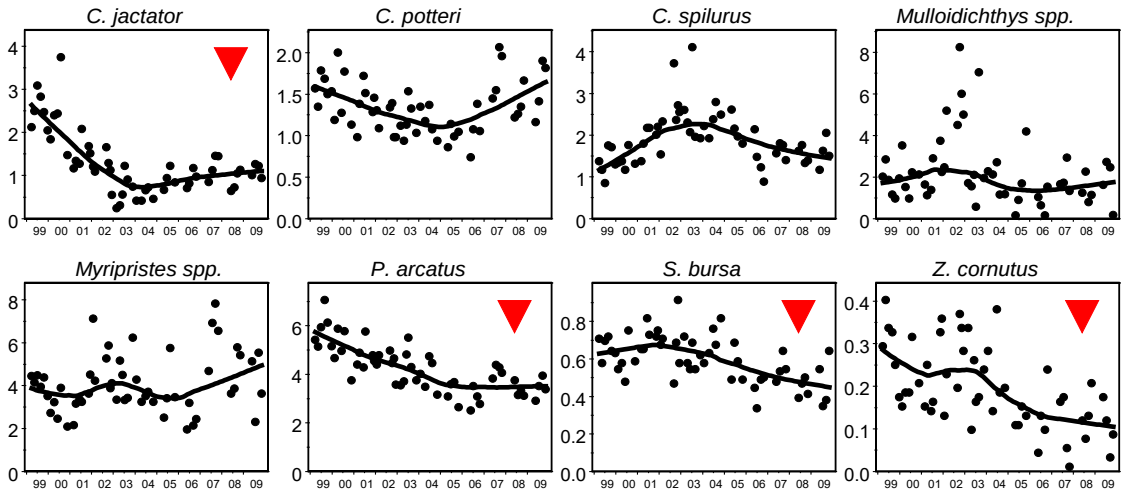


Figure 52. Temporal trend in mean fish density for various fish species of interest at West Hawai'i sites. Trend line and triangles as above.

Introduced Species

Ta'ape

From their initial introductions, ta'ape have clearly undergone an expansive period of population growth. Ta'ape were only introduced to the island of O'ahu but have subsequently spread widely throughout the islands of the archipelago. Based on free swim site surveys there was a trend for increasing numbers from 1999 to 2004 followed by a subsequent of unknown cause.

Transect data reflects overall low abundance of this species in the reef areas of the study sites (2007-2009 mean = 0.23/100m^2). Similarly ta'ape are rarely found in the shallower water where resource fish surveys are conducted (mean = xx/100m2). While Ta'ape are numerous in some locales usually along drop-offs and deeper reef areas, their distribution is highly patchy (characteristic of a schooling species) and they are not at all abundant in many reef areas in West Hawai'i. Similar to West Hawai'i, at some shallow reef locations such as in Kāne'ohe Bay, ta'ape numbers also appear to have declined from earlier periods (George Losey, pers. comm.).

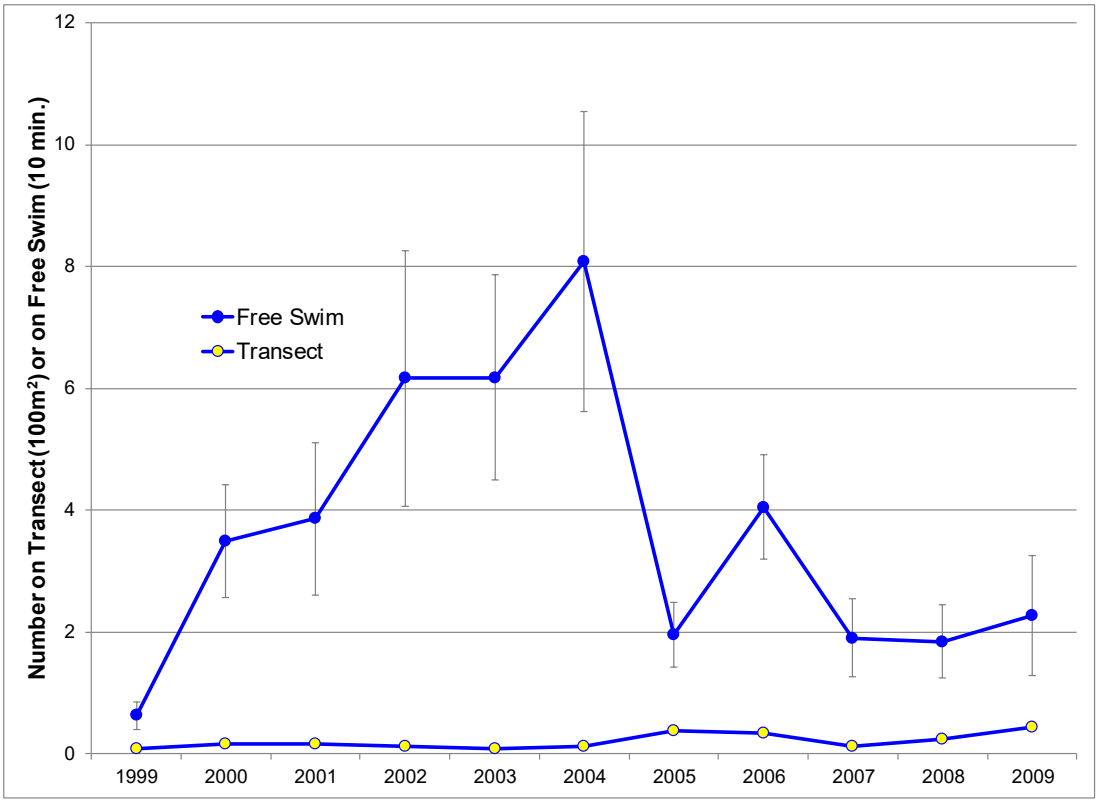


Figure 53. Ta'ape density trends on West Hawai'i transects and 10 minute free swim surveys.

Roi

Of the six species of groupers (family Serranidae) introduced to Hawai'i only roi, *Cephalopholis argus* has become established. There were more roi introduced (n=2385) than any other grouper and it was the only species introduced to the Island of Hawai'i (400 fish from Moorea in 1956). It now occurs on all the main Hawaiian Islands and in low numbers on some of the Northwest Hawaiian Islands.

As evidenced by transect and free-swim data (Figure 15) overall roi abundance at West Hawai'i sites was increasing since at least 1999 to 2004. West Hawai'i retrospective studies at Hōnaunau and Ke'ei indicate that roi populations only began to increase in the 1990's, three decades after their initial introduction. Randall notes in 1987 that "This fish (roi) has not become abundant. It has not developed a population approaching that of its native stock in the Society Islands."

Since 2004 however there has been a marked downturn in observed overall roi abundance both on West Hawai'i transect (56% decrease) and free swim surveys (55% decrease) (Figure 54). These declines occurred at 20 of 23 surveyed sites.
This recent decline may be related in part to an unusual fish die off in West Hawai'i which first became apparent in May 2006. At that time seven dead roi were found washed up on the beach at `Anaeho`omalu, North Kona (Travis Hall, pers. Comm.).

Several other species were also noted at this time including several goatfish (*Mulloidicthys sp*.), a surgeonfish (*Acanthurus dussumieri*) and a moray eel. Over the next five months there were numerous reports of dead and dying fishes, typically floating or struggling at the surface, along a wide stretch of the West Hawai'i coastline. In most instances the fish had distended swim bladders which prevented still live fish from returning to the bottom. Individuals of three species (*C. argus*, *C. sordidus* and *A. olivaceus*) were observed underwater live but having difficulty maintaining equilibrium. Roi were by far the most commonly involved species in the die off incidents but a number of other species also perished comprising a wide range of families, feeding types and depth ranges (Table 10). Similar undocumented reports of floating fish (typically roi) were also received from Maui, O'ahu and Moloka'i.

Ten specimens of nine species were collected and sent to the National Wildlife Health Center, U.S. Geological Survey in Honolulu for necropsy. Diagnostic Case Report findings typically indicated swim bladder distension, a variety of incidental lesions and, in two cases, atrophy of the liver. No gross or microscopic lesions were considered severe enough to cause death and the cause of death remains unknown (Thierry Work, pers. Comm.).

Table 10. List of fishes collected or reported in West Hawai'i die-off.

Family	Species	Common Name
Acanthuridae	*Acanthurus dussumieri*	Eyestripe surgeonfish
Acanthuridae	*Acanthurus olivaceus*	Orangeband surgeon
Acanthuridae	*Acanthurus triostegus*	Convict surgeonfish
Acanthuridae	*Ctenochaetus hawaiiensis*	Black surgeonfish
Acanthuridae	*Naso hexacanthus*	Sleek unicornfish
Acanthuridae	*Zebrasoma flavescens*	Yellow tang
Balistidae	*Melichthys niger*	Black durgon
Balistidae	*Rhinecanthus aculeatus*	Lagoon trigger
Balistidae	*Rhinecanthus rectangulus*	Reef triggerfish
Chaetodontidae	*Chaetodon auriga*	Threadfin butterflyfish
Chaetodontidae	*Forcipiger flavissimus*	Forceps fish
Kuhliidae	*Kuhlia sandvicensis*	Hawaiian flagtail
Lutjanidae	*Lutjanus kasmira*	Ta'ape (Blueline snapper)
Mullidae	*Mulloidichthys sp.*	goatfish
Muraenidae	*Gymnothorax sp.*	Moray eel
Scaridae	*Chlorurus sordidus*	Bullethead parrotfish
Scaridae	*Scarus rubroviolaceus*	Redlip parrotfish
Serranidae	*Cephalopholis argus*	Roi (Peacock grouper)
Serranidae	*Epinephelus quernus*	Hawaiian grouper

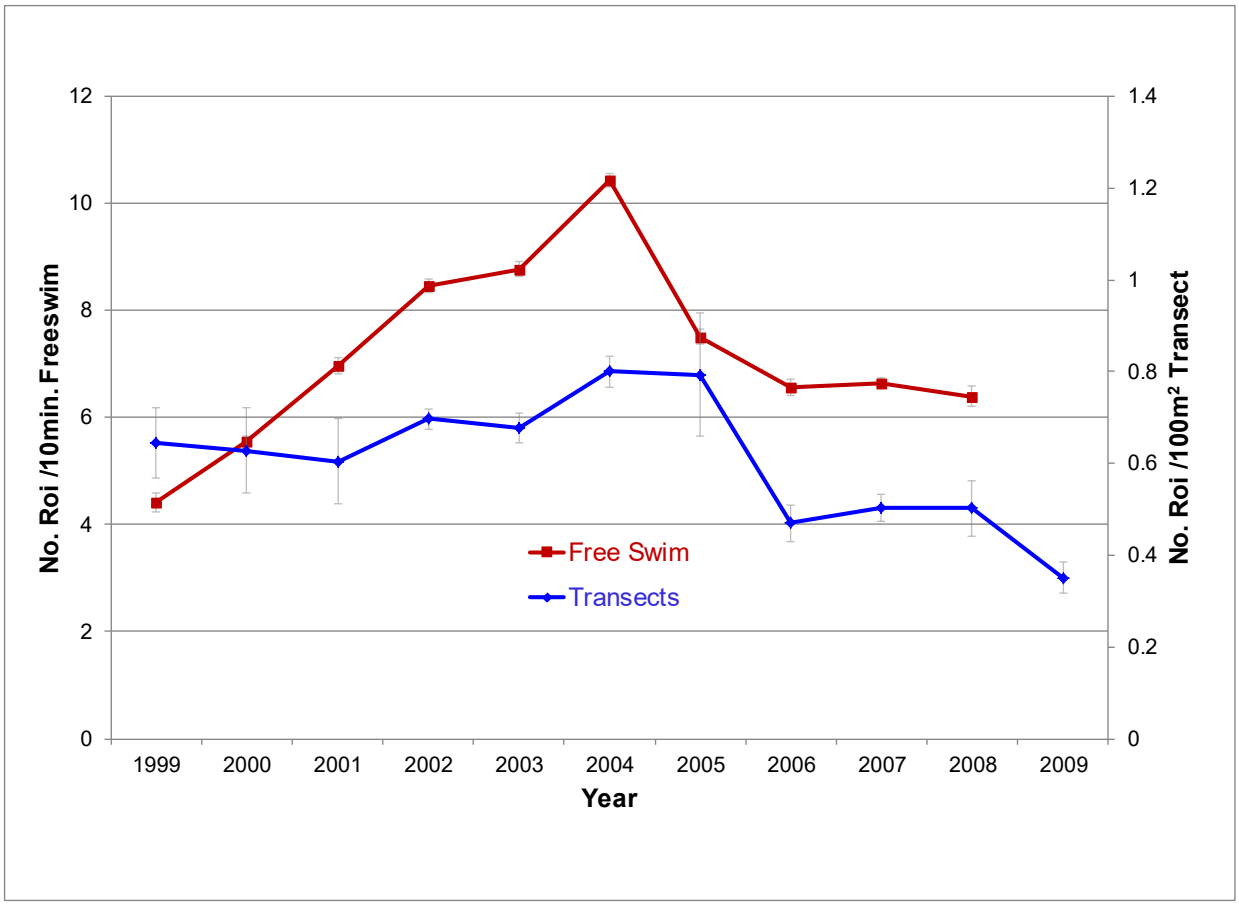


Figure 54. *C. argus* density trends in West Hawai'i. Data based on two types of underwater visual surveys at 23 long-term monitoring stations spread over approximately 100 miles of coastline. Each site was surveyed 4-6 times a year.

The following year in 2007 only a single fish was reported or found suffering similar conditions, that being the deep-sea swallower *Kali indica* (Fig 55).

Figure 55. Deep-sea swallower, *Kali indica* with inflated swim bladder.

Puffer Die-Off

Early in 2010 a die-off of large puffers, with external symptoms quite similar to the previous mortalities, began to occur on Maui and Hawai'i Island. Over the ensuing months low numbers of dead and dying puffers increased (Figure 56) and were progressively reported up the island chain as far as Kaua'i (Oct. 2010). The overall reported numbers of dead puffers decreased as fall approached. Greater than 95% of all reported mortalities were of the stripebelly puffer, *Arothron hispidus* with a few porcupine fish (*Diodon hystrix*), Hawaiian Whitespotted toby (*Canthigaster jactator*) and spotted puffer (*Arothron meleagris*) (Thierry Work, pers. comm.)

A network of concerned citizens and agency people were actively involved in this incident, filing reports of mortalities and shipping dead fish to Dr. Thierry Work, Wildlife Disease Specialist with the U.S. Geological Service (USGS) in Honolulu. As of Nov. 18, 2010 a total of 106 puffers had undergone both gross and microscopic examination. All assays for viruses (including electron microscopy) have so far come up negative and all attempts to incriminate any other infectious agent as a cause have come to naught. At present, the current last hypothesis is that these fish are being exposed to some sort of environmental toxin, probably natural given the widespread extent of mortalities.

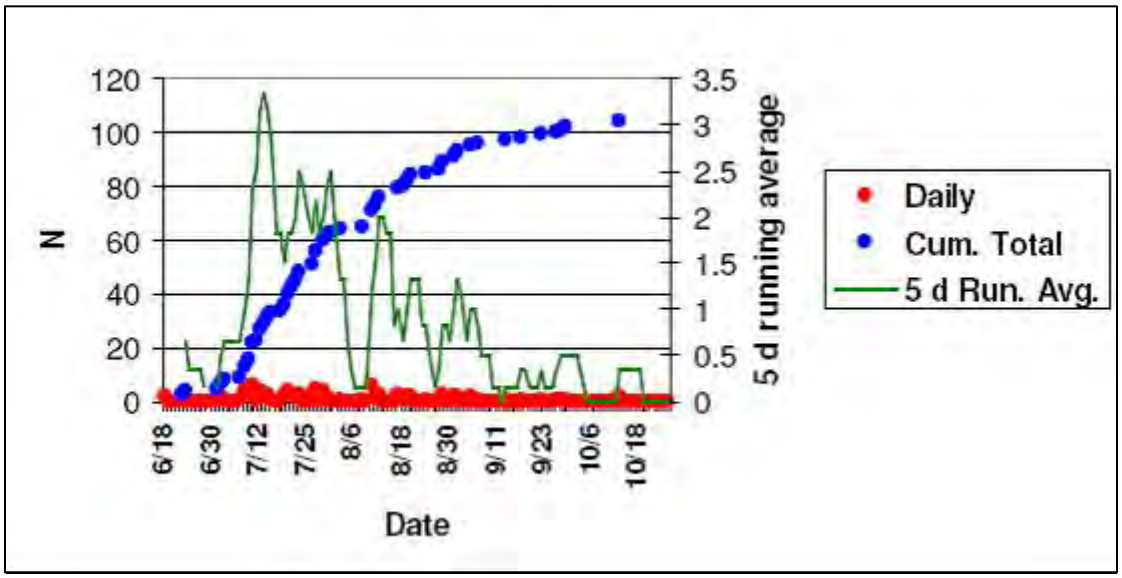


Figure 56. Number of dead puffers examined as USGS Honolulu Field Station.

West Hawai'i monitoring data indicates a substantial decline has occurred in the spotted puffer (*A. meleagris*) with a precipitous drop in 2009/2010 (Figure 57). Other large puffer species were too infrequently counted on transects to determine changes in abundance. The decline in *A. meleagris* is somewhat perplexing in that this species did not constitute a substantial portion of the reported and examined mortalities. It is of interest to note that two separate dead puffers of this species were found face down underwater at Ke'ei (photo in Fig p) and in a Wai o Pae tide pool (Jennifer Turner, pers. comm.). In a somewhat similar vein, West Hawai'i monitoring data indicates that the Hawaiian spotted toby (*C. jactator*) declined substantially over the past decade. It's unknown whether similar sorts of mortalities are responsible.

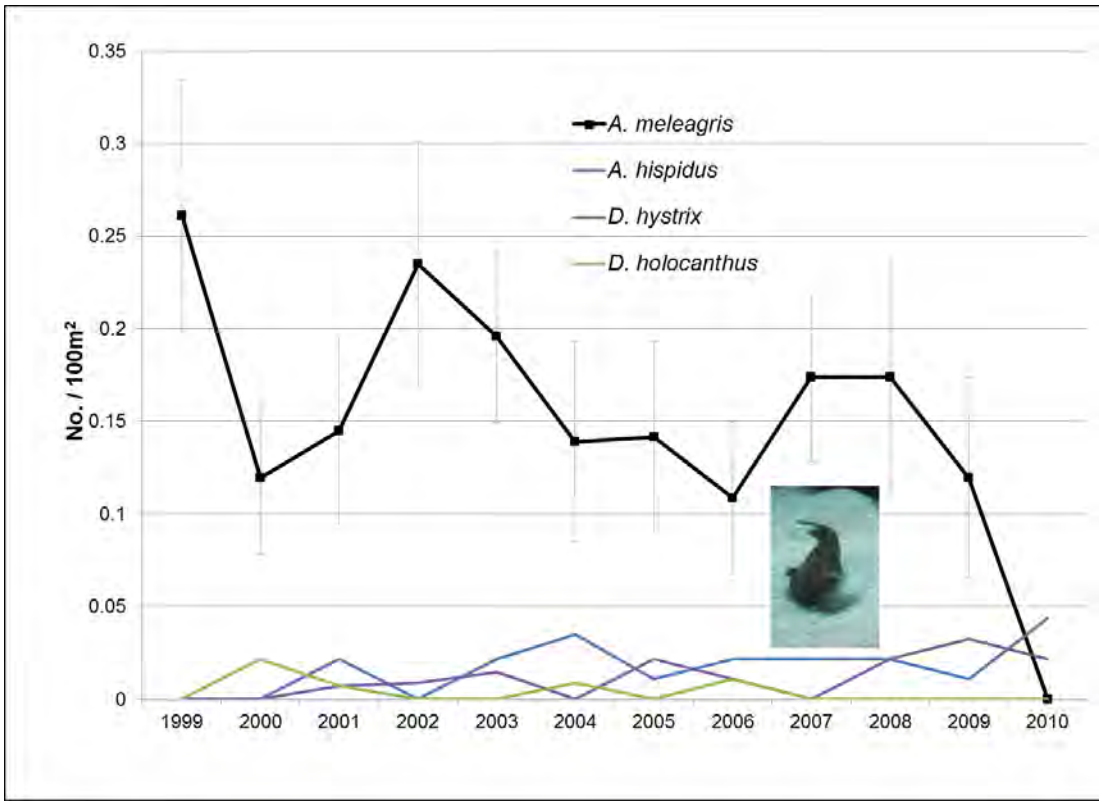


Figure 57. Pufferfish abundance trends in West Hawai'i.

Roi impacts

As previously noted, although roi was introduced to augment declining populations of food and game fishes it has not been well received by most Hawai'i fishermen due to concerns about ciguatera and more recently about negative impacts to native fish populations. As with ta'ape, roi have been blamed for a multitude of problems on the reefs, including a decline in important aquarium fish such as the yellow tang *Zebrasoma flavescens*. Concern has also been expressed over putative impacts on food fishes and invertebrates

The marked decline in the numbers of West Hawai'i roi in recent years provides an unprecedented opportunity (i.e. a 'natural' experiment) to examine responses of the reef fish community to a >50% reduction in the roi population. This work is currently planned for the coming year. It is anticipated that if roi are having major impacts on the abundances of other species they prey upon there would be detectible and consistent temporal relationships between roi and prey species abundance. An examination of roi and two of the most abundant species in roi's prime habitat the yellow tang (*Zebrasoma flavescens*) and kole (*Ctenochaetus strigosus*) fails indication direct negative impact on either species. From 1999 to 2004 as roi populations were increasing, both kole and yellow tang populations were increasing. Subsequent to 2004 as roi populations decreased yellow tans similarly decreased whereas kole numbers were fairly stable (Figure 58). This is not the pattern that would result if roi abundance was a major determinant of the abundance of these other two species.

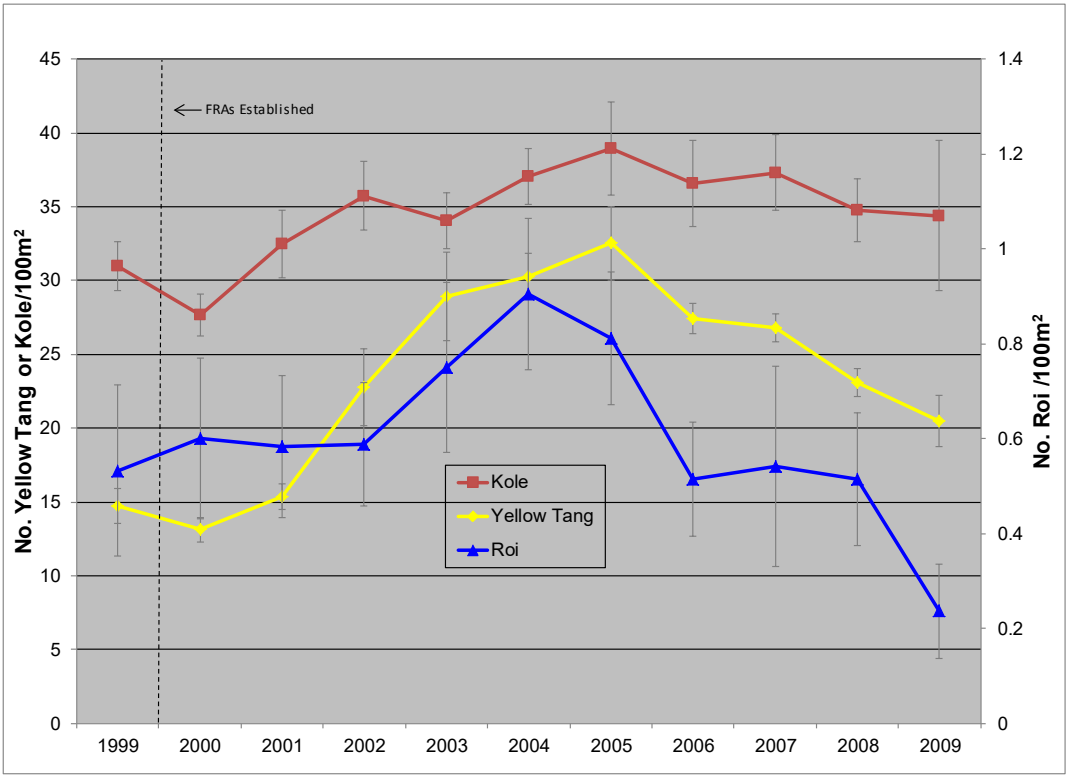


Figure 58. Temporal trends of the numbers of kole, yellow tang and roi in FRAs. Young of Year (YOY) not included.

Another complementary way of examining the extent and magnitude of potential roi impacts on West Hawai'i reef fish populations is to examine the relationship between roi abundance at each of the monitoring sites with the abundance of various species and functional groups at the sites. Figure 59 illustrates this approach for six different groups of fish; none of which show a significant negative relationship with roi abundance. In other words having more roi in an area does not result in having less; A). total fish (p=0.58), B). small prey fish (p=0.86), C). other piscivores (p=0.24), D). yellow tang YOY (0.16), E). kole YOY (p=0.79) or F). all YOY (p=0.86).

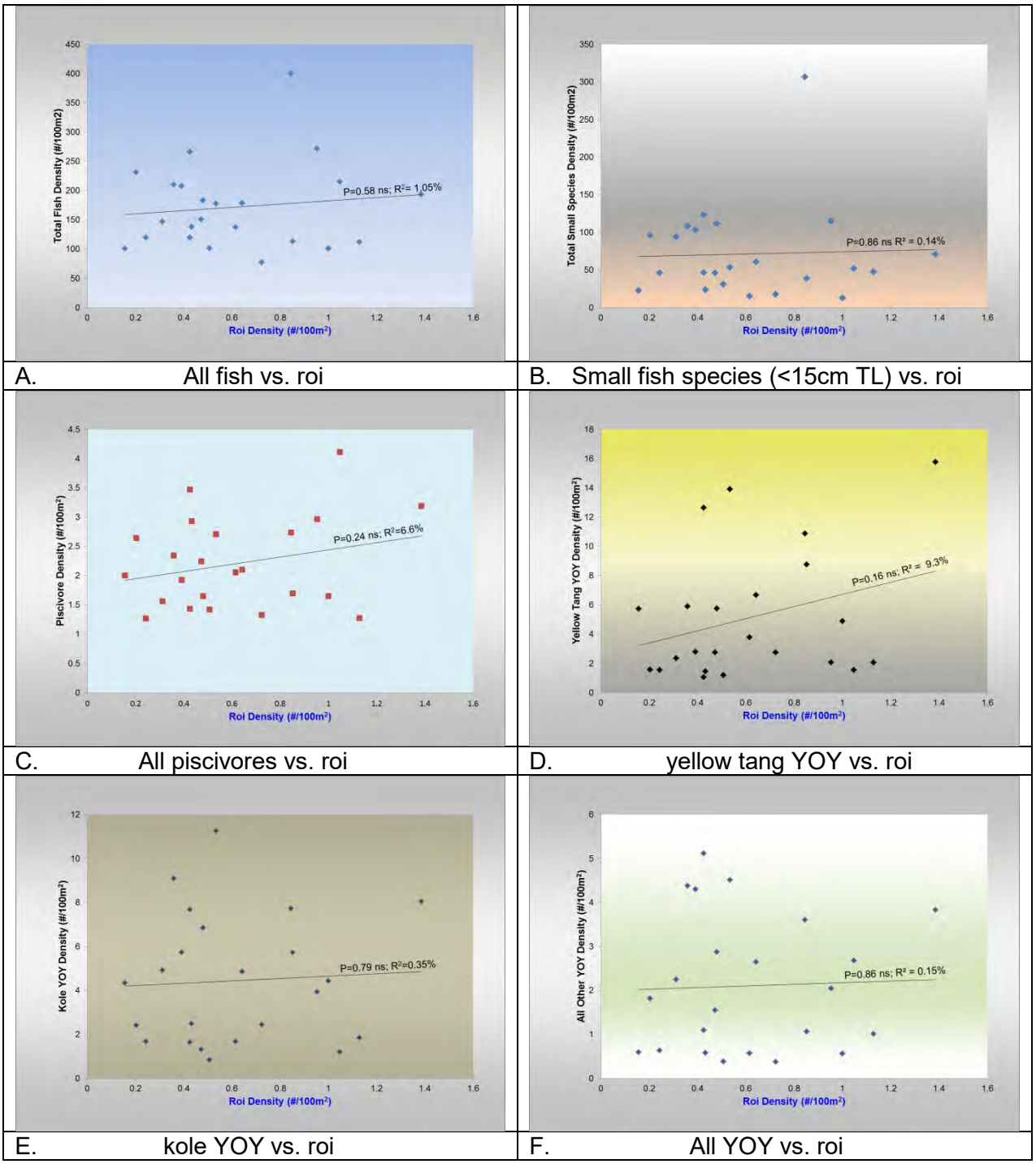


Figure 59. Relationship between Roi and various West Hawai'i fish population parameters.

Aquarium Species

The aquarium collecting industry in Hawai'i and especially in West Hawai'i has long been a subject of controversy. In contrast to other areas in the State, the West Hawai'i aquarium fishery has undergone substantial and sustained expansion over the past 30 years (Figure 60). Approximately 75% of fish caught in the State and 67% of the total aquarium catch value comes from the Big Island and almost exclusively from West Hawai'i (Table 11).

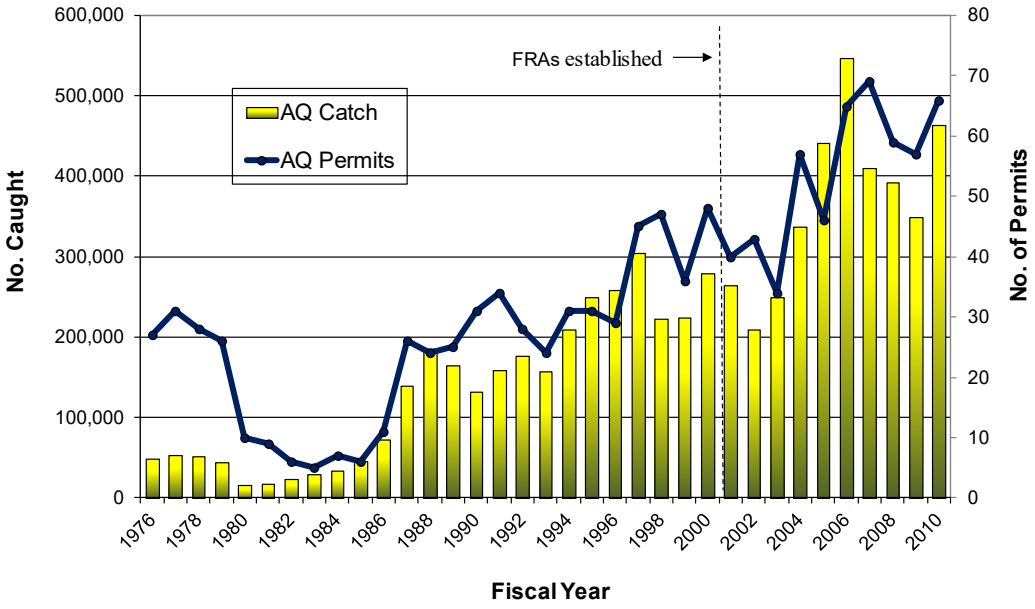


Figure 60. Number of aquarium animals collected and number of commercial aquarium permits in West Hawai'i for fiscal years 1976-2009.

Table 11. Changes in West Hawai'i aquarium fishery since implementation of the FRAs. Dollar value is adjusted for inflation.

	FY 2000	FY 2009	Δ
No. Permits	48	57	19% ↑
Total Catch	279,606	349,250	25% ↑
Total Value	$745,129	$1,271,329	71% ↑
% of State Fish Catch	70%	75%	5% ↑
% of State Fish Value	67%	69%	2% ↑
% of State Total Catch	55%	63%	8% ↑
% of State Total Value	59%	67%	8% ↑

The West Hawai'i Regional Fishery Management Area, which spans the entire West Hawai'i coastline, was established in 1998 primarily in response to the activities of aquarium collectors working the coastline. Overall, the marine aquarium fishery in the State of Hawai'i is one of the most economically valuable commercial inshore fisheries with FY 2009 reported landings of 557,673 specimens and a total value of $1.08 million. The reported values may be underestimated by a factor of approximately 2 to 5X (Cesar et al. 2002, Walsh et al. 2003). Walsh et al. 2003 provides an historical overview of the commercial aquarium fishery in Hawai'i.

In 1999, DAR in conjunction with a citizen's advisory group, the West Hawai'i Fisheries Council (WHFC), established a network of 9 Fish Replenishment Areas (FRAs) where aquarium collecting was prohibited. Along with existing protected areas 35.2% of the coastline was off limits to collecting.

In order to investigate the effectiveness of the FRAs to replenish depleted fish stocks, a consortium of researchers established the West Hawai'i Aquarium Project (WHAP) in early 1999. Funding was secured for the early years of the project through the Hawai'i Coral Reef Initiative Research Program (HCRI-RP), a federal initiative under the aegis of the National Oceanic and Atmospheric Administration (NOAA). Subsequent funding has been provided by Coral Reef Monitoring Grants under NOAA's Coral Reef Conservation Program. The initial project researchers were Dr. Brian Tissot, Washington State University, Dr. William Walsh, DAR/DLNR and Dr. Leon Hallacher, University of Hawai'i-Hilo. They have been joined in recent years by Dr. Ivor Williams, National Marine Fisheries Service, Dr. Mark Hixon, Oregon State University and Dr. Helen Fox, World Wildlife Fund.

WHAP established 23 study sites (Figure 47, Table 9) along the West Hawai'i coastline in early 1999 at 9 FRA sites, 8 open sites (aquarium fish collection areas) and 6 previously established Marine Protected Areas (MPAs) to collect baseline data both prior to and after the closure of the FRAs. The MPAs are MLCDs and Fishery Management Areas (FMAs), which have been closed to aquarium collecting for at least 9 years and were presumed to have close to "natural" levels of aquarium fish abundances. They serve as a reference or 'control' to compare with the FRAs and open areas.

The overall goals of WHAP were two-fold: 1) To evaluate the effectiveness of the FRA network by comparing targeted aquarium fishes in FRAs and open areas relative to adjacent control sites and, 2) To evaluate the impact of the FRA network on the aquarium fishery.

The general rationale for WHAP's goals was based on the premise that changes in FRAs and open areas can best be estimated by comparing them to other areas which have been protected for relatively long periods of time. These areas (MPAs) serve as control areas against which the FRAs are measured both before and after the closure of the FRAs. This rationale is derived from a well-known statistical procedure known as the BACI (Before-After-Control-Impact) procedure (Tissot et al, 2004) which is an especially appropriate and statistically powerful method for examining FRA effectiveness.

For this study FRA effectiveness (R) is measured statistically as the change in the difference between each FRA and the mean of all MPA sites during each survey (control vs. impact) from before (1991-2000) vs. after (2007-2009) FRA establishment. Details on study methodology and this procedure are covered in (Tissot et al, 2004, Division of Aquatic Resources 2004).

R measures the changes within the FRA as a percent of the baseline abundance relative to control sites. In the case of this study, R is a measure of the effectiveness or 'protective value' of the FRAs. That is, what effect is increased protection having on targeted fish?

Scientific studies on reef fishes are notoriously difficult due to the very high variability of fish abundance in both time and space. Even with a rigorous statistical design (such as

BACI) and 11 years of study, it is difficult to statistically detect changes in abundances except for the most common species that exhibit relatively large changes.

Fish Replenishment Areas (FRAs)

Changes in density for the ten most collected aquarium fishes across all FRAs are shown in Table 12. Yellow Tang density increased markedly (and significantly) in the FRAs while seven of 10 decreased (Achilles Tang, Multiband Butterflyfish and Brown Surgeonfish decreased significantly). However these seven species represent <6% of the total West Hawai'i aquarium catch.

The FRAs were 'effective' (increases in FRAs relative to long term MPAs) for eight of the top 10 collected species with three being statistically significant. As with density there were significant decreases in effectiveness for the Multiband Butterflyfish and Brown Surgeonfish. Both of these species are not very heavily collected averaging <2000 individuals per year over the last 5 years (Table 14) and are fairly abundant on the reef. It's thus not clear why their numbers are declining in the FRAs. These two species exhibited overall declines in all three types of areas with the greatest decrease in the protected areas (FRAs and MPAs). For the Brown Surgeonfish this may be the result of a competitive interaction with Yellow Tang and/or Goldring Surgeonfish (aka kole). As their numbers have increased the Brown Surgeonfish's has decreased. Both Yellow Tang and Brown Surgeonfish are herbivore browsers with quite similar diets (Jones 1968). In a possibly similar relationship Barlow (1974) found the numbers of Brown Surgeonfish and manini (*Acanthurus triostegus*) to be negatively correlated and this was attributed to the aggressive dominance of the Brown Surgeonfish.

Table 12. Overall FRA effectiveness for the top ten most aquarium collected fishes. 'Before' = Mean of 1999-2000; 'After' = Mean of 2007-2009. YOY not included.

COMMON NAME	SCIENTIFIC NAME	MEAN DENSITY (NO/100M^2)		OVERALL% CHANGE IN DENSITY	ρ	R	ρ
		Before	After				
Yellow Tang	*Zebrasoma flavescens*	12.73	19.95	**+57%**	0.01	**+77%**	<0.01
Goldring Surgeonfish	*Ctenochaetus strigosus*	28.38	32.01	+13%	0.23	+83%	0.39
Achilles Tang	*Acanthurus achilles*	0.26	0.05	**-81%**	0.01	+2%	0.09
Clown Tang	*Naso lituratus*	0.81	0.59	-27%	0.10	+2%	0.37
Black Surgeonfish	*Ctenochaetus hawaiiensis*	0.18	0.16	-12%	0.77	+3%	0.41
Longnose and Forcepsfish	*Forcipiger spp.*	0.64	0.84	+32%	0.13	**+4%**	0.03
Multiband Butterflyfish	*Chaetodon multicinctus*	5.20	3.49	**-33%**	0.02	**-5%**	<0.01
Brown Surgeonfish	*Acanthurus nigrofuscus*	8.58	4.06	**-53%**	0.03	**-26%**	0.01
Orangeband Surgeonfish	*Acanthurus olivaceus*	0.13	0.10	-20%	0.63	+3%	0.45
Ornate Wrasse	*Halichoeres ornatissimus*	0.94	0.65	-31%	0.08	+2%	0.14

Bold = statistically significant at ρ≤ 0.05

With only a single exception all of the FRAs have proven to be effective (positive R value) in enhancing Yellow Tang stocks (Figure 61). Seven of the eight increases were statistically significant. The single FRA which was ineffective was Waiaka'ilio Bay in North Kohala. This FRA had very low Yellow Tang recruitment throughout the study period and additionally the area may have been impacted by a sedimentation event in October 2006 on nearby reefs.

An examination of multiple factors associated with effective FRAs (Tissot et al., 2004) found that habitat quality, FRA size (especially reef width) and density of adult fishes are associated with significant recovery of fish stocks. Of particular importance are areas of high finger coral (*Porites compressa*) cover which is critical habitat for juvenile Yellow Tang and other fishes (Walsh, 1987). Live coral cover at Waiaka'ilio declined 12% between 2003 and 2007 (Table 7).

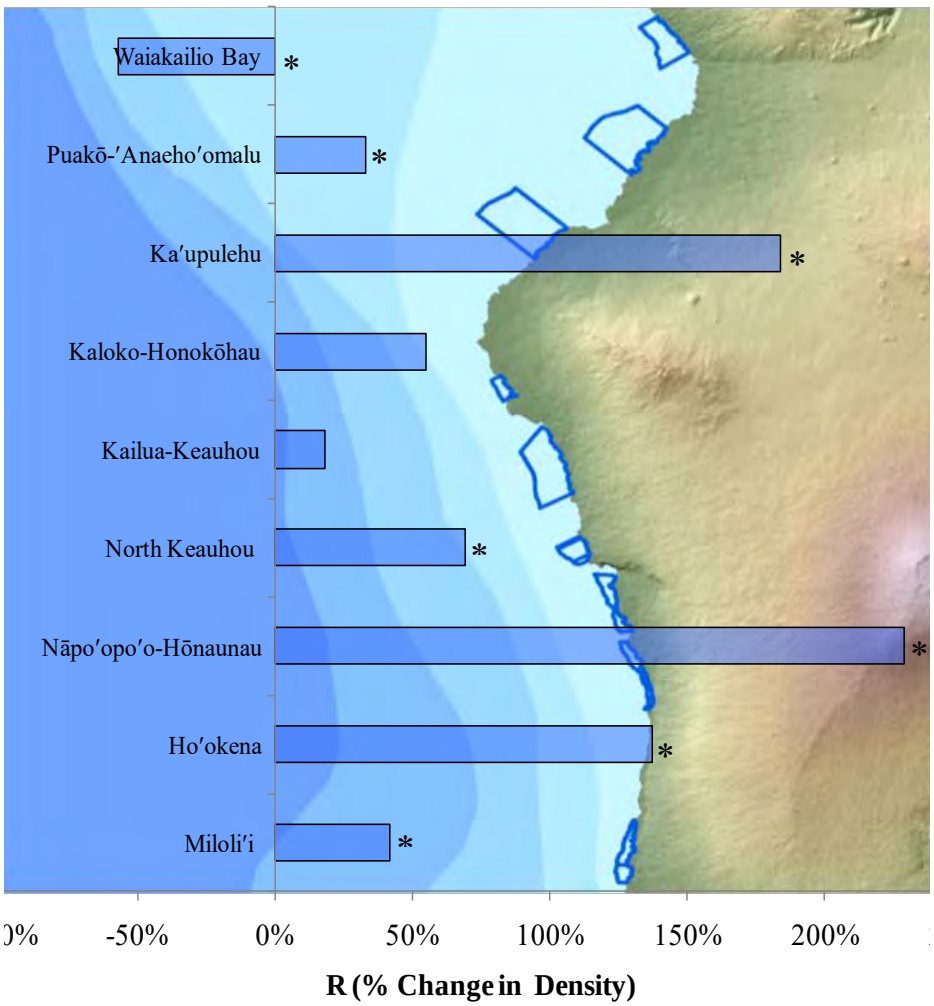


Figure 61. Effectiveness of individual FRAs to replenish yellow tang, 1999-2009. *= Statistically significant at ρ≤0.05

The overall average changes in yellow tang abundance in the three management areas are shown in Figure 62. Yellow Tang exhibited a delayed increase in abundance in all areas following a strong recruitment year in 2002. Relatively low recruitment in 5 of the 7

following years resulted in subsequent downward trends in all areas. Even with low recruitment in 6 of the past 11 years the number of adult yellow tang increased by 57% in the FRAs since they were established (Table 12).

Recent work (Claisse et al. 2009) has shown that when yellow tang reach sexual maturity they leave the deeper coral rich reef areas where they settled (and where DAR transects are located) for shallower reef habitat. For females this occurs at approximately 4-5 years of age and for males at age 5-7. Thus in the absence of substantial input of Young-of-the-Year fish, (i.e. low recruitment) yellow tang populations will invariably decline over time due to the emigration of mature fish in addition to natural mortality. This apparently is what has occurred over the last six years in the protected areas.

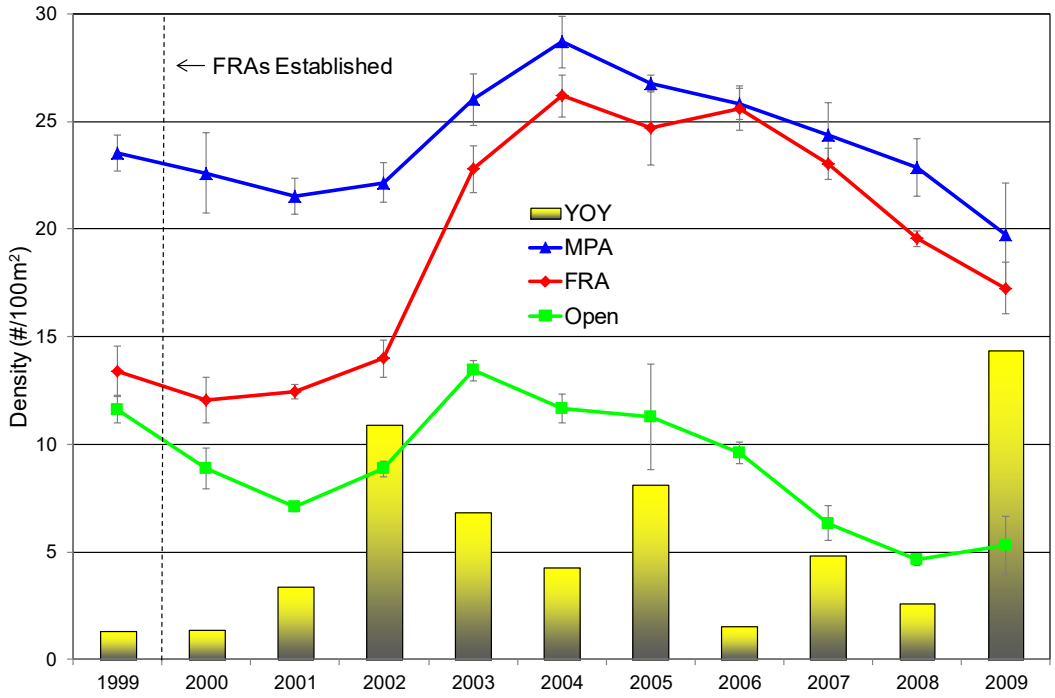


Figure 62. Overall changes in yellow tang abundance (Mean ± SE) in FRAs, MPAs and Open areas, 1999-2009. Yellow bars indicate mean density (June-Nov) Yellow Tang Young-of-Year (YOY). YOY are not included in trend line data.

The decrease of yellow tang in open areas to below baseline levels is attributable to the above factors as well as an increase in the number of aquarium collectors and collected animals relative to the period when the FRAs were established (Figure 60). The continuing decline of yellow yang in areas open to collecting has prompted several additional proposed management actions including restricting which species can be collected (See Species of Special Concern section pg.103) and the establishment of a limited entry program for the fishery. Recruitment in 2009 was the highest in the past 11 years which is likely to ameliorate current downward trends at least over the short term.

The fishing/reserve (i.e. FRA/MPA) impacts described above are striking, but of greater significance to the role such reserves have in enhancing and sustaining West Hawai'i populations and the fishery which depends on those, are effects of the reserve network

on Yellow Tang breeding stocks. Based on adult yellow tang 'jet boot' surveys (Williams et al. 2009) it was found that adult densities were highest within protected areas and in 'boundary' areas (open areas adjacent to protected areas). Densities were lowest in open areas far from protected areas. The high densities in boundary areas are evidence of 'spillover' (outward movement from reserves into surrounding open areas) and indicate that protected areas supplement adult stocks not only within their own boundaries, but also in open areas up to a kilometer or more away. Thus, the 35% of the coastline in reserves helps to sustain yellow tang breeding stocks in about 50% of the coastline.

Goldring surgeonfish or kole exhibited trends (Figure 63) quite similar to yellow tang but since they are more abundant and much less collected than the tangs, open areas have been relatively stable. Overall, kole have increased by 13% since FRA establishment (Table 3). As with yellow tang, recruitment levels have been relatively high thus enabling densities to increase in the protected areas. It is unknown at present if kole make a habitat change as they reach sexual maturity. Recruitment patterns are markedly similar between the two species, likely due to similarities in spawning seasonality, location and daily timing (Walsh 1984, 1987).

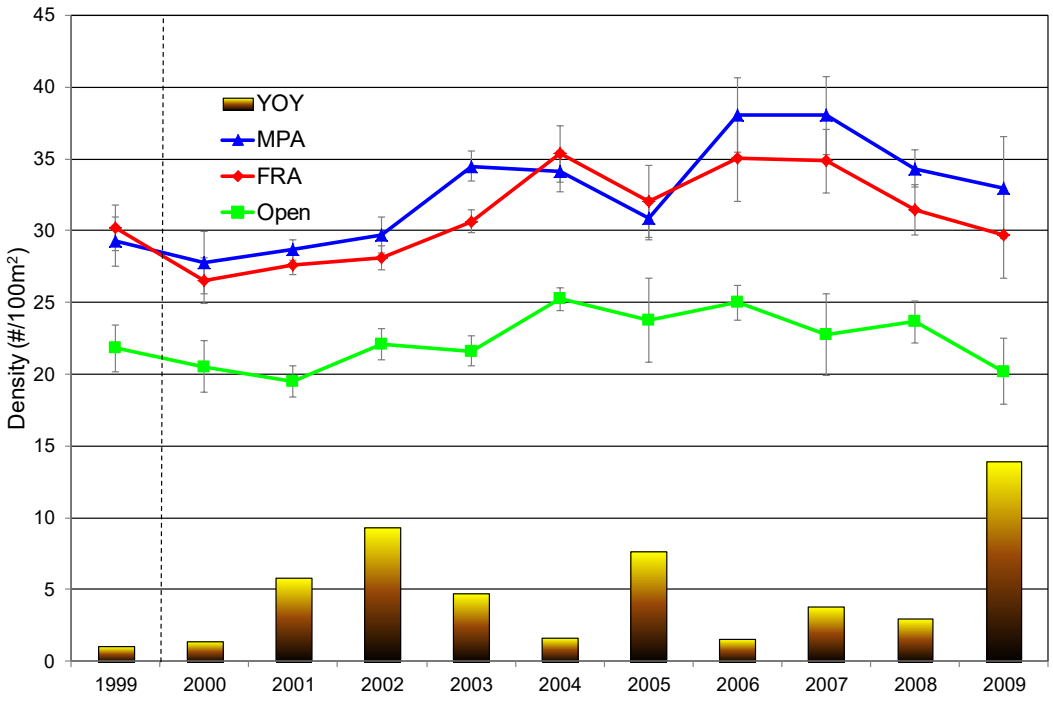


Figure 63. Overall changes in goldring surgeonfish (aka kole) abundance (Mean ± SE) in FRAs, MPAs and Open areas, 1999-2009. Bars indicate mean density (June-Nov) of goldring surgeonfish Young-of-Year (YOY). YOY are not included in trend line data.

Achilles tang (Figure 64) has generally shown a highly variable pattern in all management areas in the early years of the study with an overall decline in the last seven years. Average densities of this species is very low ($\bar{x}$ = 0.26/100m^2) on all

transects. The deeper reef areas where the DAR transects are located is not the prime habitat for adults of this species. They prefer the high energy shallower surge zones more typical of the shoreline drop-offs areas in West Hawai'i. Presumably algal food resources are more abundant in these areas. These areas reef areas are surveyed by means of the shallow water resource surveys conducted by DAR. Initial results from this program and other ancillary longer terms studies suggest there should be concern for the sustained abundance of this species. Achilles Tangs are a very popular food fish as well as an aquarium fish and thus are being harvested both as juveniles and adults. Low levels of recruitment over the past 11 years ($\bar{x}$ (Jun-Nov) = 0.09/100m^2) appear insufficient to compensate for the existing levels of harvest. DAR is currently in the process of developing a comprehensive package of size and bag limits for a number of popularly targeted species. There is a recommended bag limit of 10 Achilles tang/person/day which would apply to all harvesters including commercial fishers and aquarium collectors.

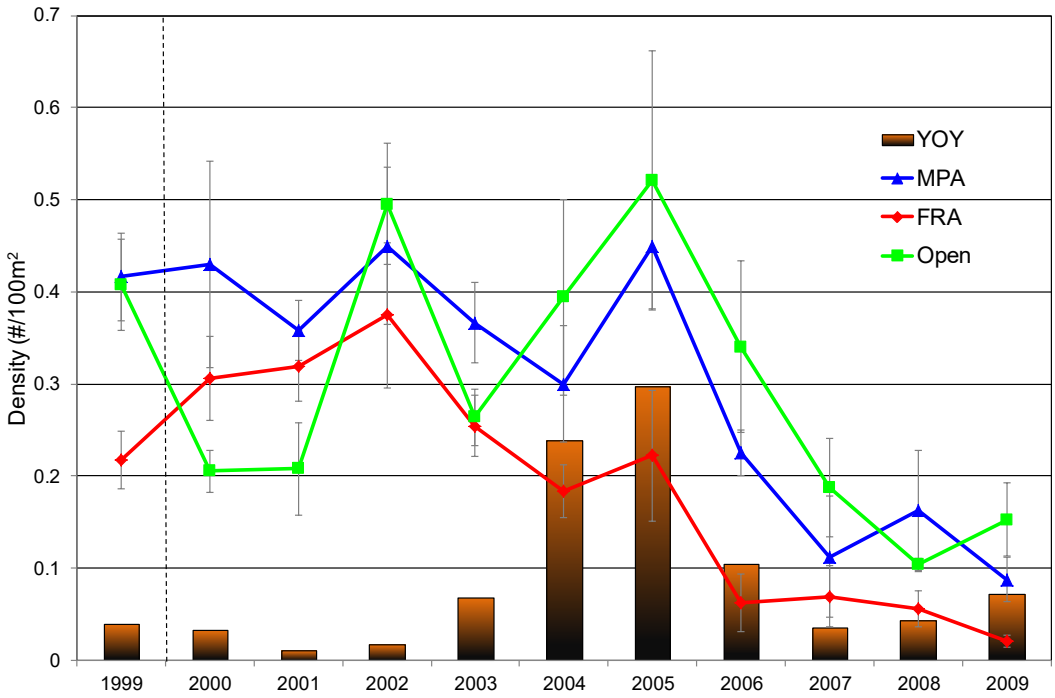


Figure 64. Overall changes in Achilles tang abundance in FRAs, MPAs and Open areas, 1999-2009. Bars indicate mean density (June-Nov) of Achilles tang Young-of-Year (YOY). YOY are not included in trend line data.

The abundance/recruitment trends of the clown tang and black surgeonfish, the fourth and fifth most collected species, are somewhat similar to Achilles tang (Figures 65 & 66). Here again the primary adult habitat is not the deeper, coral rich areas, where the DAR transects are located. Additionally the clown tang is also widely taken as a food fish as well as being an important aquarium fish. The abundance of both these species on the transects closely tracks recruitment with an upturn during 2004/2005 when there was somewhat higher recruitment followed by declining trends in subsequent years that had low recruitment. Overall, recruitment has been minimal over the last decade for both clown tang ($\bar{x}$ = 0.05/100m^2) and black surgeonfish ($\bar{x}$ = 0.05/100m^2).

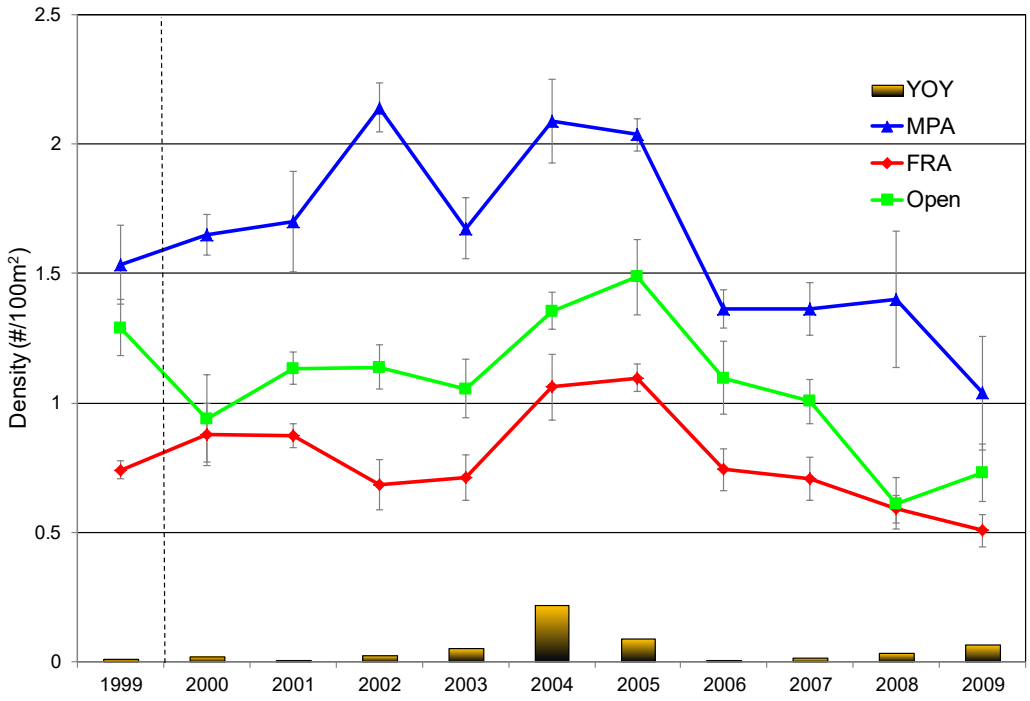


Figure 65. Overall changes in clown tang abundance (Mean ± SE) in FRAs, MPAs and Open areas, 1999-2009. Bars indicate mean density (June-Nov) of clown tang Young-of-Year (YOY). YOY are not included in trend line data.

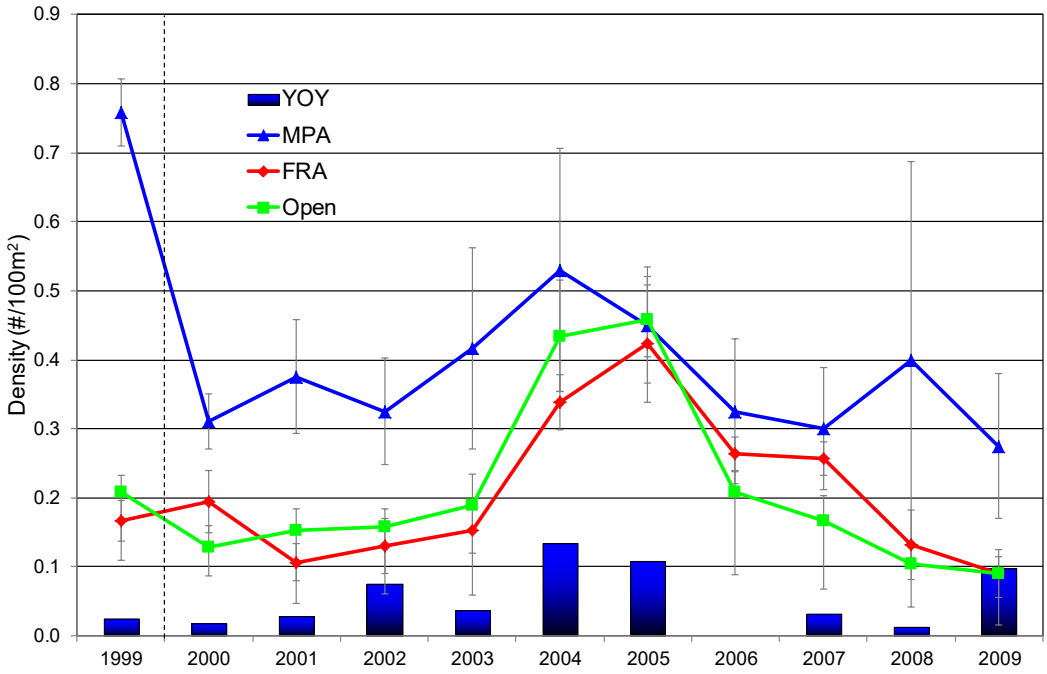


Figure 66. Overall changes in black surgeonfish abundance (Mean ± SE) in FRAs, MPAs and Open areas, 1999-2009. Bars indicate mean density (June-Nov) of black surgeonfish Young-of-Year (YOY).

As observed in previous work (Walsh 1987) and emphasized again in this work, for some species, recruitment can be highly variable between years and repeated low levels of recruitment is a regular occurrence. Without substantial input of the YOY, overall abundances on the deeper reef transects decrease over time due to ontogenetic movement out of settlement habitat and natural mortality. This decrease can occur even in areas which are not subject to aquarium collecting pressure (i.e. FRAs and MPAs).

Although only a few species comprise the bulk of the West Hawai'i aquarium fishery, over 200 different species of fishes and invertebrates have been collected from the reefs over the last five years. Some of these species are uncommon or even rare and presumably have a low resilience to harvesting pressure. Even in protected areas a considerable amount of time may be required for populations of these species to increase. A good example seems to be the flame angelfish, *Centropyge loricula*. This very attractive but uncommon species is highly desired in the aquarium trade. Demand far exceeds the supply Hawai'i can provide so substantial numbers of this species are imported to Hawai'i (for subsequent reshipping) from other locales (e.g. Christmas Island).

Flame angelfish were rarely sighted on transect or free swim surveys during the first seven years of the study (Figure 67). Beginning in 2006 however they have become noticeably more abundant presumably due to one or more years of good recruitment. The recruits are apparently cryptic so not readily surveyed.

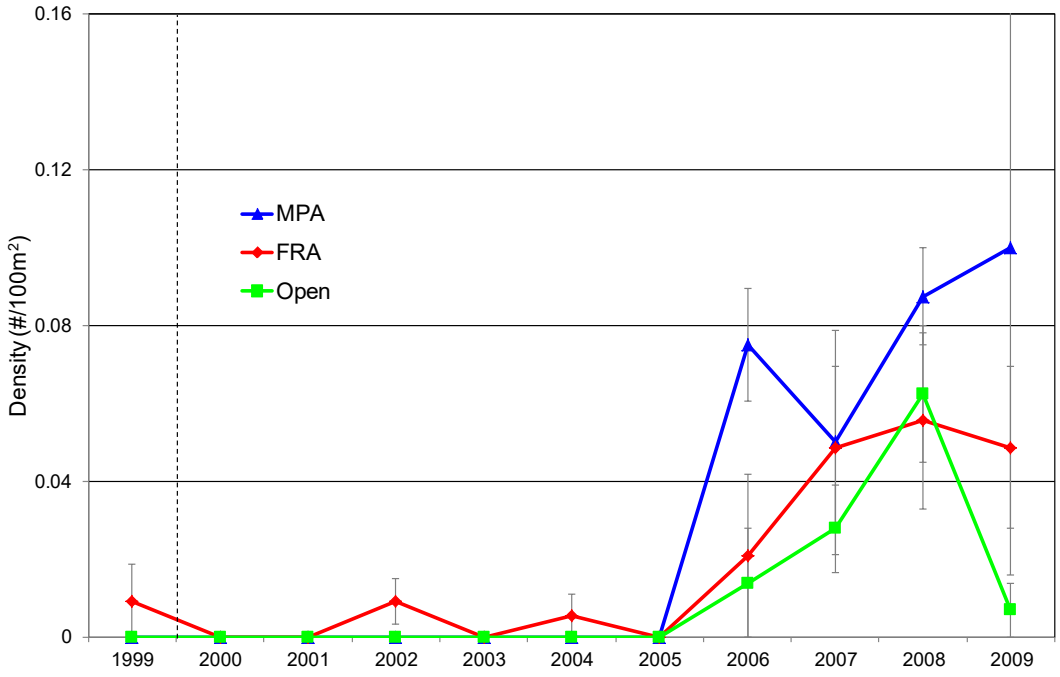


Figure 67. Sightings of flame angelfish in FRAs, MPAs and Open areas, 1999-2009.

Species of Special Concern

Coral reef animals have multiple values and they serve fundamental biodiversity and ecosystem functions. They're important not only to aquarium collectors and other fishers but also to the commercial ocean recreation industry, their visitors and Hawai'i ocean users in general. Management of this resource needs to balance these values and uses. A number of reef fish species are particularly vulnerable to depletion because they may be naturally uncommon or rare but command high prices in the aquarium trade and are thus highly sought after by collectors. Examples include the dragon moray (*Enchelycore pardalis*),Tinker's butterflyfish (*Chaetodon tinkeri*), and bandit angelfish (*Desmoholacanthus arcuatus*). All of these species (and others) are worth more (sometimes considerably more) than $50 each when collected. In a retail aquarium shop in Connecticut the author recently observed a bandit angel that sold for $3,500.

For uncommon or rare species or those that occur in deeper reef habitats, it is difficult and/or unfeasibly expensive to gather solid information on their status and trends. Nevertheless for some of these species such as the Hawaiian turkeyfish there is considerable anecdotal evidence that they have declined in recent decades. It's also clear from a number of our long term studies at Puakō, Ke'ei and Hōnaunau that a number of fairly conspicuous species have likewise declined in abundance over time – most obviously several species of butterflyfish and, in particular, the bandit angelfish.

FRAs are a key component of the sustainable management of the West Hawai'i aquarium fishery. They encompass many of the areas most utilized by residents and dive/snorkel business, and help maintain the biodiversity of our reefs people expect and visitors are willing to pay for. The FRAs do not of course provide protection for species in the open areas. While they do provide a population reservoir, intensive fishing pressure on species with low natural abundances across most of West Hawai'i's reefs is problematic. Concerns over continued expansion of the fishery (up 25% in the last decade) and harvesting effects in the open areas (65% of the coast), necessitate additional management measures.

To address such issues DAR in conjunction with The West Hawai'i Fisheries Council (WHFC) developed a 'white list' of species which could be taken by aquarium fishers (Table 13). The approach taken by the WHFC was based on the fact that the West Hawai'i aquarium fishery is very heavily focused on a relatively small number of species. Six species (yellow tang, goldring surgeonfish, Achilles tang, clown tang, black surgeonfish and Tinker's butterfly) make up 96% of the total catch value averaged over the last 5 years. The 40 species on the white list make up 99% of the total catch value so the great majority of species taken (over 180 species) have very little individual or collective value; nonetheless they are important components of the reef ecosystem. It should be noted no invertebrates are included on the white list.

The white list is part of a Hawai'i Administrative Rule (HAR 13-60.3) Amendment that is currently being processed. Although the list has been recommended and supported by the WHFC and recently approved by the newly formed Big Island Association of Aquarium Fishers (BIAFF) there nevertheless has been some criticism directed at the list. Most of the concern is generally directed to why this species or that species is included on the list (i.e. allowed to be collected). Concerns have been articulated about

collecting impacts on the species' populations and sometimes as to suitability and survivability of the species in captivity.

Aquarium Open vs. FRA Trend Analysis

In order to more comprehensively explore the 40 white list species and the current and potential impact to their populations on the reefs by aquarium collecting two different analyses were undertaken.

The first analysis examined the trends in the % difference in density between areas open to collecting and the FRAs (closed to collecting) for the species on the white list. Density was based on the overall average density of each species for the last three years (2007-2009) at all open and FRA survey sites. The % difference in fish densities between open and FRAs areas for a species was calculated as: $(Density_{OPEN} - Density_{FRA})/Density_{OPEN})$ X 100.

Table 13. Proposed 'White List' of species which can be taken by aquarium collectors within the West Hawai'i Regional Fisheries Management Area.

Common Name	Scientific Name	Common Name	Scientific Name
Achilles Tang	*Acanthurus achilles*	Potter's Angelfish	*Centropyge potteri*
Goldrim Surgeonfish	*Acanthurus nigricans*	Pyramid Butterflyfish	*Hemitaurichthys polylepis*
Yellow Tang	*Zebrasoma flavescens*	Lei Triggerfish	*Sufflamen bursa*
Psychedelic Wrasse	*Anampses chrysocephalus*	Hi Dascyllus	*Dascyllus albisella*
Chevron Tang	*Ctenochaetus hawaiiensis*	Redbarred Hawkfish	*Cirrhitops fasciatus*
Milletseed Butterflyfish	*Chaetodon miliaris*	Hi Whitespotted Toby	*Canthigaster jactator*
Forcepsfish	*Forcipiger flavissimus*	Thompson's Surgeonfish	*Acanthurus thompsoni*
Fourspot Butterflyfish	*Chaetodon quadrimaculatus*	Saddle Wrasse	*Thalassoma duperrey*
Clown Tang	*Naso lituratus*	Brown Surgeonfish	*Acanthurus nigrofuscus*
Yellowtail Coris	*Coris gaimard*	Black Durgon	*Melichthys niger*
Shortnose Wrasse	*Macropharyngodon geoffroy*	Fourstripe Wrasse	*Pseudocheilinus tetrataenia*
Gilded Triggerfish	*Xanthichthys auromarginatus*	Eightstripe Wrasse	*Pseudocheilinus octotaenia*
Goldring Surgeonfish	*Ctenochaetus strigosus*	Bluestripe Snapper	*Lutjanus kasmira*
Spotted Boxfish	*Ostracion meleagris*	Peacock Grouper	*Cephalopholis argus*
Orangeband Surgeonfish	*Acanthurus olivaceus*	Eyestripe Surgeonfish	*Acanthurus dussumieri*
Smalltail Wrasse	*Pseudojuloides cerasinus*	Tinker's Butterflyfish	*Chaetodon tinkeri*
Blackside Hawkfish	*Paracirrhites forsteri*	Blacklip Butterflyfish	*Chaetodon kleinii*
Bird Wrasse	*Gomphosus varius*	Fisher's Angelfish	*Centropyge fisheri*
Multiband Butterflyfish	*Chaetodon multicinctus*	Flame Wrasse	*Cirrhilabrus jordani*
Ornate Wrasse	*Halichoeres ornatissimus*	Hi Longfin Anthias	*Pseudanthias hawaiiensis*

There were 6 species which had distributions and/or behaviors which precluded obtaining accurate density estimates in the survey areas. *Chaetodon Kleinii* is a planktivore which typically feeds above the reef often near drop-offs or in deeper water. *Lutjanus kasmira* is a schooling species more likely to be found in deeper water at reef/sand interfaces while *Centropyge fisheri, Chaetodon tinkeri and Pseudanthias hawaiiensis* inhabit deeper (generally >50') waters. *Acanthurus dussumieri* were rarely recorded on fixed line transects and appeared to be associated with sand areas. Individuals of this species which are encountered are invariably of very large size and

small fish (e.g. YOY) are essentially rarely if ever seen. These four species were excluded from the analyses.
The results of this analysis are presented in the following graphs (Figures 68-70). Given the controversial nature of all aspects of managing the aquarium fishery and the current relevance of the issue, available data for all species are presented.

The columns (bars) represent the % difference in density between open and FRA areas for each year since 1999. Bars below the x axis indicate densities which are lower in the open areas relative to the FRAs and similarly bars above the x axis indicate densities which are higher in the open areas relative to the FRAs. The number to the right of the species name represents the 3 year ('07-'09) % difference.

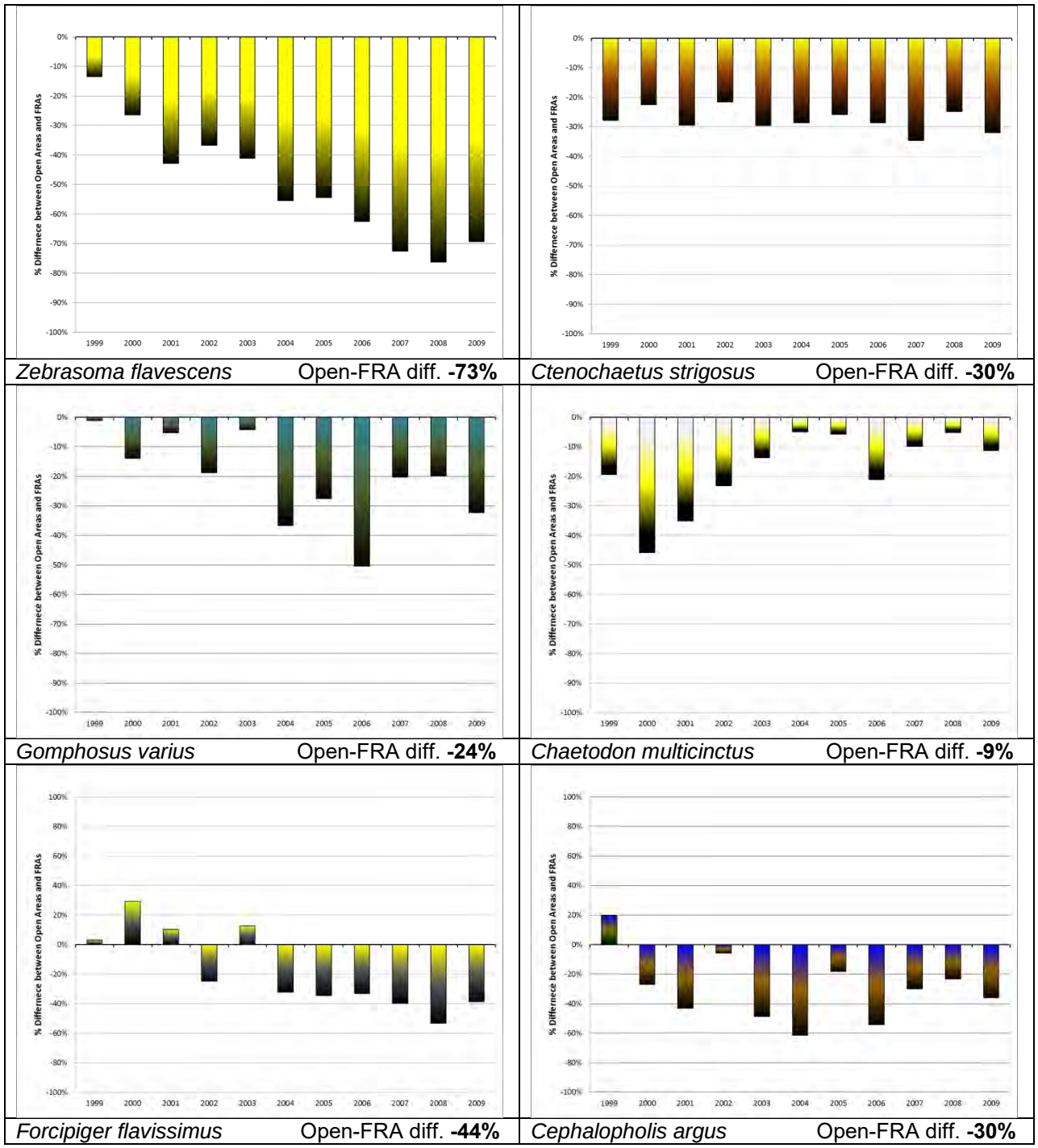
The white list species can be classified into three groups based on their densities in the open areas relative to FRAs. Group1 species (6 spp., Fig 68) had consistently lower densities in the open areas. The yellow tang, *Zebrasoma flavescens* is particularly noteworthy as the disparity between the open areas and the FRAs is substantial and continually increasing. Averaged over the past three years ('07-'09) yellow tang are 73% less abundant in the open areas as compared to the FRAs. Yellow tangs are by far the most heavily targeted species in West Hawai'i and over the past decade the numbers of aquarium collectors and collected fish have increased substantially (Figure 60). A substantial and increasing impact of collecting is clear on yellow tang indicating the need for additional management measures.

The second most collected species, the kole, Ctenochaetus strigosus, also exhibits a collecting impact but in contrast to yellow tang the disparity between open and protected areas has not been increasing. For kole, open areas contain 30% fewer fish than the FRAs. Roi, *Cephalopholis argus* is, also less abundant in the open areas but this is not due to aquarium collecting as very few individuals of this species are collected (Table 14). There is some indication that aquarium collectors kill this grouper on occasion or as a matter of course which may explain the difference between areas.

Group 2 species (12 spp. Figure 69) did not exhibit any consistent pattern of differences in abundance in open vs. FRAs. In some years densities were higher in the FRAs while in other years they were higher in the open areas. In some years there were essentially no differences between areas.

Group 3 species (16 spp., Figure 70) had consistently greater densities of fishes in the open areas vs. the FRAs. This pattern, as with Group 2 species, appears to relate to the comparatively low number of fishes collected relative to the size of their population on the reefs (see Table 14).

In summary, there was clear evidence of collecting impact for only 5 species of the 34 white list species which were analyzed. Four of the 5 (not *G. varius*) were all among the 10 most heavily collected species in the fishery (Walsh 2010). For the others, it appears that, at least based on the past 11 years data, inclusion on the white list poses little or no threat to their populations. The caveat is that this assumes collecting preferences will remain similar to the past decade and the amount of collecting effort (i.e. number of collectors) does not substantially increase. Furthermore these findings do not mean that aquarium collecting may not be having major impacts on species not on the white list especially uncommon, rare and valuable species.



Zebrasoma flavescens Open-FRA diff. **-73%**

Ctenochaetus strigosus Open-FRA diff. **-30%**

Gomphosus varius Open-FRA diff. **-24%**

Chaetodon multicinctus Open-FRA diff. **-9%**

Forcipiger flavissimus Open-FRA diff. **-44%**

Cephalopholis argus Open-FRA diff. **-30%**

Figure 68. White list species showing fairly consistent lower densities in areas open to aquarium collecting. The graph columns represent the % difference in density between open and FRA areas. Bars below the x axis indicate densities are lower in the open areas relative to the FRAs.

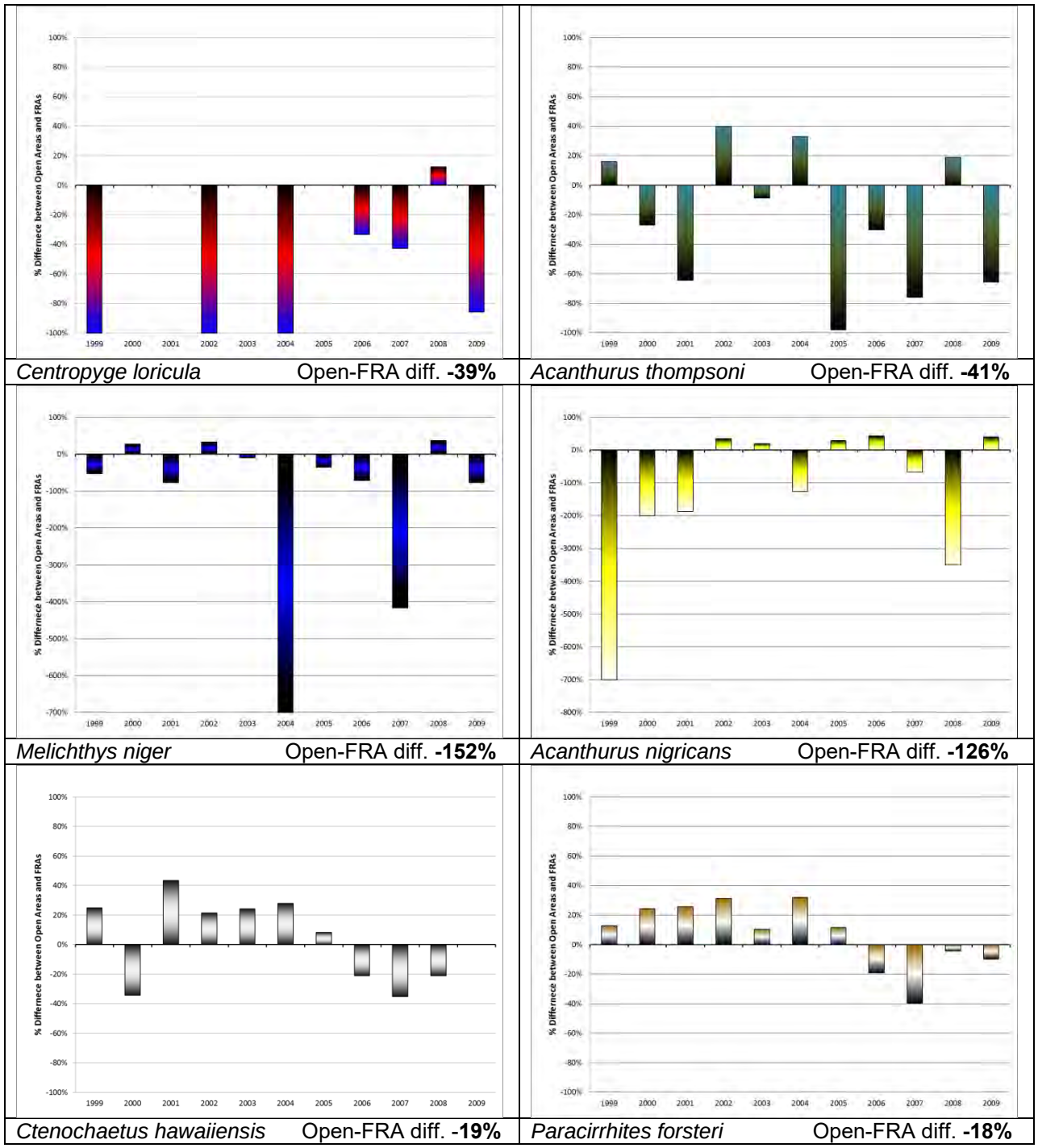


Figure 69. White list species exhibiting inconsistent differences in density between areas open to aquarium collecting and FRAs. The graph columns represent the % difference in density between open and FRA areas. Bars below the x axis indicate densities are lower in the open areas relative to the FRAs. Note different Y axis scale for *M. niger* and *A. nigricans*. Note *C. loricula* (flame angelfish) is *not* on white list and graph is shown just for comparison.

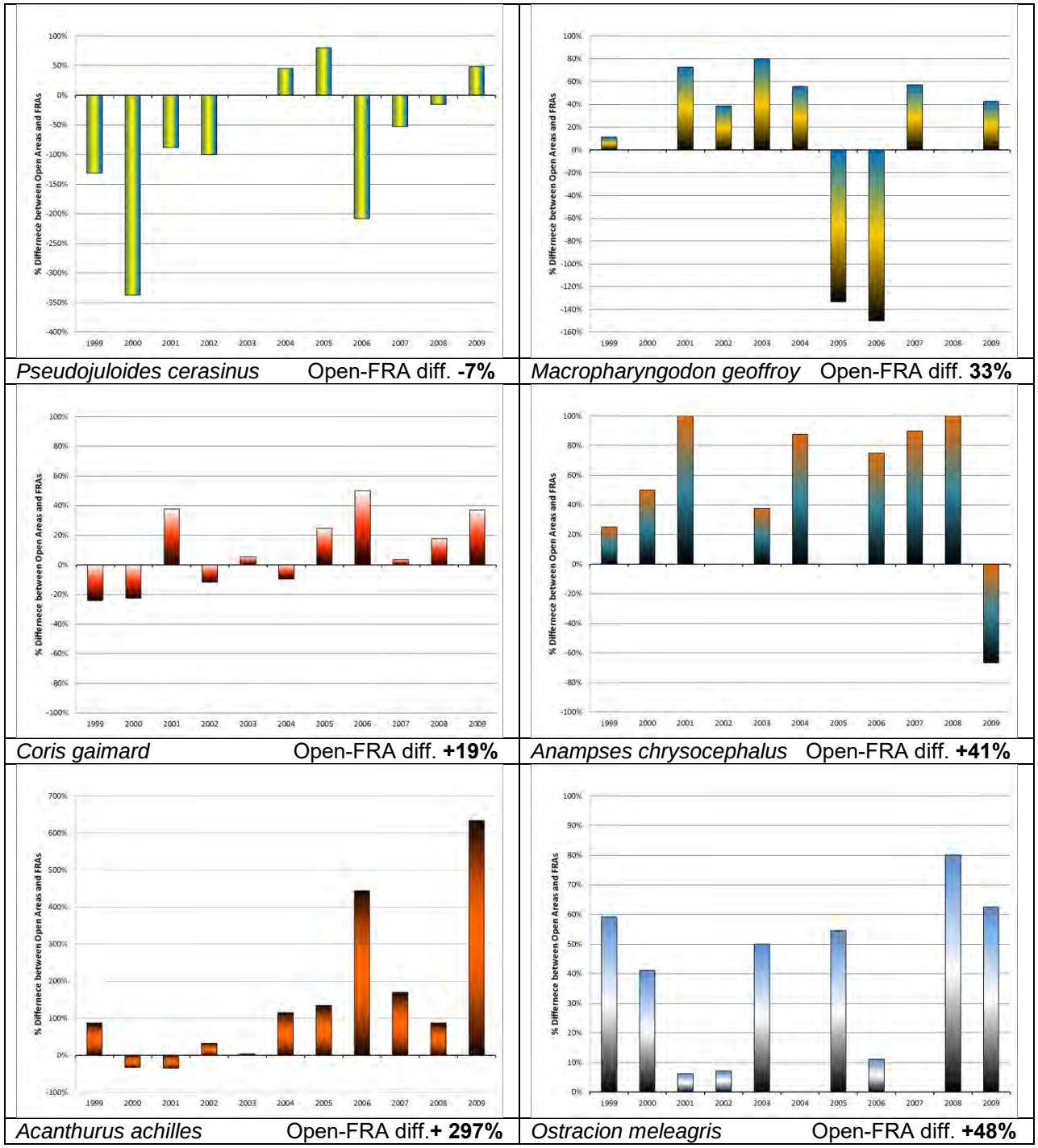
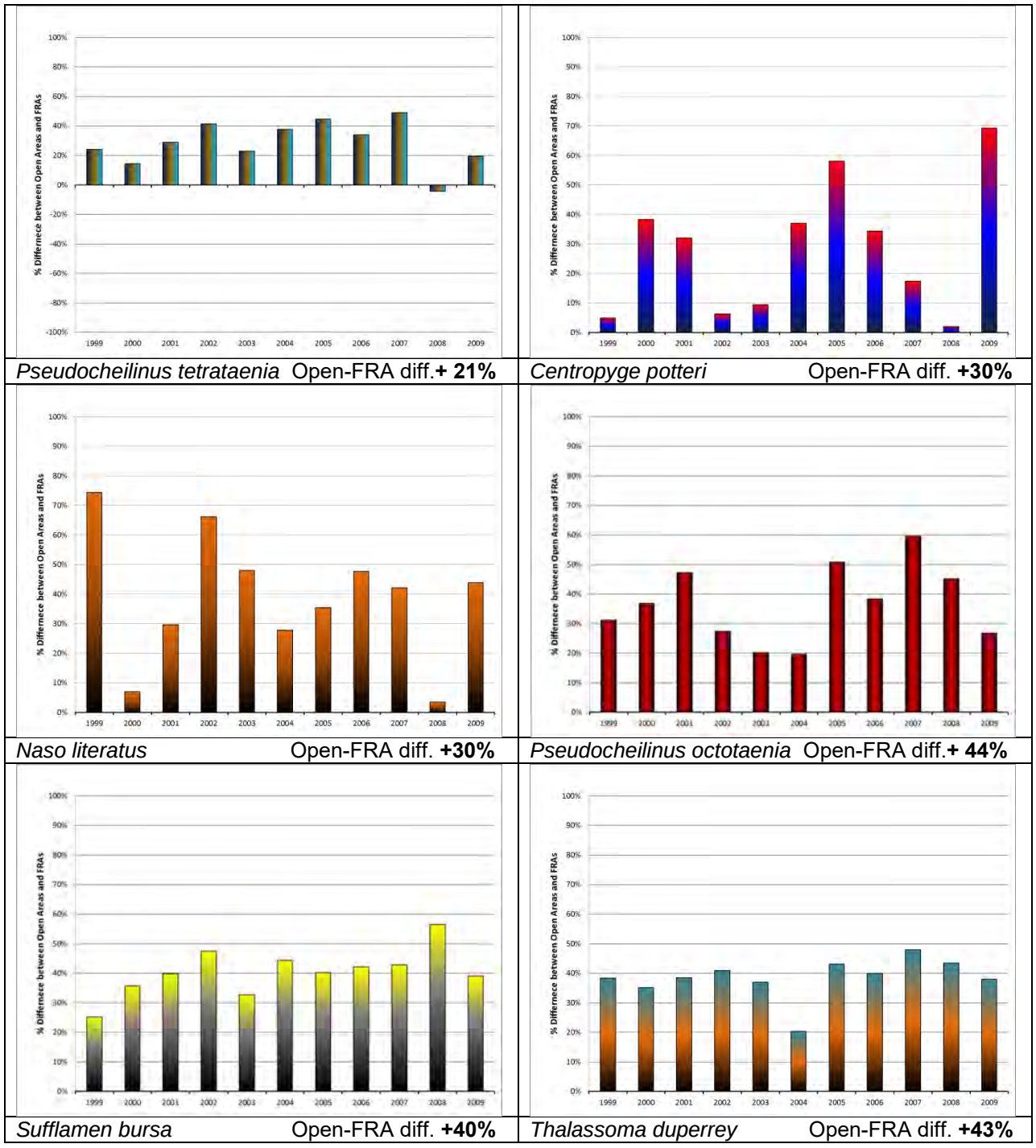


Figure 69 con't. White list species exhibiting inconsistent differences in density between areas open to aquarium collecting and FRAs. The graph columns represent the % difference in density between open and FRA areas. Bars below the x axis indicate densities are lower in the open areas relative to the FRAs. Bars above the x axis indicate densities are higher in the open areas relative to the FRAs. Note different Y axis scale for *P. cerasinus* and *M. geoffroy*.



Pseudocheilinus tetrataenia Open-FRA diff.**+ 21%**

Centropyge potteri Open-FRA diff. **+30%**

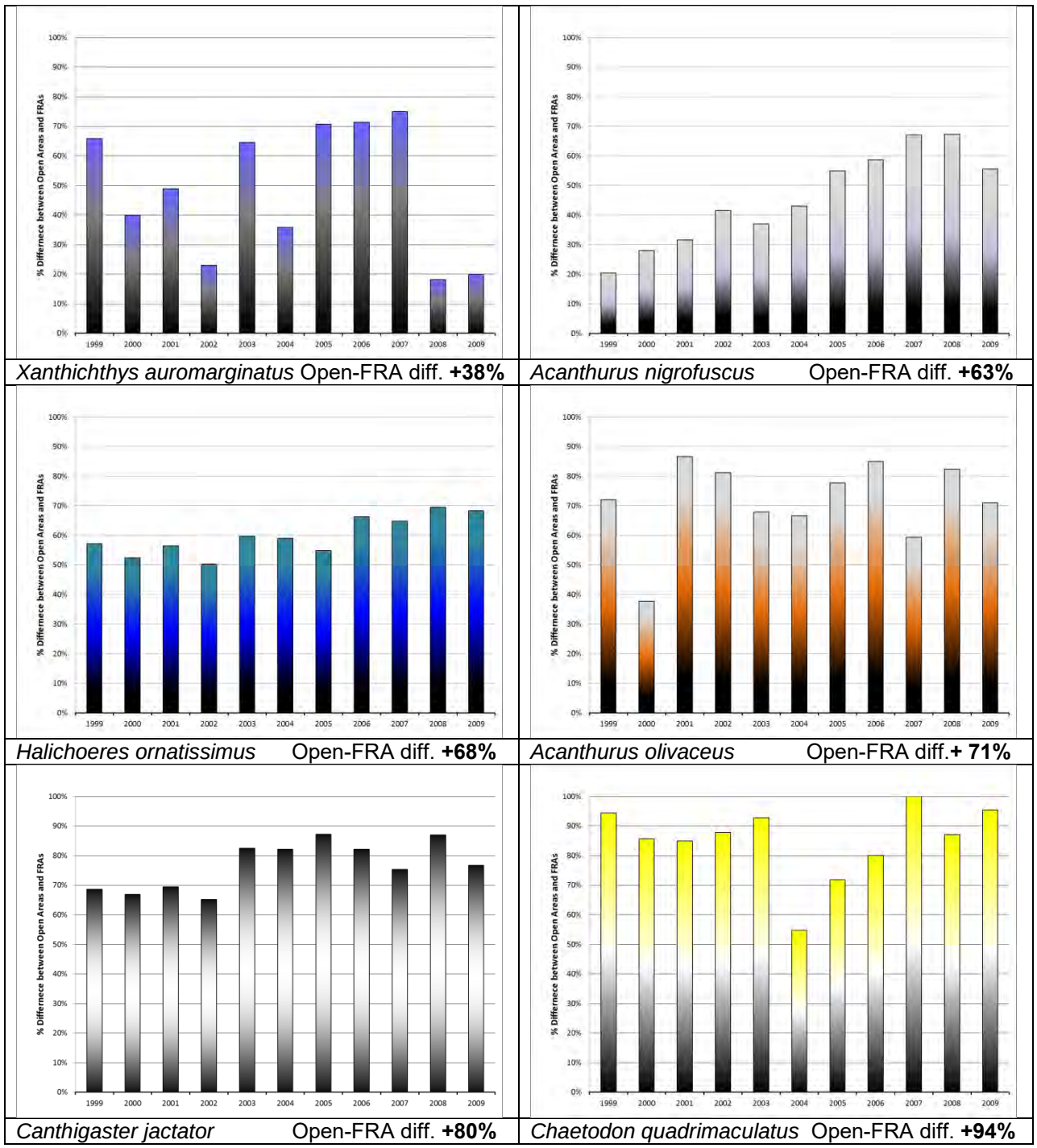
Naso literatus Open-FRA diff. **+30%**

Pseudocheilinus octotaenia Open-FRA diff.**+ 44%**

Sufflamen bursa Open-FRA diff. **+40%**

Thalassoma duperrey Open-FRA diff. **+43%**

Figure 70. White list species exhibiting higher population densities in areas open to collecting relative to FRAs. The graph columns represent the % difference in density between open and FRA areas. Bars above the x axis indicate densities are higher in the open areas relative to the FRAs.



Xanthichthys auromarginatus Open-FRA diff. **+38%**

Acanthurus nigrofuscus Open-FRA diff. **+63%**

Halichoeres ornatissimus Open-FRA diff. **+68%**

Acanthurus olivaceus Open-FRA diff.**+ 71%**

Canthigaster jactator Open-FRA diff. **+80%**

Chaetodon quadrimaculatus Open-FRA diff. **+94%**

Figure 70 con't. White list species exhibiting higher population densities in areas open to collecting relative to FRAs. The graph columns represent the % difference in density between open and FRA areas. Bars above the x axis indicate densities are higher in the open areas relative to the FRAs.

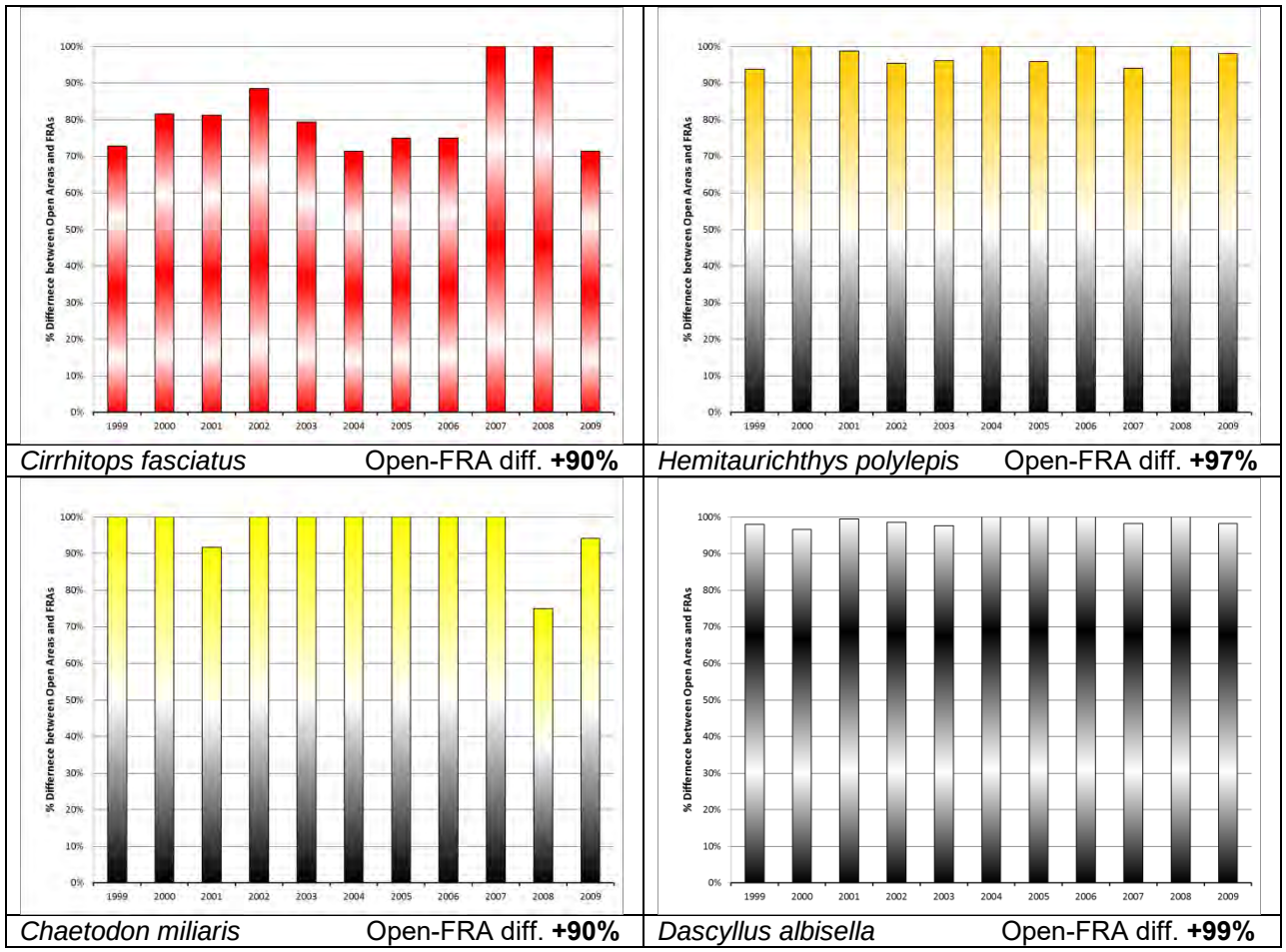


Figure 70 con't. White list species exhibiting higher population densities in areas open to collecting relative to FRAs. The graph columns represent the % difference in density between open and FRA areas. Bars above the x axis indicate densities are higher in the open areas relative to the FRAs.

Aquarium Population and Catch Analysis

The second approach to assessing white list inclusion estimated actual populations of the species on the list and related those numbers to the aquarium catch of that species. Most aquarium collecting in West Hawai'i occurs primarily in mid-depth ranges. While abundance and conditions can and will alter collecting depths, Tissot and Stevenson (2010) reported that the majority of aquarium fishers collect between 41'- 59'. A population estimate was thus made based on a depth range of 30'-60' (open area = 7.08 km^2) which makes fixed transect data highly appropriate (Table 14). Added advantages are that survey sites span a considerable portion of the West Hawai'i coastline and include both open and closed areas.

Mean densities for the same 34 species on the white list for which adequate data existed were calculated for the period 2007-2009 at open survey sites. A GIS was used to determine the total area of hard bottom reef in the 30' -60' depth range that was open to aquarium collecting. Open areas at the extreme north and south parts of the West Hawai'i coast were excluded due to the remoteness of the areas and the difficulty of operating and collecting there. Total populations were the product of open area density

Table 14. Population estimates and % of population taken by aquarium collectors of 'White List' species. 'E' indicates an endemic species, Catch is the average aquarium catch over FY' 06-'10 and Population is an estimate of total numbers of fish in collected open areas of hard bottom from 30'-60' depths. Catch as % of Population is the % of the species' population in collected open areas taken annually by aquarium collectors.

Scientific Name		Catch	30'-60' Population	Catch as % of Population
Acanthurus achilles		8,477	10,655	79.56%
Zebrasoma flavescens		324,211	536,842	60.39%
Ctenochaetus hawaiiensis		3,926	8,524	46.06%
Acanthurus nigricans	E	794	2,951	26.91%
Naso lituratus		5,972	55,405	10.78%
Anampses chrysocephalus	E	229	2,623	8.73%
Forcipiger flavissimus		2,643	33,604	7.87%
Macropharyngodon geoffroy		170	2,623	6.48%
Chaetodon quadrimaculatus		982	16,556	5.93%
Coris gaimard		678	11,802	5.74%
Acanthurus olivaceus		1,039	25,080	4.14%
Chaetodon miliaris		228	5,573	4.09%
Ostracion meleagris		112	3,606	3.11%
Ctenochaetus strigosus		36,244	1,841,492	1.97%
Pseudojuloides cerasinus		175	10,327	1.69%
Gomphosus varius		512	55,733	0.92%
Chaetodon multicinctus	E	1,877	291,288	0.64%
Centropyge potteri		796	123,925	0.64%
Xanthichthys auromarginatus		67	11,802	0.57%
Dascyllus albisella	E	164	29,014	0.57%
Halichoeres ornatissimus		1,040	187,034	0.56%
Paracirrhites forsteri	E	60	11,147	0.54%
Sufflamen bursa		221	42,292	0.52%
Melichthys niger		53	11,474	0.46%
Lutjanus kasmira		26	7,376	0.35%
Thalassoma duperrey		766	257,848	0.30%
Cirrhitops fasciatus	E	11	4,098	0.27%
Acanthurus thompsoni		229	86,059	0.27%
Acanthurus nigrofuscus	E	1,551	892,060	0.17%
Hemitaurichthys polylepis	E	39	22,949	0.17%
Canthigaster jactator		186	123,597	0.15%
Pseudocheilinus octotaenia		118	136,055	0.09%
Pseudocheilinus tetrataenia		119	189,165	0.06%
Cephalopholis argus		2	26,063	0.01%
Chaetodon tinkeri		395	NA	NA
Acanthurus dussumieri	E	473	NA	NA
Chaetodon kleinii		98	NA	NA
Centropyge fisheri		89	NA	NA
Cirrhilabrus jordani		54	NA	NA
Pseudanthias hawaiiensis		39	NA	NA
		Total	5,076,643	

X open area (7.08 km^2). This population was then related to the average catch of the species for the period 2005-2009.

Based on this analysis aquarium collecting is having the largest impacts on Achilles and yellow tang. Achilles tang has had low levels of recruitment over the past decade (Fig 64) and substantial numbers of larger fish (i.e. 'breeders') are taken for human consumption. Given these factors, population declines and a substantial aquarium impact are not surprising. Yellow tang has generally recruited reliably but aquarium take has risen dramatically to currently unsustainable levels.

For most of the species however collecting impact, in terms of the % of the population being removed annually, is relatively low with 10 species having single digit % catch and 19 species having % catch values <1%.

To put the issue of putative roi impacts and community eradication attempts into better perspective, the above analysis estimated the roi population in West Hawai'i at 30' – 60' depths to be 58,839.

Gill net management

As mandated by Legislative Act 306 (SLH 1998) ,a laynet (i.e. gill net) management plan was developed over four years by the WHFC and DAR. The recommended plan became

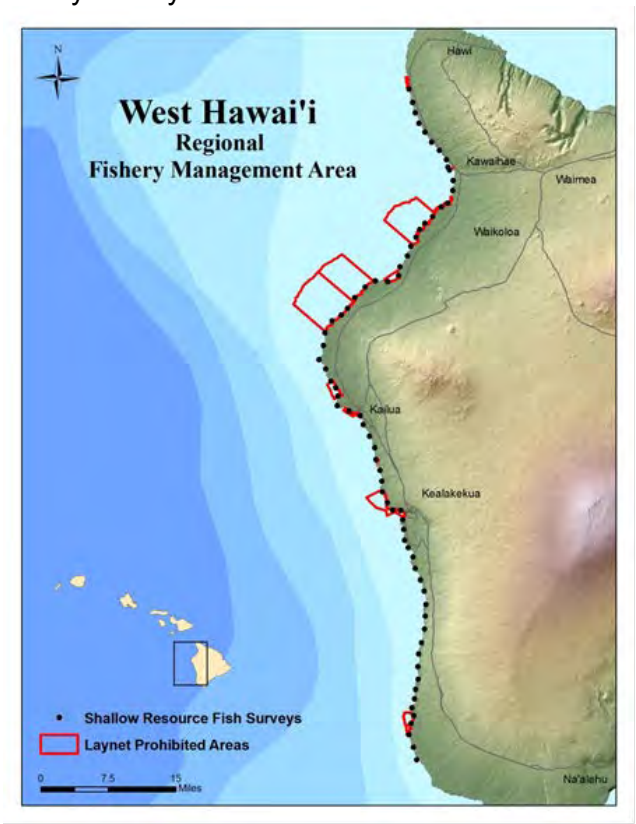


Figure 71. Locations of laynet prohibited areas in West Hawai'i and shallow water resource fish survey sites.

a Hawai'i Administrative Rule in 2005. The rule provides for continued small-scale subsistence-level netting while effectively controlling large-scale commercial netting. Eight areas have been designated where the use of gill nets is prohibited. Along with existing no gill-netting areas, approximately 25% of the coastline now prohibits the use of such nets (Figure 71).

Additional provisions of the rule were designed to encourage responsible net use and enhance enforcement. These include requirements such as net registration and numbered identification (floats and tags), maximum soak time of four hours and maximum net length of 125'. One area (Kaloko-Honokōhau FRA) was designated a Hawaiian cultural netting area where only locally constructed handmade nets of natural fibers may be used. The West Hawai'i laynet rules served as a model for the rest of the state and have generally been adopted elsewhere except for Maui which completely banned their use

Transects conducted in shallow water habitats most likely to be impacted by lay gill netters (Figure 71) indicate there is presently little difference in the biomass of targeted food fishes between areas open to netting and those prohibiting netting either beginning in 2005 or MPAs which have had longer (>10 years) prohibitions on laynetting (Figure 72).

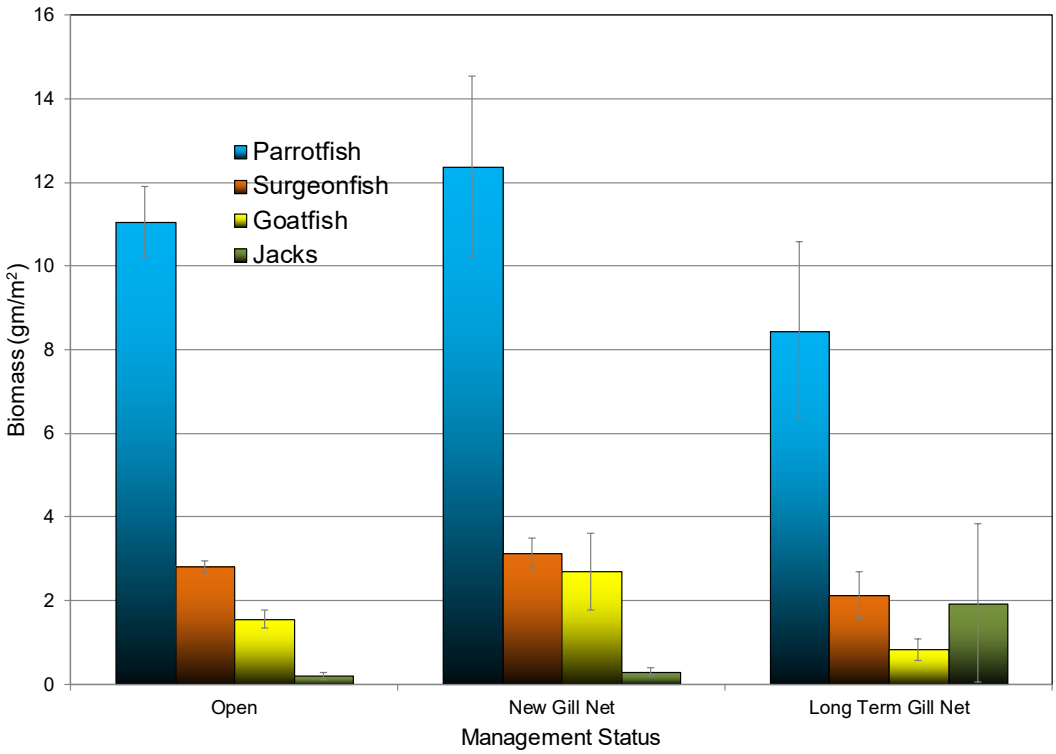


Figure 72. Biomass of 'Resource' (i.e. food) fish on shallow water transects. Only fish > 15 cm TL are censused. 'Open' denotes surveys (n=99) in areas where lay gill netting is permitted. 'New Gill Net' are survey areas (=32) which were closed to gill netting in 2005 and 'Long Term Gill Net' are survey sites (n=11) within MPAs which have prohibited netting for >10 years.

The reasons for the lack of differences between open and laynet protected areas may relate to one or more of several factors: (i) the newly protected areas haven't had sufficient time to work; (ii) the protected areas are not effectively enforced; (iii) the sites of many of the shallow water resource transects may be areas where netting is impractical (i.e. rocky shorelines, sharp reef drop-offs, etc.) and (iv) the overall level of laynet fishing is relatively low. This last factor is supported by the low number of lay gill nets registered in West Hawai'i (52 as of Dec. 2009) as compared to the other islands (e.g. 796 on O'ahu).

Invertebrates - Crown of thorns (COTS)

While *Acanthaster planci* is native to Hawai'i and not an introduced species it nevertheless is of substantial concern to the general public due to its reputation as a 'coral killer' and the publicity generated by massive outbreaks on other Pacific islands. The last reported large-scale occurrence in Hawai'i of the crown-of-thorns starfish, was in August 1969 when approximately 20,000 starfish were observed off the south shore of Moloka`i. Since that time there have only been scattered reports of COTS aggregations and all have been of considerably lesser magnitude. COTS have been implicated in recent coral declines on Maui.

Data from both transect and free-swim surveys reflect the low absolute abundance on the West Hawai'i reefs and indicate a previous increasing trend in COTS abundance has been reversed over the last four years (Figure 73).

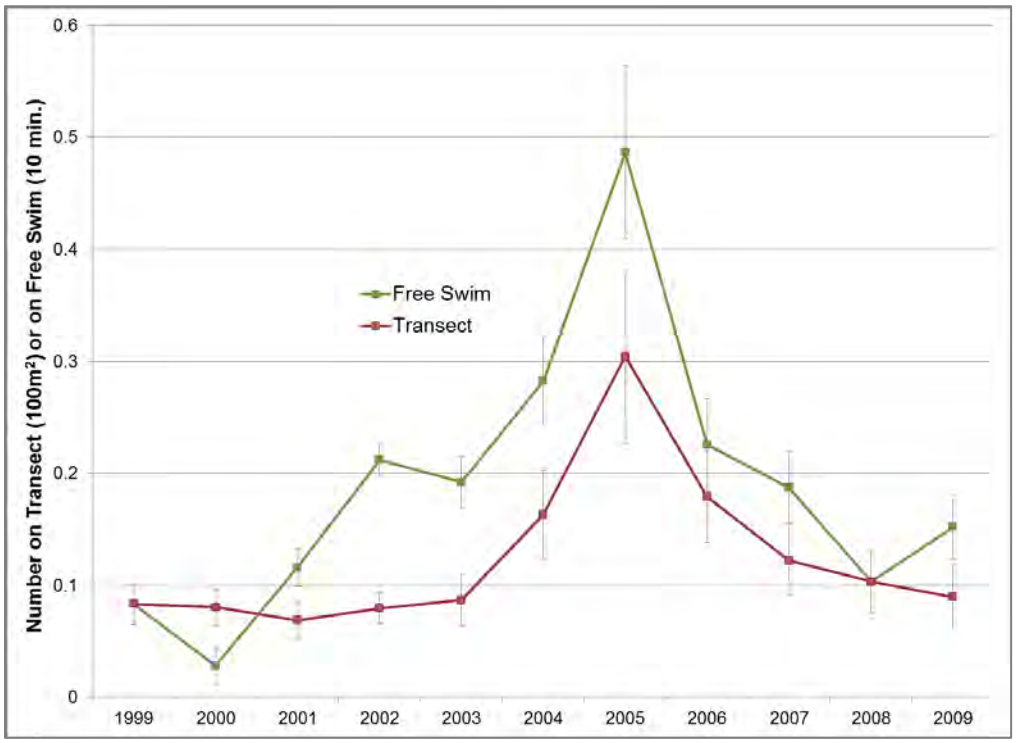


Figure 73. Overall Crown-of-Thorns abundance on West Hawai'i transects and 10 minute free swim surveys.

Urchins

Three of more common surveyed urchin species have increased in West Hawai'i since monitoring began in 1999 with the collector urchin (*Tripneustes gratilla*) showing the greatest increase (figure 74). This increase does not appear to be related to a substantial increase in food supply (i.e. benthic algae) along the coast. Likewise there is no indication that potential food competitors such as herbivorous fishes (e.g. acanthurids) have markedly decreased. In actuality some of the most abundant surgeonfish have increased along with the urchins.

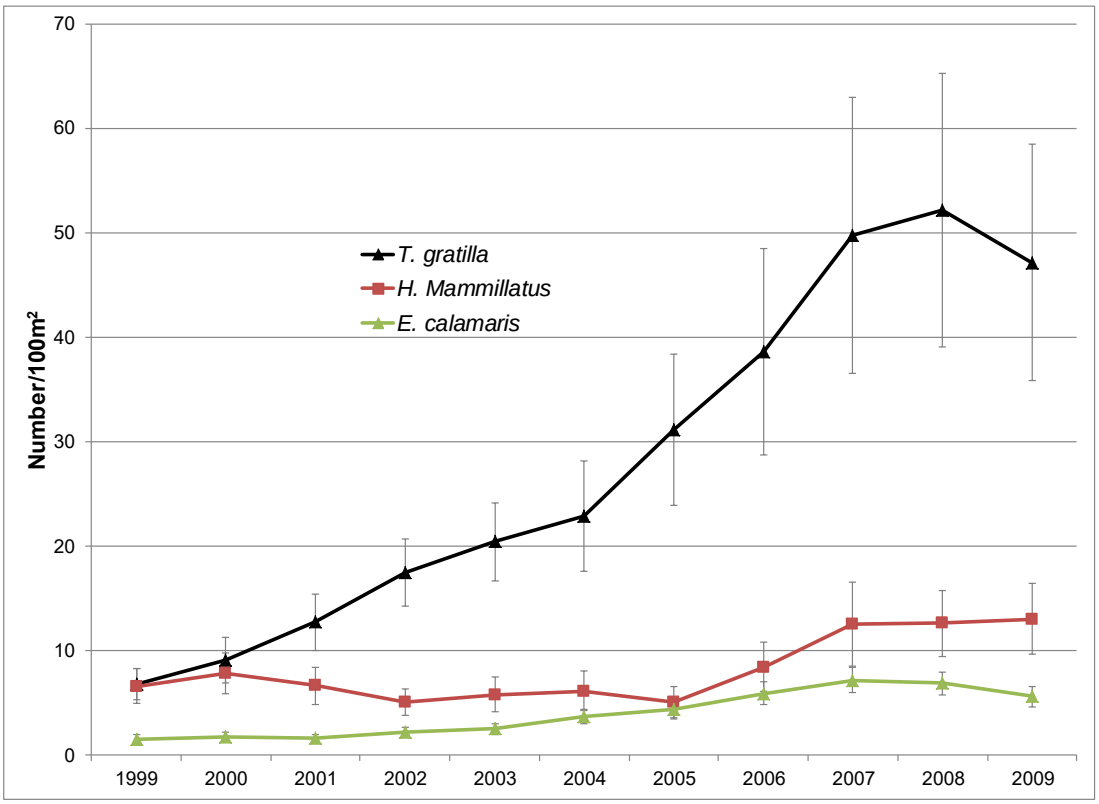


Figure 74. Abundance (*Mean ± SE) of* collector urchin *Tripneustes gratilla,* red pencil urchin *Heterocentrotus mammillatus* and banded urchin *Echinothrix calamaris* on transects.

East Hawai'i Fish Survey Results

To date, abundance of fishes among sites is significantly different, being more abundant at both Waiopae sites than at Richardson's Ocean Center (Figure 75 A). Species richness among sites is also significantly different among sites, being higher on MLCD transects compared to ROC (Figure 75 B). There are no among-site differences in species diversity (p= 0.435) (Figure 75 C). The MLCD and ROC sites have the highest

similarity in their fish communities, and the OPEN and ROC communities have the lowest similarity (Table 15).

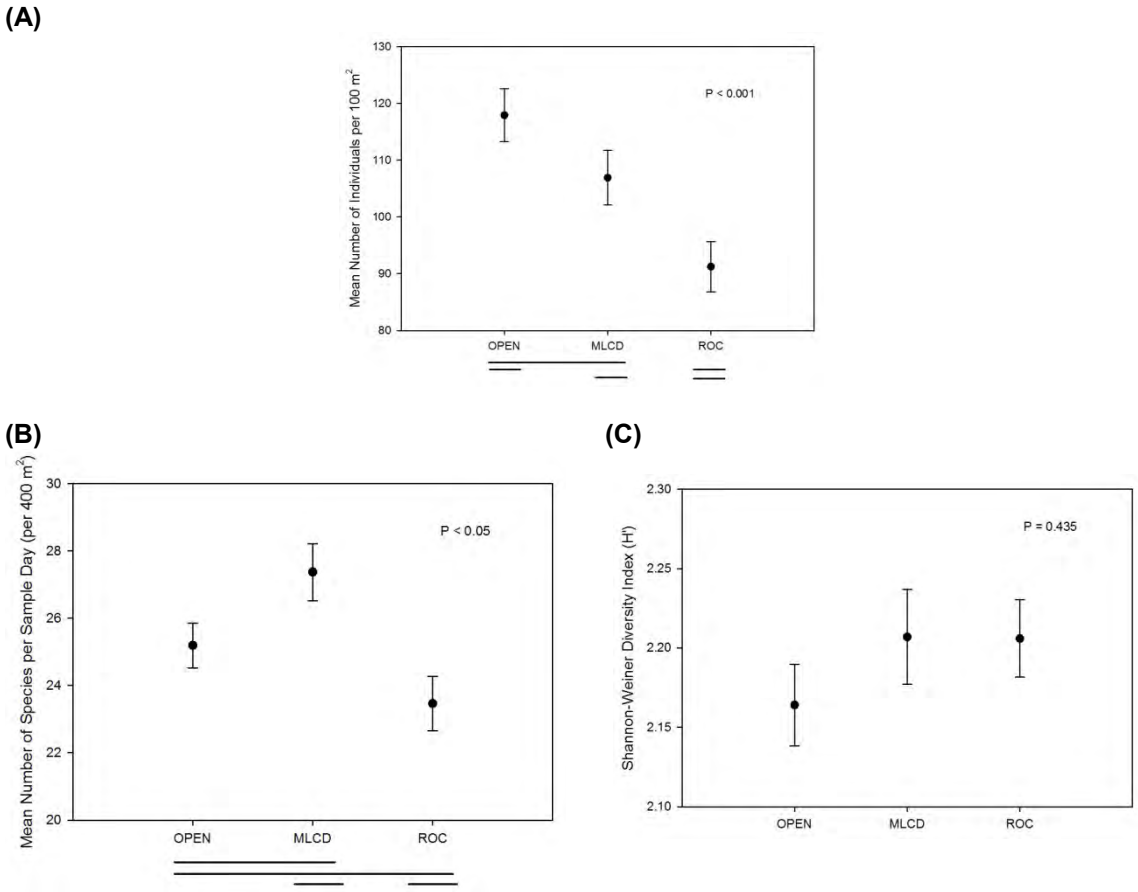


Figure 75. Fish community parameters at Waiopae (MLCD & OPEN) and Richardson's Ocean Center (all survey years pooled) Data are means and standard errors. (A) abundance; (B) Species richness; (C) S-W Diversity.

Table 15. Percent Similarity from pairwise site comparisons.

Location	Percent Similarity
MLCD vs. OPEN	69.3%
MLCD vs. ROC	72.7%
OPEN vs. ROC	53.1%

Over the twelve years of surveying of fishes at Waiopae and Richardson's, there appears to have been a slight increase in fishes observed between 1999 and 2006,

followed by a three-year decline, with an upturn on fishes seen so far in 2010 (Figure 70). There is generally good concordance in the year-to-year abundance of fishes among survey sites (Figure 70). Since the delineation of the Waiopae MLCD on June 16, 2003, no net increase in fish abundance has been observed.

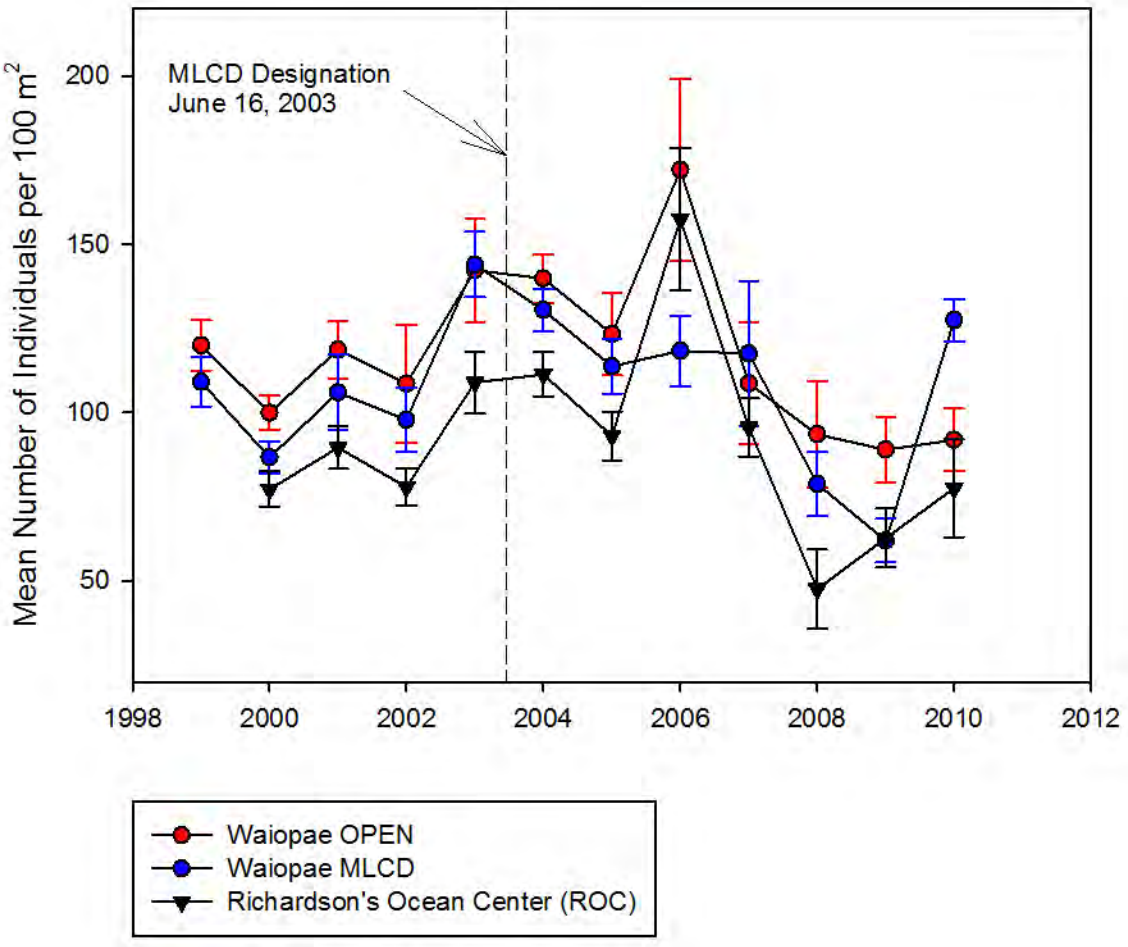


Figure 76. Annual mean abundance (+SE) of fishes at Waiopae and Richardson's Ocean Center.

Of the 136 species recorded on transects at the three locations, most individuals are from one of six families: Labridae, Scaridae, Acanthuridae, Pomacentridae, Tetraodontidae, and Chaetodontidae (Table 15, Figure 71). Labrids and pomacentrids were particularly abundant at all three sampling areas, but scarids were only abundant on Waiopae Open transects. All of the transect lines in this area are deeper than other sites and two traverse a level area with abundant turf algae which appears to attract large numbers of scarids. Species densities at the three East Hawai'i sites are listed in Appendix G.

Table 16. Individuals per 100 m^2 by family at East Hawai'i sites (n = 224 transects at Waiopae Sites; n = 172 at Richardson's Ocean Center).

Family	OPEN	MLCD	ROC
Acanthuridae	13.10	6.12	9.88
Apogonidae	0.02	0.00	0.00
Aulostomidae	0.05	0.02	0.01
Balistidae	0.04	0.05	0.13
Belonidae	0.00	0.10	0.09
Blenniidae	1.30	1.06	0.35
Caracanthidae	0.00	0.01	0.04
Chaetodontidae	2.33	2.99	1.26
Cirrhitidae	0.11	0.40	1.41
Diodontidae	0.00	0.00	0.00
Fistulariidae	0.33	0.09	0.06
Gobiidae	0.03	0.01	0.00
Holocentridae	0.03	0.04	0.01
Kyphosidae	0.00	0.59	0.00
Labridae	48.54	52.46	39.52
Lutjanidae	0.04	0.40	0.00
Monacanthidae	0.02	0.01	0.01
Mugilidae	0.00	0.01	0.11
Mullidae	0.62	0.14	0.05
Muraenidae	0.09	0.14	0.14
Myliobatidae	0.00	0.00	0.00
Ophichthidae	0.00	0.00	0.00
Ostraciidae	0.05	0.19	0.05
Pomacanthidae	0.00	0.00	0.00
Pomacentridae	16.91	33.54	33.31
Scaridae	29.29	4.12	1.31
Scorpaenidae	0.00	0.07	0.23
Serranidae	0.15	0.41	0.01
Synodontidae	0.03	0.03	0.03
Tetraodontidae	4.12	4.11	2.72
Zanclidae	0.06	0.10	0.03
Pooled Individuals/100 m^2 =	117.3	107.2	90.7

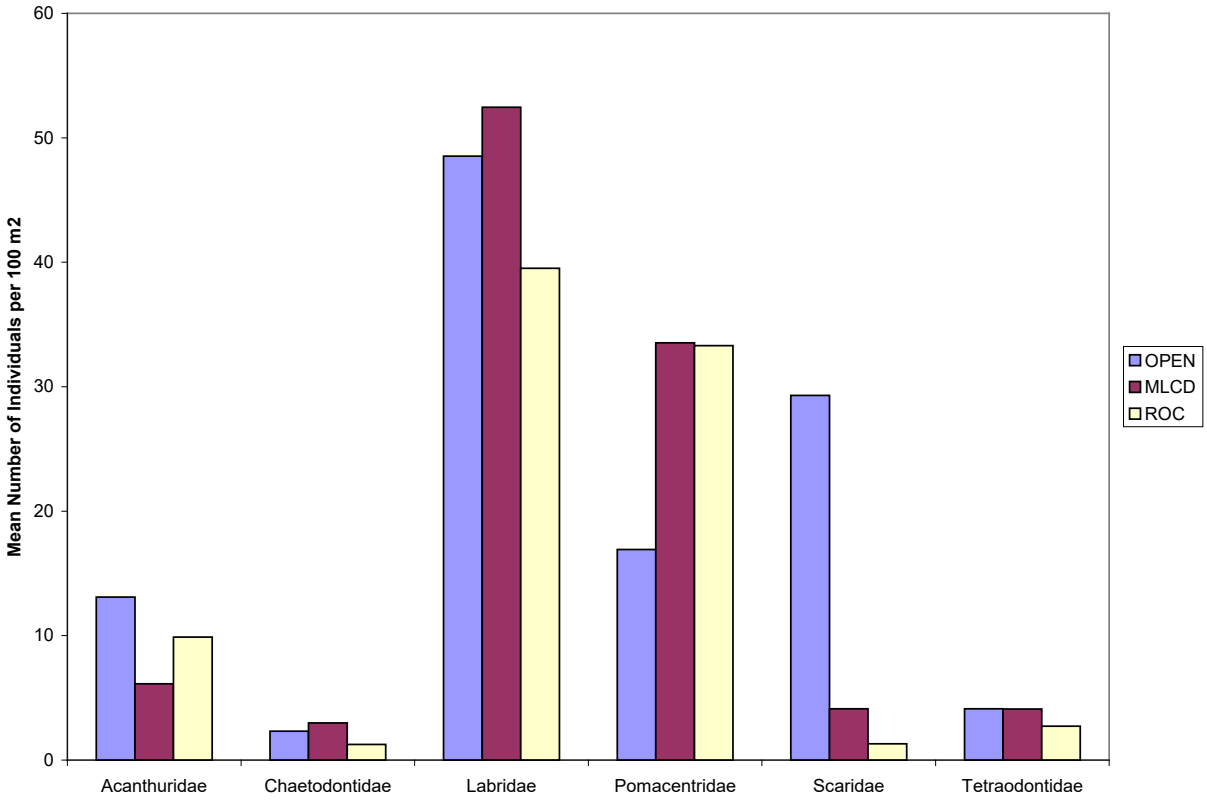


Figure 77. Wai Opae Open/MLCD and ROC fish abundance by family (all years pooled).

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Appendix A

Occurrences of eight coral diseases documented across 30 monitoring sites in West Hawai‘i (GA = growth anomaly, TRE = trematodiasis, TLS = tissue loss syndrome, MFTL = multifocal tissue loss, HYP = hypermycosis).

ID	Site	*Porites* GA	*Porites* TRE	*Porites* TLS	*Porites* MFTL	*Pavona* HYP	*Montipora* GA	*Pocillopora* senescence reaction	*Pocillopora* TLS
SITE1	Lapakahi	x	x						
SITE2	Kamilo Gulch	x		x					
SITE3	Waiaka‘ilio Bay	x		x					
SITE4	Puakō	x	x	x		x			
SITE5	Mauna Lani	x	x	x					
SITE6	Keawaiki		x			x			
SITE7	Ka‘upulehu	x	x						
SITE8	Makalawena	x	x	x		x	x		
SITE97	Unualoha Pt.		x				x	x	
SITE9	Wawaloli Beach	x	x	x					
SITE10	Wawaloli FMA	x	x	x			x		
SITE11	Kaloko-Honokōhau	x	x	x					
SITE13	Papawai	x	x	x					
SITE98	Old Kona Airport	x	x	x					
SITE14	S. Oneo Bay	x	x	x		x			
SITE15	Keauhou	x	x	x					
SITE15x	Keauhou X	x	x	x		x			
SITE15y	Keauhou Y	x	x	x	x				
SITE15z	Keauhou Z	x	x	x					
SITE16	Kualani Pt. (Red Hill)	x	x	x	x		x		
SITE17	Red Hill	x	x						
SITE18	Keopuka	x		x					
SITE19	Kealakekua	x	x	x		x			
SITE20	Ke‘ei	x	x	x	x				
HO	Hōnaunau drop off	x	x	x					
SITE21	Ho‘okena (Kalahiki)	x	x	x	x				
SITE22	Ho‘okena (Auau)	x		x				x	x
SITE23	Omaka‘a Bay	x	x	x			x		
SITE99	Okoe Bay	x	x	x					
SITE24	Manukā	x	x	x					

Appendix B. West Hawai'i Benthic Cover 2007 Surveys

Broad Benthic Categories

Survey Site	Coral	Turf-Bare	Crustose Coralline	Encrusting Macroalgae	Macroalgae	Sand	Sessile Invert	Other
'Anaeho'omalu	31.5%	56.9%	7.1%	0.1%	0.3%	2.4%	0.1%	1.6%
Ho'okena	28.4%	57.7%	4.8%	2.3%	6.3%	0.1%	0.1%	0.3%
Honokōhau	48.5%	31.6%	3.3%	0.5%	0.3%	2.4%	12.9%	0.1%
Kalahiki	39.6%	48.3%	5.2%	2.2%	1.5%	2.0%	0.0%	1.2%
Kamilo	38.2%	51.0%	7.1%	0.3%	0.2%	0.7%	0.0%	2.3%
Ka'upulehu	31.2%	59.9%	5.8%	0.2%	0.0%	1.8%	0.0%	1.3%
Keawaiki	16.7%	74.9%	5.7%	0.4%	0.2%	0.3%	0.1%	1.7%
Kealakekua	28.6%	65.0%	4.1%	0.7%	0.1%	0.1%	0.0%	1.4%
Ke'ei	28.7%	58.4%	3.6%	0.4%	6.9%	0.3%	0.0%	1.7%
Keopuka	15.6%	75.8%	4.1%	1.3%	0.1%	1.8%	0.1%	1.2%
Kualanui	59.8%	33.4%	3.7%	0.1%	1.3%	0.3%	0.1%	1.1%
Lapakahi	11.4%	56.7%	1.6%	0.9%	0.2%	28.6%	0.1%	1.4%
Makalawena	47.6%	47.5%	1.9%	0.1%	0.0%	1.8%	0.2%	0.6%
Manukā	33.2%	52.9%	9.7%	1.2%	0.1%	1.5%	0.0%	1.5%
N. Keauhou	31.1%	61.4%	5.0%	0.4%	0.4%	0.5%	0.1%	1.1%
Omaka'a	27.1%	61.8%	2.5%	0.2%	0.2%	7.7%	0.0%	0.5%
Papawai	38.3%	39.9%	3.1%	0.6%	4.0%	1.9%	11.0%	1.2%
Puakō	47.8%	42.0%	6.7%	0.6%	0.2%	0.3%	0.0%	2.4%
Red Hill	33.2%	59.4%	2.2%	1.8%	0.1%	2.7%	0.0%	0.6%
S. Oneo	61.9%	31.7%	3.7%	0.9%	0.1%	1.2%	0.1%	0.0%
Waiaka'ilio	42.5%	47.7%	5.5%	0.5%	0.1%	1.2%	0.1%	2.2%
Wawaloli	37.5%	55.3%	3.1%	0.1%	0.0%	0.4%	3.1%	0.5%
Wawaloli Beach	42.3%	52.8%	0.3%	0.0%	0.0%	3.1%	0.3%	1.3%
Keauhou X	57.6%	37.6%	3.3%	0.3%	0.1%	0.6%	0.5%	0.3%
Keauhou Y	40.3%	55.0%	3.0%	0.1%	0.2%	1.0%	0.0%	0.4%
Keauhou Z	42.5%	45.9%	6.6%	0.4%	0.1%	1.2%	2.6%	0.7%
Okoe Bay	34.0%	55.3%	6.0%	0.0%	0.1%	3.3%	0.0%	1.3%
Old Kona Airport	53.2%	25.2%	2.4%	0.3%	0.1%	10.8%	8.0%	0.0%
Unualoha	36.8%	57.3%	1.1%	0.1%	1.1%	1.4%	0.3%	1.8%

Appendix C. West Hawai'i Coral Cover By Species 2007 Surveys

Survey Site	*Montipora capitata*	*Montipora patula*	*Pavona varians*	*Pocillopora meandrina*	*Porites compressa*	*Porites evermanni*	*Porites lobata*	Other
Anaeho'omalu	1.1%	0.8%	0.6%	0.3%	14%	0.0%	14.2%	0.4%
Ho'okena	3.5%	0.2%	0.0%	2.3%	3.4%	0.4%	19.4%	0.0%
Honokōhau	0.2%	0.0%	0.0%	0.3%	16.0%	0.5%	31.4%	0.4%
Kalahiki	0.1%	0.0%	0.0%	0.3%	13.6%	1.0%	25.5%	0.1%
Kamilo	0.6%	0.1%	0.1%	0.0%	17.1%	0.0%	20.5%	0.2%
Ka'upulehu	0.2%	0.1%	0.1%	0.2%	2.8%	0.0%	27.6%	0.2%
Keawaiki	0.7%	1.6%	1.9%	0.0%	7.4%	0.0%	4.9%	0.1%
Kealakekua	0.1%	0.0%	1.1%	0.2%	11.9%	0.2%	14.9%	0.4%
Ke'ei	0.2%	0.0%	0.1%	0.1%	20.2%	1.5%	6.7%	0.0%
Keopuka	0.2%	0.3%	0.0%	4.8%	1.6%	0.6%	8.2%	0.1%
Kualanui	0.1%	0.4%	0.1%	0.7%	3.2%	18.7%	36.8%	0.0%
Lapakahi	0.1%	0.0%	0.0%	0.0%	1.7%	0.2%	9.4%	0.1%
Makalawena	2.0%	2.6%	1.7%	1.5%	6.2%	0.1%	27.8%	5.7%
Manukā	0.3%	0.0%	0.0%	0.3%	9.9%	1.0%	22.2%	0.1%
N. Keauhou	0.0%	0.0%	0.3%	0.0%	21.2%	0.1%	9.7%	0.0%
Keauhou X	0.1%	0.0%	0.1%	0.0%	18.8%	2.9%	35.7%	0.0%
Keauhou Y	0.1%	0.1%	0.0%	0.0%	26.1%	0.0%	13.2%	0.0%
Keauhou Z	0.0%	0.0%	0.0%	0.1%	24.0%	0.5%	19.1%	0.0%
Okoe Bay	0.3%	0.0%	0.0%	0.3%	4.5%	2.6%	26.3%	0.0%
Old Kona Airport	0.2%	0.0%	0.0%	0.5%	14.1%	0.6%	38.0%	0.0%
Omaka'a	0.9%	0.1%	0.1%	1.2%	7.7%	2.3%	14.9%	0.1%
Papawai	0.2%	0.1%	0.1%	0.4%	3.5%	1.8%	32.4%	0.3%
Puakō	1.3%	0.7%	0.2%	0.5%	17.2%	0.3%	27.2%	1.0%
Red Hill	1.0%	0.2%	0.1%	1.4%	10.2%	1.7%	19.4%	0.0%
S. Oneo	0.2%	0.5%	0.6%	0.3%	30.5%	1.7%	28.2%	0.0%
Unualoha	1.0%	0.1%	0.0%	3.3%	4.5%	0.3%	26.5%	0.2%
Waiaka'ilio	0.5%	0.4%	0.5%	0.3%	14.7%	0.0%	26.4%	0.1%
Wawaloli	0.5%	0.0%	0.1%	3.9%	4.0%	0.3%	28.0%	0.9%
Wawaloli Beach	1.1%	0.0%	0.0%	0.9%	4.0%	1.4%	34.8%	0.0%

Appendix D. West Hawai`i Benthic Cover 2003 Surveys

Broad Benthic Categories

Survey Site	Coral	Turf-Bare	Crustose Coralline	NCC Macroalgae	Macroalgae	Sand	Sessile Invert	Other
‘Anaeho’omalu	41.2%	38.8%	8.6%	0.6%	0.0%	3.3%	0.0%	7.5%
Ho’okena	28.5%	55.3%	6.1%	4.3%	0.2%	1.0%	0.3%	4.3%
Honokōhau	48.3%	18.5%	6.8%	0.5%	0.1%	1.7%	11.6%	12.4%
Kalahiki	37.1%	45.6%	5.4%	2.8%	0.3%	3.1%	0.0%	5.7%
Kamilo	49.5%	29.1%	7.4%	3.9%	1.2%	1.1%	0.0%	7.9%
Ka’upulehu	40.9%	40.7%	8.5%	0.3%	0.0%	1.6%	0.0%	7.9%
Keawaiki	29.9%	51.7%	9.4%	0.0%	0.6%	0.2%	0.0%	8.1%
Kealakekua	27.7%	51.1%	8.0%	2.5%	0.0%	0.0%	0.0%	10.7%
Ke’ei	31.3%	40.0%	14.3%	0.9%	0.0%	0.2%	0.0%	13.4%
Keopuka	16.5%	62.5%	8.2%	1.8%	0.0%	1.3%	0.0%	9.6%
Kualanui	53.3%	36.0%	4.6%	0.7%	0.0%	0.4%	0.2%	4.7%
Lapakahi	19.5%	53.8%	1.4%	0.9%	0.0%	23.0%	0.0%	1.3%
Makalawena	45.2%	44.8%	4.0%	0.3%	0.0%	2.3%	0.1%	3.3%
Manukā	30.8%	50.4%	9.0%	2.7%	0.1%	2.1%	0.0%	4.8%
N. Keauhou	32.9%	41.5%	15.1%	0.4%	0.0%	0.2%	1.3%	8.5%
Omaka'a	30.2%	52.2%	4.2%	0.7%	0.0%	8.4%	0.0%	4.3%
Papawai	32.8%	30.1%	6.2%	0.5%	0.0%	3.0%	19.8%	7.6%
Puakō	49.9%	32.2%	7.5%	0.9%	0.0%	0.9%	0.0%	8.6%
Red Hill	31.5%	40.9%	6.6%	3.9%	0.2%	5.3%	0.8%	10.7%
S. Oneo	57.0%	23.3%	10.5%	0.3%	0.1%	2.1%	0.2%	6.6%
Waiaka’ilio	54.4%	29.1%	5.3%	0.9%	0.8%	1.3%	0.1%	8.1%
Wawaloli	37.9%	45.8%	2.3%	0.2%	0.3%	2.0%	2.5%	9.0%
Wawaloli Beach	33.8%	51.9%	2.4%	0.2%	0.0%	7.1%	0.3%	4.3%

Appendix E. West Hawai`i Coral Cover By Species 2003 Surveys

Survey Site	*Montipora capitata*	*Montipora patula*	*Pavona varians*	*Pocillopora meandrina*	*Porites compressa*	*Porites evermanni*	*Porites lobata*	Other
‘Anaeho’omalu	0.8%	2.2%	1.0%	1.1%	15.2%	0.2%	19.6%	1.2%
Ho’okena	1.6%	0.7%	0.0%	2.0%	2.0%	0.3%	19.3%	2.4%
Honokōhau	0.0%	0.0%	0.0%	0.2%	14.4%	1.8%	31.8%	0.0%
Kalahiki	0.0%	0.0%	0.0%	0.2%	13.4%	0.0%	22.9%	0.6%
Kamilo	0.8%	0.2%	0.1%	0.2%	23.3%	0.1%	24.3%	0.4%
Ka’upulehu	0.2%	0.1%	0.0%	0.3%	6.7%	1.1%	31.9%	0.4%
Keawaiki	0.5%	3.8%	1.4%	0.9%	12.7%	0.0%	8.9%	1.6%
Kealakekua	0.1%	0.3%	1.9%	0.2%	10.6%	0.0%	13.7%	0.8%
Ke’ei	0.1%	0.0%	0.1%	0.0%	19.6%	1.8%	9.4%	0.1%
Keopuka	0.0%	0.1%	0.1%	4.2%	1.0%	0.0%	9.6%	1.6%
Kualanui	0.5%	0.5%	0.1%	0.1%	3.0%	13.7%	34.3%	1.2%
Lapakahi	0.2%	0.0%	0.0%	0.6%	3.1%	0.0%	15.4%	0.1%
Makalawena	1.0%	4.0%	1.0%	1.0%	6.4%	0.5%	26.5%	4.7%
Manukā	0.2%	0.0%	0.0%	0.4%	7.6%	0.4%	21.5%	0.7%
N. Keauhou	0.0%	0.0%	0.6%	0.0%	16.2%	0.0%	15.0%	1.0%
Omaka’a	0.5%	0.4%	0.1%	0.2%	6.8%	2.3%	18.4%	1.4%
Papawai	0.2%	0.1%	0.0%	0.8%	1.8%	0.8%	28.1%	1.0%
Puakō	0.4%	1.7%	0.3%	0.7%	16.9%	0.2%	28.5%	1.3%
Red Hill	0.6%	0.1%	0.1%	0.6%	10.0%	2.0%	16.9%	1.1%
S. Oneo	0.2%	0.6%	0.4%	0.2%	27.2%	1.9%	25.4%	1.0%
Waiaka’ilio	0.6%	2.3%	0.1%	0.7%	19.4%	0.0%	30.5%	0.8%
Wawaloli	0.1%	0.1%	0.0%	5.5%	3.5%	0.0%	27.3%	1.3%
Wawaloli Beach	0.4%	0.1%	0.0%	1.5%	3.2%	1.7%	26.1%	0.7%

Appendix F.

Table 2003 and 2007 Octocoral Percent Cover Comparison

Sites (North to South)	2003	2007	P=
Lapakahi (01)	0.0%	0.0%	N/A
Kamilo (2)	0.0%	0.0%	N/A
Waiaka'ilio Bay (03)	0.0%	0.0%	N/A
Puakō (4)	0.0%	0.0%	N/A
'Anaeho'omalu (05)	0.0%	0.0%	N/A
Keawaiki (06)	0.0%	0.0%	N/A
Ka'upulehu (07)	0.0%	0.0%	N/A
Makalawena (8)	0.0%	0.0%	N/A
Wawaloli Beach (09)	0.4%	0.3%	0.908
Wawaloli (10)	2.3%	3.1%	0.232
Honokōhau (11)	10.6%	12.7%	0.592
Papawai (13)	18.2%	10.9%	0.018
S. Oneo Bay (14)	0.2%	0.1%	0.058
N. Keauhou (15)	1.2%	0.1%	0.13
Kualanui Pt. (16)	0.1%	0.1%	0.231
Red Hill (17)	0.5%	0.0%	0.262
Keopuka (18)	0.0%	0.0%	N/A
Kealakekua Bay (19)	0.0%	0.0%	N/A
Ke'ei (20)	0.0%	0.0%	N/A
Ho'okena (Kalahiki) (21)	0.2%	0.0%	0.141
Ho'okena (Auau) (22)	0.0%	0.0%	N/A
Miloli'i (Omaka'a) (23)	0.0%	0.0%	N/A
Miloli'i (Manuka) (24)	0.0%	0.0%	N/A

APPENDIX G.

Table X3. Individuals per 100 m^2 by species at East Hawai'i sites (n = 224 transects at Waiopae; n = 172 at Richardson's Ocean Center).

Taxa	OPEN	MLCD	ROC
Abudefduf abdominalis	0.09	0.74	3.20
Abudefduf sordidus	0.00	0.22	0.03
Abudefduf vaigiensis	0.00	0.04	0.05
Acanthurus achilles	0.00	0.04	0.01
Acanthurus blochii	0.02	0.00	0.00
Acanthurus leucopareius	0.03	0.25	0.25
Acanthurus nigrofuscus	10.35	2.92	6.18
Acanthurus nigroris	0.00	0.04	0.02
Acanthurus triostegus	1.83	2.48	3.36
Aetobatis narinari	0.00	0.00	0.00
Aluterus scriptus	0.00	0.00	0.00
Anampses chrysocephalus	0.00	0.00	0.00
Anampses cuvier	0.03	0.00	0.01
Apogon kallopterus	0.01	0.00	0.00
Apogon menesemus	0.00	0.00	0.00
Arothron hispidus	0.03	0.02	0.01
Arothron meleagris	0.08	0.24	0.07
Asterropteryx semipunctatus	0.03	0.00	0.00
Aulostomus chinensis	0.05	0.02	0.01
Belonidae	0.00	0.01	0.01
Blenniella gibbifrons	0.02	0.01	0.03
Blenniidae	0.00	0.00	0.00
Bodianus bilunulatus	0.03	0.00	0.00
Calotomus carolinus	0.01	0.00	0.00
Cantherhines dumerilii	0.01	0.01	0.01
Canthigaster amboinensis	0.36	1.18	1.06
Canthigaster jactator	3.65	2.67	1.58
Canthigasteridae	0.00	0.00	0.00
Caracanthus typicus	0.00	0.01	0.04
Centropyge potteri	0.00	0.00	0.00
Cephalopholis argus	0.15	0.41	0.01
Chaetodon auriga	0.10	0.05	0.04
Chaetodon lineolatus	0.00	0.00	0.00
Chaetodon lunula	1.50	2.15	0.70
Chaetodon lunulatus	0.00	0.00	0.04
Chaetodon miliaris	0.03	0.00	0.00
Chaetodon multicinctus	0.00	0.00	0.00
Chaetodon ornatissimus	0.12	0.22	0.03
Chaetodon quadrimaculatus	0.49	0.48	0.44
Chaetodon unimaculatus	0.08	0.00	0.00
Cheilio inermis	0.00	0.00	0.00

Chlorurus perspicillatus	0.38	0.04	0.00
Chlorurus sordidus	16.30	1.93	0.63
Chromis agilis	0.09	0.01	0.14
Chromis ovalis	0.78	0.02	0.00
Chromis hanui	0.00	0.00	0.02
Chromis vanderbilti	10.01	9.33	2.82
Cirrhitops fasciatus	0.01	0.04	0.64
Cirrhitus pinnulatus	0.01	0.13	0.14
Cirripectes vanderbilti	0.89	0.54	0.18
Coris flavovittata	0.00	0.01	0.01
Coris gaimard	0.33	0.47	0.41
Coris venusta	0.02	0.08	0.32
Ctenochaetus hawaiiensis	0.00	0.00	0.00
Ctenochaetus strigosus	0.41	0.31	0.00
Dascyllus albisella	0.19	0.03	0.01
Dendrochirus barberi	0.00	0.00	0.00
Diodon hystrix	0.00	0.00	0.00
Echidna nebulosa	0.02	0.00	0.00
Exallias brevis	0.01	0.04	0.02
Fistularia commersonii	0.33	0.09	0.06
Forcipiger flavissimus	0.01	0.06	0.00
Forcipiger longirostris	0.00	0.02	0.00
Gnatholepis anjerensis	0.00	0.00	0.00
Gomphosus varius	4.88	5.74	1.23
Gymnomuraena zebra	0.01	0.02	0.03
Gymnothorax eurostus	0.00	0.04	0.01
Gymnothorax flavimarginatus	0.02	0.03	0.02
Gymnothorax melatremus	0.00	0.00	0.00
Gymnothorax meleagris	0.01	0.04	0.05
Gymnothorax sp.	0.02	0.01	0.02
Gymnothorax undulatus	0.01	0.00	0.00
Halichoeres ornatissimus	0.04	1.04	0.58
Hemitaurichthys thompsoni	0.00	0.00	0.00
Kyphosus bigibbus	0.00	0.28	0.00
Kyphosus sp.	0.00	0.26	0.00
Kyphosus vaigiensis	0.00	0.04	0.00
Labroides phthirophagus	1.50	0.97	0.05
Lutjanus fulvus	0.02	0.00	0.00
Lutjanus kasmira	0.02	0.40	0.00
Lutjanus sp.	0.00	0.00	0.00
Macropharyngodon geoffroy	0.00	0.05	0.06
Melichthys vidua	0.00	0.01	0.00
Mulloidichthys flavolineatus	0.04	0.01	0.03
Mulloidichthys vanicolensis	0.04	0.00	0.00
Myrichthys magnificus	0.00	0.00	0.00
Naso lituratus	0.07	0.05	0.04
Naso unicornis	0.03	0.00	0.01
Neomyxus leuciscus	0.00	0.01	0.11

Neoniphon sammara	0.01	0.00	0.00
Novaculichthys taeniourus	0.01	0.01	0.02
Ostracion meleagris	0.05	0.19	0.05
Oxycheilinus unifasciatus	0.07	0.02	0.02
Paracirrhites arcatus	0.08	0.19	0.58
Paracirrhites forsteri	0.00	0.04	0.05
Parupeneus bifasciatus	0.15	0.07	0.00
Parupeneus cyclostomus	0.05	0.01	0.01
Parupeneus multifasciatus	0.34	0.02	0.02
Parupeneus porphyreus	0.00	0.03	0.00
Pervagor aspricaudus	0.01	0.00	0.00
Plagiotremus ewaensis	0.04	0.05	0.05
Plagiotremus goslinei	0.34	0.41	0.07
Platybelone argalus	0.00	0.09	0.08
Plectroglyphidodon imparipennis	1.58	2.98	8.22
Plectroglyphidodon johnstonianus	0.96	1.07	1.42
Plectroglyphidodon sindonis	0.00	0.00	0.02
Priolepis aureoviridis	0.00	0.00	0.00
Pseudocheilinus evanidus	0.03	0.02	0.02
Pseudocheilinus octotaenia	0.14	0.06	0.00
Pseudocheilinus tetrataenia	0.13	0.14	0.01
Pseudojuloides cerasinus	0.00	0.00	0.00
Pterois sphex	0.00	0.00	0.00
Rhinecanthus rectangulus	0.04	0.04	0.13
Sargocentron diadema	0.01	0.00	0.00
Sargocentron punctatissimum	0.02	0.00	0.01
Sargocentron xantherythrum	0.00	0.03	0.00
Scarus dubius	0.29	0.02	0.01
Scarus psittacus	11.69	1.85	0.47
Scarus rubroviolaceus	0.62	0.28	0.20
Scuticaria tigrinus	0.00	0.01	0.00
Sebastapistes coniorta	0.00	0.06	0.22
Stegastes fasciolatus	3.21	19.10	17.38
Stethojulis balteata	5.04	7.98	14.18
Synodus binotatus	0.00	0.01	0.03
Synodus sp.	0.02	0.02	0.00
Synodus ulae	0.00	0.01	0.00
Synodus variegatus	0.01	0.00	0.00
Taenianotus triacanthus	0.00	0.01	0.00
Thalassoma ballieui	0.02	0.04	0.05
Thalassoma duperrey	36.21	35.76	22.38
Thalassoma purpureum	0.00	0.01	0.01
Thalassoma quinquevittatum	0.02	0.00	0.00
Thalassoma trilobatum	0.04	0.06	0.15
Zanclus cornutus	0.06	0.10	0.03
Zebrasoma flavescens	0.35	0.03	0.01
Pooled Individuals/100 m^2 =	117.3	107.2	90.7

NOAA FISHERIES

Pacific Islands Fisheries Science Center

WEST HAWAI'I INTEGRATED ECOSYSTEM ASSESSMENT ECOSYSTEM STATUS REPORT

2019

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Executive Summary

West Hawai'i is home to a dynamic and productive marine ecosystem. Economic and socio-cultural value is provided to residents through numerous ecosystem services, such as commercial and non-commercial fishing, cultural and traditional practices, recreation, tourism, and coastal protection. However, ecological communities across West Hawai'i—particularly, coral reefs—have suffered recent and unprecedented declines. Marine ecosystem degradation can compromise underlying ecosystem functions and processes and undermine the numerous goods, services, and benefits upon which local communities depend.

This report summarizes a suite of ecosystem indicators that track the status of the region's marine ecosystem. In total, 30 indicators are presented that include climate and oceanic drivers of ecosystem change, the states of ecological communities, and the activities and relationships between people and marine resources in West Hawai'i. Ecosystem indicators were identified through a collaborative and participatory process led by the West Hawai'i Integrated Ecosystem Assessment, a NOAA program dedicated to providing robust scientific information that meets current and future marine management needs in the region.

The marine environment is a substantial contributor to economic productivity and community well-being in West Hawai'i. Fisheries, in particular, are socially and culturally important, with the pelagics fishery (e.g., tunas and billfishes) serving as the largest commercial fishery in the region. Since 2003, the total catch from the pelagics commercial fishery was over 6 times the combined commercial catch (by weight) of all other commercial fisheries and represented 62.3% of the total commercial fisheries revenue generated in West Hawai'i. Total catch of pelagics peaked in 2012 with 1.9 million pounds and $5.4 million in annual revenue. In recent years, the fishery has declined: total catch in 2017 was 1.02 million pounds, representing a 46% decline in just 5 years.

Reef-fish fishing for recreational, subsistence, and cultural purposes (i.e., non-commercial) makes up the second largest fishery (by weight) in West Hawai'i. The estimated annual average catch was nearly 406,000 pounds from 2003 to 2013, representing an 11.5-, 2.7-, and 24-fold increase over the annual average commercial catch of bottomfish, coastal pelagics, and reef fish, respectively. In the most heavily fished coastal areas, such as between Puakō and Kawaihae and near Kailua-Kona, approximately 29,000–33,000 pounds of reef fish were caught in an average year. As with the pelagic fishery, non-commercial reef fish catch has declined in recent years. Total catch was estimated at 265,200 pounds in 2013, approximately a 50% drop from the 525,600 pounds caught in 2008.

In terms of economic value, the commercial aquarium fishery is the most valuable inshore commercial fishery and the second most valuable commercial fishery in West Hawai'i. Average annual revenue from commercial aquarium fishing in West Hawai'i was $1.35 million over the last 14 years, comprising nearly 25% of the revenue generated from all commercial fishing activities in the region. The average total number of individuals caught was approximately 360,000 per year since 2003, with juvenile yellow tang comprising over 80% of the fishery. More recently, total revenue has increased to an average of $1.58 million per year over the last 5 years with no significant change in the number of individuals caught.

Coral reef fish indicators, such has fish abundance, size, diversity, and biomass, provide a fisheries independent assessment on the status and health of reef fish communities. Importantly, reef fish indicators provide a basis for evaluating the efficacy of the three primary management designations in West Hawai'i: marine protected areas (MPAs; prohibition of fishing), fish replenishment areas (FRAs; prohibition of aquarium fish collection only), and open areas (fishing allowed). Juvenile yellow tang, for example, have increased between 60 and 80% in the last 14 years across all three management designations in West Hawai'i, suggesting a potential spillover effect from managed to unmanaged areas.

Herbivorous fishes, which are important for reef resilience, constitute roughly 50% of total fish biomass in the region. Herbivore biomass has not changed in open areas or FRAs in the past 14 years. However, herbivore biomass in MPAs has increased by nearly a third since 2003 and is currently (2017) 1.7 times greater compared to FRAs and open areas. In fact, all reef fish indicators—total abundance and biomass, adult fish length, species richness, herbivore biomass, juvenile yellow tang—were 1.1–2 times higher in MPAs over open areas in 2017. The significant differences in key fish indicators between management designations suggest a clear and positive influence of fisheries management on the structure and function of coral reef fish communities in protected areas.

Despite the substantial contributions of commercial fishing, tourism represents the single largest source of economic activity in West Hawai'i. Visitor arrivals and visitor spending have steadily increased over the last decade, exceeding 1.3 million arrivals and $2.1 billion in spending in 2016. December is the highest month of visitor spending each year. It has increased 75%, or from $133 million to $233 million, over the past 15 years.

Alongside visitor growth, the resident population has steadily risen through time, increasing by over 3-fold since the 1970s. Approximately 45% of the Big Island's population currently lives in West Hawai'i. Over 25% of the resident population live one mile or less from the coast, and over 80% live within 5 miles.

With steadily increasing visitor arrivals and an increasing coastal resident population, the corresponding pressures of human activities, such as habitat degradation, fishing pressure, coastal development, and pollution are also increasing. Human wastewater, for example, is principally disposed via on-site sewage disposal systems (OSDS) in West Hawai'i. OSDS leach excess pollution and nutrients into groundwater that flows to the ocean, threatening human health and degrading marine ecosystem integrity. An estimated 680 million gallons of wastewater was released into West Hawai'i's coastal environment in 2017. The highest concentrations of OSDS (>800 OSDS/km^2) are located in the vicinity of Kailua-Kona, where 125 million gallons of wastewater and 87,500 pounds of nitrogen enter nearshore waters each year.

In addition to pressures from local human activities, variations in the physical environment are also driving changes to marine ecosystem structure and function in West Hawai'i. Ocean temperature, an indicator of regional and climatic forcing that is influential on numerous marine ecological processes, has been anomalously warm in recent years. The warmest year on record, 2015, resulted in widespread and severe coral bleaching in West Hawai'i. Approximately 50% of coral cover in the region was lost due to the warm temperature anomaly. Owing to climate change, ocean temperatures are projected to substantially increase by the middle of the century resulting in a 1°C (1.8°F) warming in monthly ocean temperatures compared to present-day. Importantly, projected ocean warming will cause severe coral bleaching similar to that experienced in 2015 on an annual basis by 2040 in West Hawai'i.

The marine ecosystem in West Hawai'i is critically important to resident well-being and the economy vitality of the region. The ecosystem indicators presented herein provide a means for tracking ecosystem status and help evaluate the efficacy of existing marine management. This interdisciplinary report is intended to provide key insights and important context on the social-ecological system in West Hawai'i and support ecosystem-based management of this highly productive and biologically diverse system.

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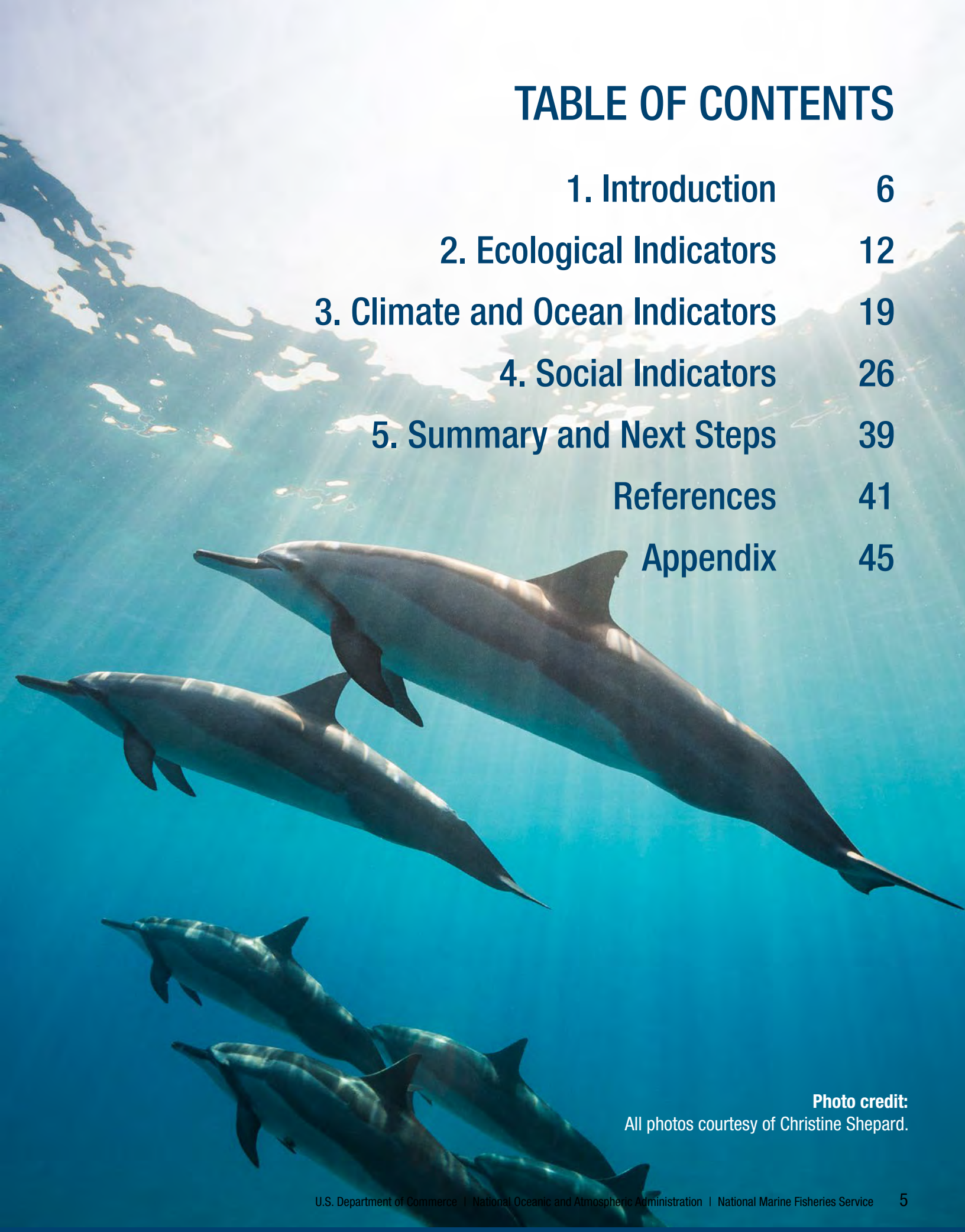

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1. INTRODUCTION

West Hawai'i is home to a dynamic and productive marine ecosystem. Economic and socio-cultural value is provided to residents through numerous ecosystem services, such as commercial and non-commercial fishing, cultural and traditional practices, recreation, tourism, and coastal protection. However, ecological communities across West Hawai'i—particularly, coral reefs—have suffered recent and unprecedented declines. Marine ecosystem degradation can compromise underlying ecosystem functions and processes and undermine the numerous goods, services, and benefits upon which local communities depend.

This report summarizes a suite of ecosystem indicators that track the status of the region's marine ecosystem and help assess the efficacy of management's decision-making in West Hawai'i. In total, 30 indicators are presented that include climatic and oceanic drivers of ecosystem change, the states of ecological communities, and the activities and relationships of people with marine resources in West Hawai'i (Table 1). Ecosystem indicators were identified through a collaborative and participatory process led by the West Hawai'i Integrated Ecosystem Assessment (*https://www.integratedecosystemassessment.noaa.gov*), a NOAA program dedicated to providing robust scientific information that meets current and future marine management needs in the region.

EXISTING MARINE MANAGEMENT IN WEST HAWAI'I

The State of Hawai'i Division of Aquatic Resources holds legal authority to manage West Hawai'i's nearshore marine environment (≤3 nautical miles from shore). In 1998, the Hawai'i State Legislature passed Act 306, which established the West Hawai'i Regional Fishery Management Area (WHRFMA). The WHRFMA was created largely in response to public concerns regarding an expanding and unregulated aquarium fishery. The overarching purposes of the WHRFMA were three-fold:

1. Effectively manage fishery activities to ensure sustainability.
2. Enhance nearshore resources.
3. Minimize conflicts of use.

In 2000, the WHRFMA designated multiple marine managed areas encompassing approximately 35% of the coastal waters in West Hawai'i (Rossiter and Levine 2014; Tissot et al. 2004). These managed areas were designated as fish replenishment areas (FRAs), where aquarium fish collecting was prohibited. The geographical boundaries of the restricted areas were selected using biological data and local community input (Rossiter and Levine 2014, Tissot et al. 2009). Current marine management areas encompass a range of spatial extents and various levels of fishing restrictions (Figure 1.1).

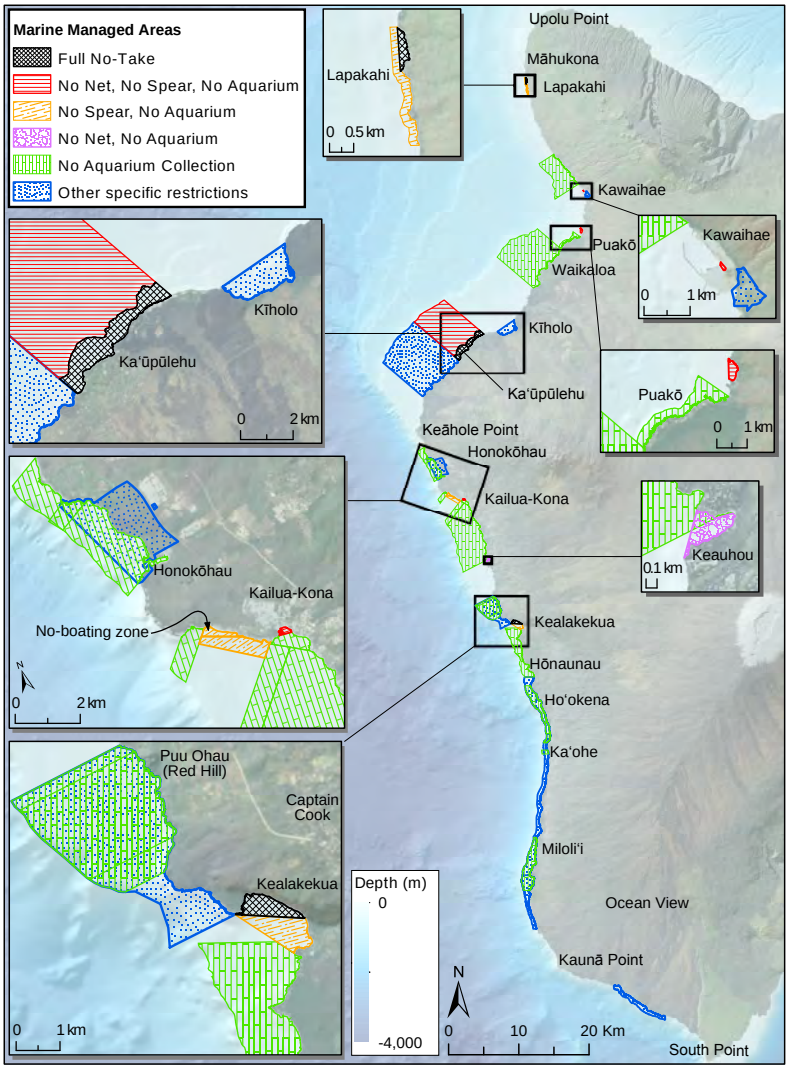


Figure 1.1. Map of West Hawai'i highlighting current marine managed areas (MMAs). The categories shown on the map indicate the regulations for each MMA (with respect to reef fish only) which explicitly prohibit three broad gear categories (line, net, and spear) and aquarium collection. MMAs designated as "other specific restrictions" can include species-specific take limits or gear-specific restrictions that do not prohibit an entire gear category. All other categories displayed are not necessarily all encompassing within each MMA. For example, an MMA shown as prohibiting spearfishing may also restrict take of particular species, restrict the number of lines or hooks allowed per person, or prohibit lay netting but allow throw netting. The full no-take area at Ka'ūpūlehu went into effect in July 2016, as a 10-year no-take area. See Hawai'i DAR (*http://dlnr.hawaii.gov/dar*) for more information on marine management in West Hawai'i.

A key stipulation in Act 306 was the requirement of *substantive involvement of the community in resource management decisions*. The West Hawai'i Fishery Council (WHFC; *http://westhawaiifisherycouncil.org*) was convened in 1998 to facilitate this requirement. Comprised of various stakeholders, community members, and user groups, the WHFC provided the vehicle for the community to directly participate in the development of resource management actions. In addition to the development of the network of FRAs and other measures, the WHFC has supported and facilitated the implementation of several marine management rules in the region:

- The limitation of large-scale commercial lay netting while continuing to allow subsistence netting.
- Ka'ūpūlehu Marine Reserve, a community-based initiative prohibiting the take of nearshore marine life for 10 years.

- SCUBA spear fishing prohibition.
- Prohibition on the take of *Species of Special Concern*, which includes a variety of rays and sharks.

Table 1. Summary of indicators assessing the status of West Hawai'i's marine ecosystem. Indicators are divided into three broad categories—Ecological, Climate and Ocean, Social—based on the ecosystem pressure or ecosystem attribute they represent. Indicators were selected based on local stakeholder input and information in the peer-reviewed literature, as identified under "Justification."

ECOLOGICAL

Pressure or Attribute	Indicator	Definition and Rationale	Justification	Time Presented
Reef Fish Community Integrity	Total Fish Abundance	The total number of reef fish standardized by the unit area of reef. Fish density is a major factor determining the influence reef fishes have in a coral reef ecosystem. Fish abundance varies by habitat quality, environmental variability, and its influence on population demography (i.e., recruitment and natural mortality) and fishing pressure.	(Friedlander & DeMartini 2002, Sale 2004, Feary et al. 2007, Guillemot et al. 2014)	2003–2017
	Total Fish Biomass	The total weight of the entire fish assemblage per unit area. It is useful to consider biomass, in addition to abundance, because the ecological impact of fishes on a reef is often related to the size of fishes, and the status of the fishery is more directly related to fish population biomass rather than solely on the number of fish.	(Guillemot et al. 2014)	2003–2017
	Mean Adult Fish Length	The mean length of adult fishes (calculated here as those above 40% of their expected maximum length) provides an indication of the size structure of the entire adult reef fish community.	(Ault et al. 2014, Guillemot et al. 2014, Nadon et al. 2015, Ingram et al. 2018)	2003–2017
	Species Richness	Total number of species recorded per survey. Biodiversity is intrinsically linked to ecosystem function and greater species richness supports more productive fisheries. Furthermore, species richness is linked to diversity in responses to environmental change amongst species that perform similar ecosystem functions on a reef, and as such is considered a critical aspect of ecosystem resilience.	(Moberg & Folke 1999, McClanahan et al. 2011)	2003–2017

Pressure or Attribute	Indicator	Definition and Rationale	Justification	Time Presented
Reef Fish Community Integrity	Herbivore Biomass	Herbivores (i.e., species for which plant material makes up a majority of their diet) are a key component of coral reef ecosystem resilience the ability of a reef to maintain or recover to a coral dominated state following disturbance, and avoid a phase-shift into algal dominance compromise.	(Green & Bellwood 2009, Kittinger et al. 2015, Williams et al. 2015b)	2003–2017
	Juvenile Yellow Tang Abundance	Approximately 70% of the aquarium fish caught in the State are from West Hawai'i with juvenile yellow tang (*Zebrasoma flavescens*) comprising approximately 82% of the total catch.	(Walsh et al. 2003, Williams et al. 2009, Walsh et al. 2013)	2003–2017
	Mean Adult Fish Length	The mean length of adult fishes (calculated here as those above 40% of their expected maximum length) provides an indication of the size structure of the entire adult reef fish community.	(Ault et al. 2014, Guillemot et al. 2014, Nadon et al. 2015, Ingram et al. 2018)	2003–2017
	Species Richness	Total number of species recorded per survey. Biodiversity is intrinsically linked to ecosystem function and greater species richness supports more productive fisheries. Furthermore, species richness is linked to diversity in responses to environmental change amongst species that perform similar ecosystem functions on a reef, and as such is considered a critical aspect of ecosystem resilience.	(Moberg & Folke 1999, McClanahan et al. 2011)	2003–2017
Benthic Reef Community Integrity	Hard Coral Cover	The percent cover of hard coral in a given area reflects the amount of reef topographic complexity, habitat structure, reef accretion, and diversity and abundance of coral-dependent species.	(Walsh 1984, McClanahan et al. 2011, Ingram et al. 2018)	2003–2017
	Fleshy Algal Cover	The percent cover of fleshy algae (macroalgae + turf algae) serves as an indicator for benthic community organization and health. Fleshy algae can grow rapidly and potentially inhibit coral recruitment and growth, and reduce coral survival. Tracking the abundance of fleshy algal cover can also indicate other important processes occurring within coral reef ecosystems, including nutrient enrichment and herbivory intensity.	(McClanahan et al. 2002, Hughes et al. 2007, McClanahan et al. 2011)	2003–2017
	Ratio of Calcifying: Noncalcifying	The ratio of calcified to non-calcified organisms represents the combined cover of reef building hard corals (Scleractinian) and calcifying algae (crustose coralline algae and *Halimeda*) to the combined cover of turf and fleshy macroalgae. Tracking the calcified to non-calcified ratio of benthic organisms serves as an important indicator of coral reef community dynamics and the extent to which a given system is dominated by reef accreting versus non-accreting benthic organisms.	(Cinner et al. 2013, Williams et al. 2013, Smith et al. 2016)	2003–2017

CLIMATE AND OCEAN

Pressure or Attribute	Indicator	Definition and Rationale	Justification	Time Presented
Sea Level Rise	Coastal Sea Level	Tracking the status and trends in sea level is important for coastal communities and nearshore marine ecosystems. Over long time periods, sea level rise can lead to chronic coastal erosion, coastal flooding, and drainage problems and can exacerbate short-term fluctuations in coastal sea level driven by waves, storms, and extreme tides.	(Fletcher 2010, Ingram et al. 2018)	1990–2018
Precipitation	Rainfall and Standardized Precipitation Index	Changes in rainfall drive changes in ground water and surface water transport to the marine environment which impacts nearshore salinity, ocean temperature, suspended sediment, and nutrient concentrations. Monthly rainfall and the Standardized Precipitation Index (SPI) are provided to track the status of rainfall in West Hawai‘i. The SPI is a standardized index that characterizes periods of drought or abnormal wetness that correspond with the availability of different water resources (e.g., groundwater and river discharge).	(Keyantash 2018), Kevin Kodoma of NWS Honolulu	1975–2018
Large-scale Climate Forcing	North Pacific Gyre Oscillation	The North Pacific Gyre Oscillation (NPGO) index is an indicator of the variation in the rotational speed of the North Pacific Subtropical Gyre. Ocean currents in the Subtropical Gyre transport waters from the northeast Pacific to the west and south, warming as they move to the subtropical Pacific and the vicinity of Hawai‘i. A lower NPGO, or slower Subtropical Gyre, results in warmer SST, and vice versa.	(Walsh 1984, McClanahan et al. 2011, Ingram et al. 2018)	2003–2017
	ENSO (El Niño/La Niña)	The Multivariate ENSO Index (MEI) is an indicator of the El Niño Southern Oscillation (ENSO): an irregular, large-scale ocean-atmosphere climate phenomenon. El Niño represents the warm phase of the ENSO cycle, characterized by weakening of the trade winds across much of the Pacific and warming of ocean temperatures in the Equatorial Pacific. La Niña represents the cool phase and is associated with stronger than normal trade winds and anomalously cool ocean temperatures.	(McClanahan et al. 2002, Hughes et al. 2007, McClanahan et al. 2011)	2003–2017
	Pacific Decadal Oscillation	The Pacific Decadal Oscillation (PDO) is often described as a long-lived El Niño-like pattern of Pacific climate variability. Extremes in the PDO pattern are marked by widespread variations in the Pacific that can drive prolonged (years–decades) changes in sea surface temperature, ocean mixing, and biological productivity. When a positive phase of PDO is coincident with a positive phase of ENSO (i.e., El Niño), an increase in hurricane activity in Hawai‘i can occur during the summer months (as observed in 2015).	(Cinner et al. 2013, Williams et al. 2013, Smith et al. 2016)	2003–2017

Pressure or Attribute	Indicator	Definition and Rationale	Justification	Time Presented
Ocean Temperature	Sea Surface Temperature	Sea surface temperature (SST) plays an important role in a number of ecological processes in West Hawai'i and varies on diel to decadal time scales. Anomalously warm SST can lead to high levels of thermal stress for corals and other marine organisms.	(Ingram et al. 2018, Wedding et al. 2018)	1900–2018
Climate Change	Projections of Future Sea Surface Temperature	Climate change is warming SST across the world's oceans, driving an increase in storms and thermal stress events that are causing coral damage and mass bleaching events.	(van Hooidonk et al. 2016)	2006–2100

SOCIAL

Pressure or Attribute	Indicator	Definition and Rationale	Justification	Time Presented
Human Population	Population Growth	Human population growth can put pressure on the ecosystem through overuse, habitat degradation, and fishing pressure.	(Ingram et al. 2018)	1831–2018
	Number of Visitors and Visitor Spending	The total number of visitors serves as an indicator of tourism use of the marine environment. Tourism expenditures represent the single largest source of economic activity in Hawai'i. Moreover, beach and water sports, such as swimming, snorkeling, and scuba diving, are by far the most popular recreational activities among visitors.	(Ingram et al. 2018)	1990–2016
Coastal Development	Impervious Surfaces	Coastal development paves over natural land, and the resulting impervious surfaces increase the rate of pollution runoff from streets and sidewalks into the nearby ocean.	(Ingram et al. 2018, Wedding et al. 2018)	1992–2017
Human Wastewater	Total Number, Total Effluent, and Total Nitrogen Flux from On-Site Sewage Disposal Systems (OSDS)	OSDS (e.g., cesspools and septic tanks) leach excess pollution and nutrients (e.g., nitrogen) into groundwater that flows to the ocean. This runoff from land can result in harmful algal blooms, fish kills, and potential disease threats to humans. We have included the current spatial distribution and historical time series of 3 indicators of OSDS: Total Number, Total Effluent, and Total Nitrogen Flux.	(Smith et al. 1999, Anderson et al. 2002, Ingram et al. 2018, Wedding et al. 2018)	2000–2017

Pressure or Attribute	Indicator	Definition and Rationale	Justification	Time Presented
Fisheries	Total Non-Commercial Catch of Reef-Fish and Total Commercial Catch of Aquarium Fish, Reef-Fish, Coastal Pelagics, Bottom Fish, and Pelagics	West Hawai'i communities are deeply intertwined with nearshore fisheries due to their contributions to the local economy, food supply chain, and perpetuation of cultural customs and practices. In an effort to track fishing activities, we have included 6 indicators that encompass both commercial and non-commercial fisheries catch from West Hawai'i.	(Friedlander & DeMartini 2002, Friedlander et al. 2014, Kittinger et al. 2015, Ingram et al. 2018, Wedding et al. 2018)	2003–2017
Fisheries	Commercial Fisheries: Annual Revenue and Fisher Engagement	Fisheries represent an important contribution to the livelihoods of local residents and the economy in West Hawai'i. We report the annual financial revenue generated from commercial fisheries and the associated annual number of fishers engaged in the commercial fishing of pelagics, aquarium, bottomfish, coastal pelagic, and reef fish in West Hawai'i.	(Kittinger et al. 2015, Grafeld et al. 2017, Teneva et al. 2018)	2003–2016

2. ECOLOGICAL INDICATORS

Coral reefs are highly productive and biologically diverse marine ecosystems. Nearly a quarter of reef-associated fish species found in Hawai'i occur nowhere else on the planet (Randall 2007). Coral reef ecosystems provide critically important services to local communities, such as coastal protection, food-resources, tourism, cultural practices, and fisheries (Knowlton 2001). Pressures from pollution, overfishing, invasive species, and climate change are negatively impacting reefs (Knowlton & Jackson 2008, Ingram et al. 2018) and undermining the economic, social, and cultural benefits provided to the local communities in West Hawai'i (Kittinger et al. 2012, Ingram et al. 2018).

Coral reef fish and benthic indicators are presented to help track the status of West Hawai'i's reef ecosystem. These data were collected as part of a long-term monitoring effort implemented by the Division of Aquatic Resources' West Hawai'i Aquarium Project (WHAP; Walsh et al. 2013). Indicators are based on a combination of ecological relevance, sensitivity to local pressures (e.g., fishing pressure), and being applicable to the in situ survey data collected by the WHAP monitoring program. All values presented are statistically significant ($p < 0.05$) unless stated otherwise.

REEF FISH

We present a combination of indicators that relay information regarding the coral reef ecosystem and fishery status. The indicators we selected track the status and trends at the individual species, functional group, and community levels. As described in more detail below, these indicators convey information specific to detecting fishing effects, ecosystem structure and function, and coral reef ecosystem resilience.

Total Abundance – Fish density is a major factor determining the functional role and influence of reef fishes. Spatial and temporal variability in fish density is a product of numerous factors. For instance, fish abundance varies by habitat quality (Feary et al. 2007), environmental variability and its influence on population demography (i.e., recruitment and natural mortality) (Sale 2004), and fishing pressure (Friedlander & DeMartini 2002, Guillemot et al. 2014).

The total abundance of nearshore fishes has shown a positive trend in all management areas— MPAs, FRAs, and open areas—across West Hawai'i since 2003 (Figure 2.1, Total Abundance). Total abundance has increased by 28.9%, 36.0%, and 34.9% in MPAs, FRAs, and open areas, respectively (Table 2.1). Total abundance of fishes differed based on management status. For example, the total abundance of fish in 2017 was greater in MPAs compared to FRAs and open areas by 61.4% and 34.8% (Table 2.2). An anomalous recruitment pulse was observed in 2014 across a number of locations in the state (Talbot 2014) and in West Hawai'i (Walsh 2014). The recent increase in fish abundance observed across management areas may be attributed in part to high levels of recruitment in 2014.

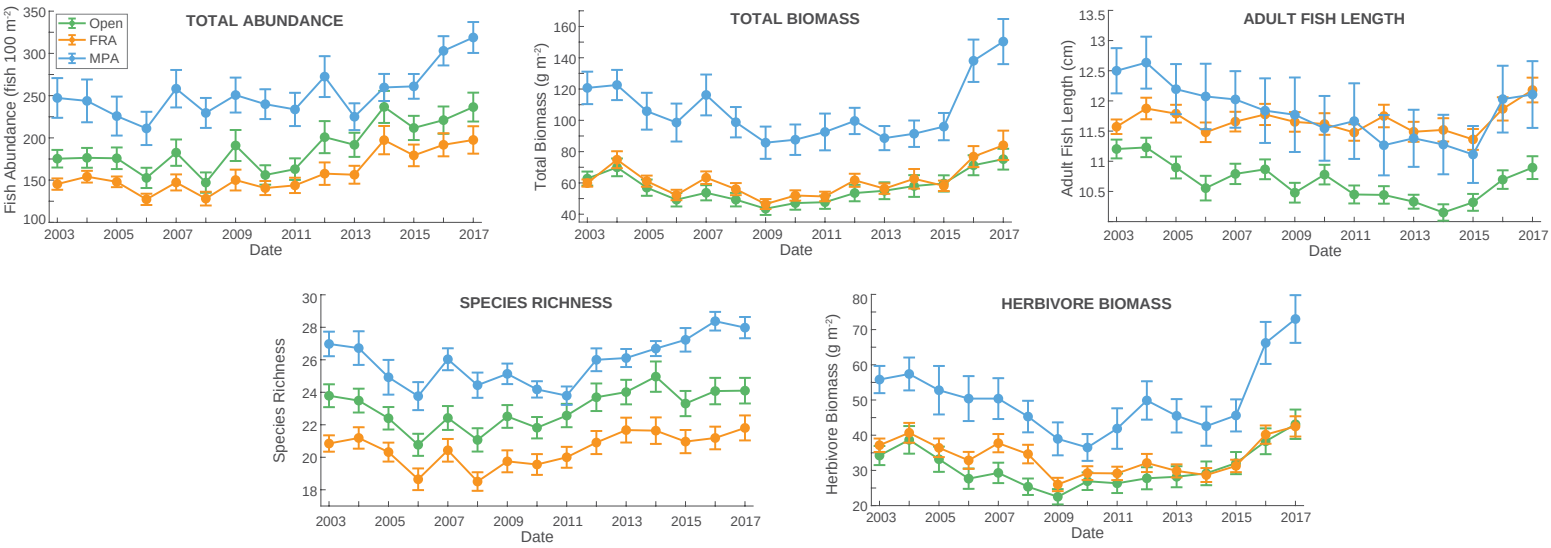


Figure 2.1. Reef fish indicators for West Hawai'i include total fish abundance, fish biomass, adult fish length, species richness, and herbivore biomass. Indicators are grouped by management status (blue line = marine protected area (MPA); orange line = fish replenishment area (FRA); green line = open to fishing). Error bars represent ±1 standard error. Data Source: DAR's West Hawai'i Aquarium Project (WHAP).

Total Fish Biomass – Total fish biomass conveys related but slightly different information compared to total fish abundance. Specifically, two reefs might have the same abundance but very different biomass estimates based on the size distribution of fishes in the assemblage. It is useful to consider biomass in addition to abundance because the ecological function or importance of fishes on a reef is often related to the size of fishes (see herbivore biomass description below). In addition, the status of the fishery is more directly related to fish population biomass rather than solely on the number of fish (Guillemot et al. 2014).

Total fish biomass, which is the body weight of the entire reef-fish assemblage per unit area, has increased in FRAs by nearly 40% since 2003 (Figure 2.1, *Total Biomass*; Table 1). Total biomass showed no significant change in MPAs or open areas over the same time period (Table 1). The most recent survey indicated that total fish biomass in MPAs was nearly 80% higher compared to FRAs and twice the biomass in open areas (Table 2).

Adult Fish Mean Length – As fishing pressure increases, the average length of targeted species decreases (Ault et al. 2014, Nadon et al. 2015). This relationship exists because fishers tend to target large fishes, and because fishing mortality reduces the number of fishes that reach older and larger life stages. Previous work has found that reductions in mean length of the whole assemblage are indicative of a shift towards smaller species and/or smaller individuals of the same species, and that this can be driven by moderate levels of fishing pressure (Guillemot et al. 2014).

Adult fish length, or the mean length (cm) of mature fishes (i.e., fishes reaching ≥40% of their maximum length), increased by 5.3% in FRAs with no significant change in MPAs or open areas since 2003 (Figure 2.1, *Adult Fish Length*; Table 2.1). In terms of management status, adult fish length in 2017 was approximately 11% greater in MPAs and FRAs compared to open areas (Table 2.2).

Table 2.1: Changes in mean reef fish and benthic coral reef community indicators by management status from 2003 to 2017. Indicators are grouped by management status (MPA, marine protected area; FRA, Fish Replenishment Area; Open, open to fishing). Bold values represent statistically significant differences ($p < 0.05$).

INDICATOR	MANAGEMENT STATUS	2003	2017	PERCENT CHANGE
Total Fish Abundance (number of fish/100 m²)	MPA	247.26	318.82	**+28.9%**
	FRA	145.30	197.54	**+36.0%**
	Open	175.35	236.46	**+34.9%**
Total Fish Biomass (g/m²)	MPA	120.73	150.34	+24.5%
	FRA	59.90	84.03	**+40.3%**
	Open	62.77	75.18	+19.8%
Mean Adult Fish Length (cm)	MPA	12.50	12.11	-3.1%
	FRA	11.57	12.18	**+5.3%**
	Open	11.20	10.89	-2.8%
Species Richness (number of species/survey)	MPA	26.98	27.98	+3.7%
	FRA	20.85	21.81	+4.6%
	Open	23.79	24.10	+1.3%
Herbivore Biomass (g/m²)	MPA	55.81	73.01	**+30.8%**
	FRA	37.15	42.50	+14.4%
	Open	34.22	43.11	+26.0%
Juvenile Yellow Tang (number of fish/100 m²)	MPA	14.95	26.89	**+79.8%**
	FRA	18.90	30.78	**+62.9%**
	Open	10.06	16.18	**+60.8%**
Coral Cover (%)	MPA	35.29	16.77	**-52.5%**
	FRA	40.96	17.30	**-57.8%**
	Open	33.76	17.31	**-48.7%**
Total Algal Cover (%)	MPA	40.84	56.59	+36.5%
	FRA	37.26	54.31	**+43.5%**
	Open	48.99	58.79	+18.6%
Calcifying:Non-Calcifying Ratio	MPA	1.11	0.79	+36.5%
	FRA	1.57	0.79	**+43.5%**
	Open	0.94	0.59	+18.6%

Table 2.2: Relative difference in reef fish and benthic coral reef community indicators by management status in 2017. Indicators are grouped by management status (MPA, marine protected area; FRA, fish replenishment area; Open, open to fishing). Bold values represent statistically significant differences ($\rho < 0.05$). See Table 2.1 for 2017 indicator values.

INDICATOR	2017 DIFFERENCE IN MANAGEMENT STATUS (%)		
	MPA – FRA	MPA – Open	FRA – Open
Total Abundance	**+61.4**	**+34.8**	-16.5
Total Biomass	**+78.9**	**+100.0**	+11.8
Adult Fish Length	-0.6	**+11.1**	**+11.8**
Species Richness	**+28.3**	**+16.1**	**-9.5**
Herbivore Biomass	**+71.8**	**+69.3**	-1.4
Juvenile yellow tang	-12.7	**+66.2**	**+90.2**
Coral Cover	-3.1	-3.2	0.0
Total Algal Cover	+4.4	-3.9	-7.9
Calcifying: Non-Calcifying Ratio	0.2	34.6	34.4

Species Richness – Coral reefs are renowned for being one of the most diverse and complex ecosystems on the planet, providing important ecosystem services. The majority of tourists that visit Hawaiʻi engage in marine-based activities, including diving and snorkeling (Beukering & Cesar 2004), and fish diversity is one amongst a variety of factors that drives visitor destination choice (Uyarra et al. 2005). In addition to the aesthetic value, biodiversity is intrinsically linked to ecosystem function, and greater species diversity supports more productive fisheries (Moberg & Folke 1999, McClanahan et al. 2011).

Species richness, or the total number of species present per survey, has not changed within each management area over the last 15 years (Figure 2.1, *Species Richness*; Table 2.1). As with other fish indicators, species richness in 2017 was greatest in MPAs compared to FRAs and open areas (Table 2.2). Note: visual surveys of reef fishes do not capture all species present in an area; therefore, the data here are considered a relative measure of species richness, which is one measure of biological diversity.

Herbivore Biomass – Herbivores (i.e., species for which plant material makes up a majority of their diet) comprise a large part of the fish community assemblage in Hawaiʻi (Williams et al. 2015b). Herbivorous fishes are a key component and indicator of resilience. Resilience is defined as the ability of a reef to maintain or recover to a coral dominated state following disturbance and avoiding a phase-shift into algal dominance (Green & Bellwood 2009). Multiple anthropogenic drivers operating at various scales can undermine coral reef resilience, such as over-extraction of herbivores, pollution, and climate change. Of these, the diminished abundance of functionally important herbivores is one of the few drivers that is possible to ameliorate through local action.

Herbivore biomass, which represents the total weight of herbivorous fishes per unit area, increased by 30.8% in MPAs

from 2003 to 2017 (Figure 2.1, *Herbivore Biomass*; Table 2.1). FRAs and open areas have shown no change in herbivore biomass over the same time period. Herbivore biomass was approximately 70% greater in MPAs over FRAs and open areas in the most recent survey (Table 2.2). Of note, herbivores in West Hawai'i constitute roughly half of the total biomass in each of the management areas.

Juvenile yellow tang – The yellow tang is important to the West Hawai'i aquarium industry as it is the primary species collected (Walsh et al. 2003). In fact, the majority of the aquarium trade sources fish from West Hawai'i; approximately 70–80% of the fish caught in the state are from West Hawai'i with juvenile yellow tang comprising ~82% of the total catch (Walsh et al. 2013). Therefore, the status of this fish around West Hawai'i is of high relevance for fisheries management. Observed declines in reef fishes due to the aquarium trade triggered the establishment of FRAs and associated monitoring surveys in West Hawai'i in 1999. The data presented here are collected as part of the long-term monitoring conducted to assess the efficacy of this network of closed areas, which have proven over time to be highly effective in increasing the density of these long-lived species. Collectors target young juveniles, and as such, we report juvenile yellow tang abundance here.

From 2003 to 2017, the abundance of juvenile yellow tang increased by 79.8%, 62.9%, and 60.8% in MPAs, FRAs, and open areas, respectively (Figure 2.2; Table 2.1). In 2017, MPAs and FRAs had 66.2% and 90.2% more juvenile yellow tang than in open ares (Table 2.2).

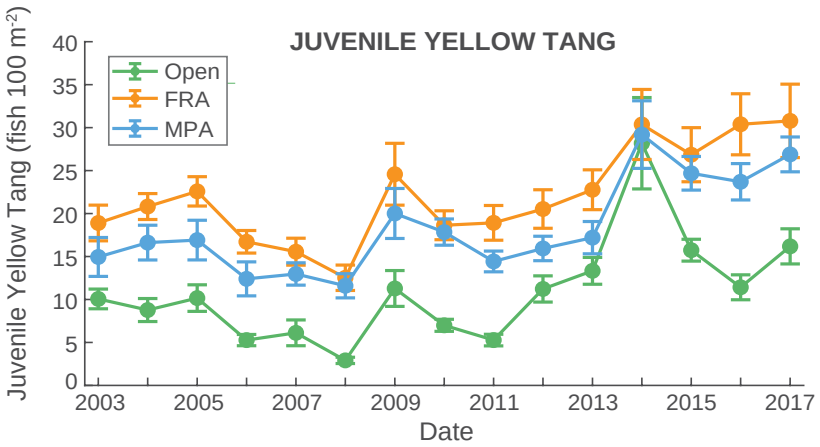
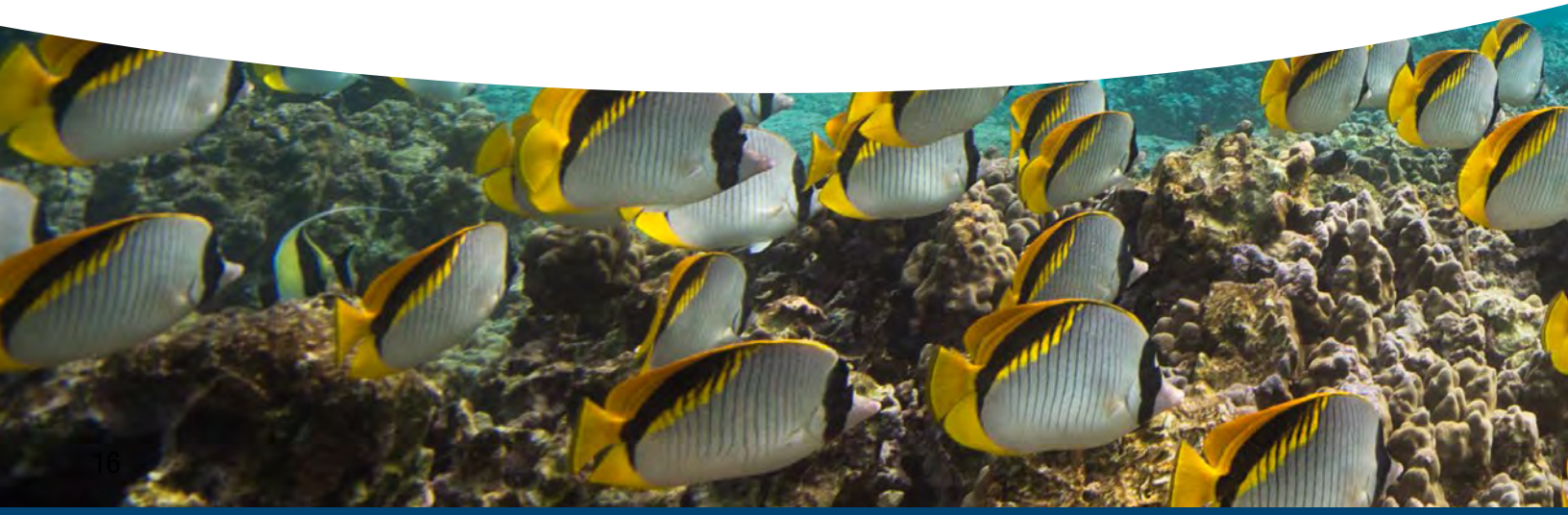


Figure 2.2 Reef fish indicator juvenile yellow tang abundance grouped by management status (blue line = marine protected area (MPA); orange line = fish replenishment area (FRA); green line = open to fishing). Error bars represent ±1 standard error. Data Source: DAR's West Hawai'i Aquarium Project (WHAP).



BENTHIC CORAL REEF COMMUNITIES

Coral reef development and persistence are reliant on benthic, sessile organisms that deposit calcium carbonate, namely hard (Scleractinian) corals and crustose coralline algae (CCA). Fleshy algae, such as turf and various forms of erect macroalgae, also serve important ecological functions, such as providing food resources for several reef fishes (Mumby et al. 2006). In the absence of local human pressures, calcifying organisms tend to dominate coral reef benthic ecosystems (Williams et al. 2015a). Although variations in environmental forcing can tip the competitive balance in favor of fleshy algae on remote, undisturbed reefs (Gove et al. 2015), human-related pressures are more often responsible for shifting reef communities towards a dominance of weedy, faster growing algal species (Pandolfi et al. 2005). Monitoring changes in benthic community organization is, therefore, critical to understanding coral reef community succession and responses to various environmental and human-related pressures. We present a few key indicators that track the status and trends in ecological function and integrity of benthic coral reef communities.

Hard Coral Cover – The total cover of hard coral (Scleractinian) in a given area generally corresponds with the amount of reef topographic complexity, habitat structure, reef accretion, and diversity and abundance of coral-dependent species (McClanahan et al. 2011). Many reef-fish species are also heavily reliant on the availability of coral-dominated, structurally-complex areas, serving as the preferred habitat for fish recruitment and fish in juvenile stages (Walsh 1984).

The total cover of hard coral across West Hawai'i was approximately 18% in 2017, representing a relative change of -52.5%, -57.8%, and -48.7% in MPAs, FRAs, and open areas since 2003, respectively (Figure 2.3, *Hard Coral Cover*; Table 2.1). Much of the coral loss can be attributed to a thermal stress event in 2015, when up to 90% of corals bleached across West Hawai'i (Kramer et al. 2016 - see Section 3 for more detail on the thermal stress event). It is important to note that coral cover was as high as 80% in specific locations (e.g., Puakō) in the 1970s, indicating dramatic losses in coral cover in at least some locations over the past 40–50 years (Minton et al. 2012, Walsh et al. 2018).

Total Algal Cover – Fleshy (i.e., non-calcifying) algae are part of a healthy reef community, providing food for a variety of herbivorous fishes and invertebrates. However, fleshy algae can grow rapidly and compete with hard corals for reef space, inhibit coral recruitment, and reduce coral survival (Hughes et al. 2007). Tracking the abundance of macroalgae and turf algae (i.e., total algal cover) serves as an indicator of benthic community organization, intensity of herbivory, and local pressures, such as nutrient enrichment (McClanahan et al. 2002).

Fleshy algal cover has increased across West Hawai'i since 2003; however, FRAs are the only management area that exhibited a significant increase (Figure 2.3, *Total Algal Cover*; Table 2.1). In the most recent survey, fleshy algal cover was approximately 55%, with no significant difference in cover between MPAs, FRAs, and open areas (Table 2.2). Changes in algal cover across West Hawai'i are predominantly due to changes in turf algae, as West Hawai'i has very low (<2%) macroalgae percent cover (Walsh 2014, Williams et al. 2015b).

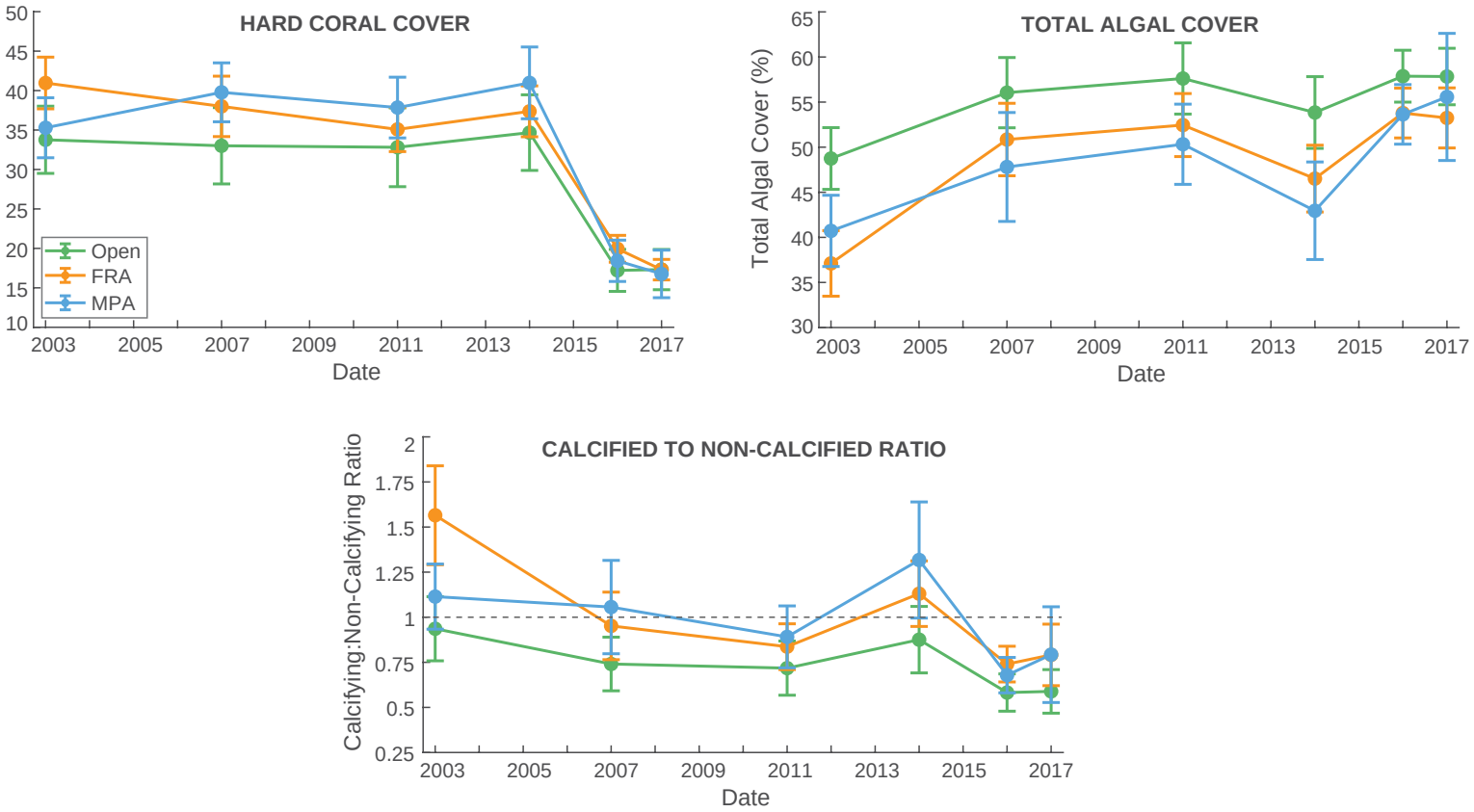


Figure 2.3. Coral reef benthic community indicators for West Hawai'i include hard coral cover, total algal cover, calcified to non-calcified ratio. Indicators are grouped by management status (blue line = marine protected area (MPA); orange line = fish replenishment area (FRA); green line = open to fishing). Error bars represent ±1 standard error. Data Source: DAR's West Hawai'i Aquarium Project (WHAP).

Calcified to Non-calcified Ratio – Foundational benthic organisms that contribute to coral reef development and persistence are calcifying, serving a number of key ecological processes, including settlement, recruitment, and cementation of reef structure (Williams et al. 2015a). Fleshy algae directly compete with calcifying organisms for space, and in high abundance, can indicate a degraded ecological state (Hughes et al. 2010). The ratio of the combined cover of reef-building hard corals (Scleractinian) and calcifying algae (crustose coralline algae and Halimeda) to the combined cover of fleshy algae indicates benthic community dynamics and the extent to which a given system is dominated by reef-accreting benthic organisms.

In 2017, the ratio of calcified to non-calcified cover across West Hawai'i was ≤1 (Figure 2.3, *Calcified to Non-calcified*

Ratio). This threshold represents a relative dominance of non-calcifying benthic organisms. The relative dominance of reef builders to maintain net accretion is likely reef specific as oceanographic conditions, community structure, and local human impacts each play a role in overall reef growth. However, it seems logical that coral reef ecosystems with a greater abundance of reef builders will have higher rates of net reef growth and accretion compared to reefs dominated by non-calcifying organisms (Smith et al. 2016).

3. CLIMATE AND OCEAN INDICATORS

Large-scale climate patterns shape the physical environment of marine organisms, influencing feeding, migration, and reproductive success. Significant climatological changes, including increased sea surface temperature, sea level rise, decreased ocean pH, and shifting storm patterns are predicted to occur in coming decades.

It is increasingly important to understand the major physical forces impacting West Hawai‘i and the effects these forces may have on the biology and management of the ecosystem. Climate and oceanographic indicators are presented here to help track and predict changes in the natural environment of West Hawai‘i’s marine ecosystem.

Sea Level – Long-term sea level rise can lead to chronic coastal erosion, coastal flooding, and drainage problems. Long-term sea level rise also exacerbates short-term fluctuations in coastal sea level driven by waves, storms, and extreme tides. Tracking the status and trends in sea level is critically important for coastal planning and management of nearshore marine ecosystems.

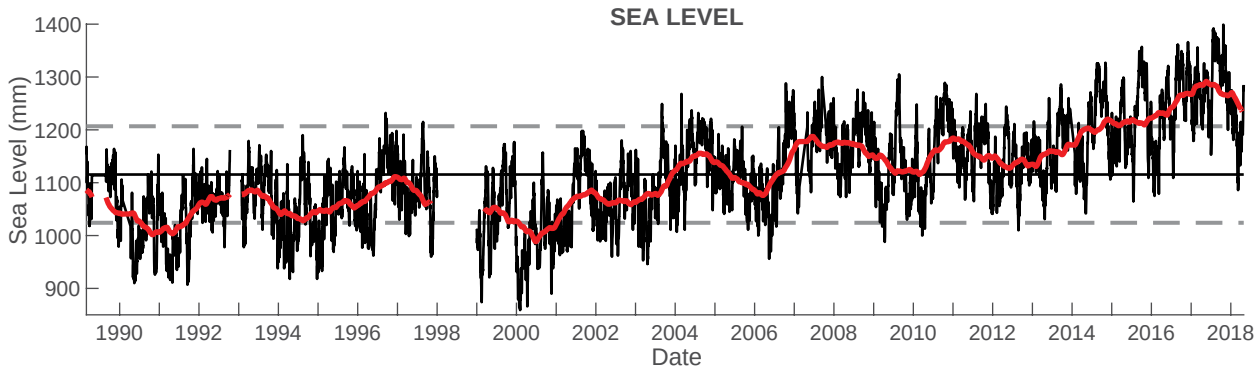
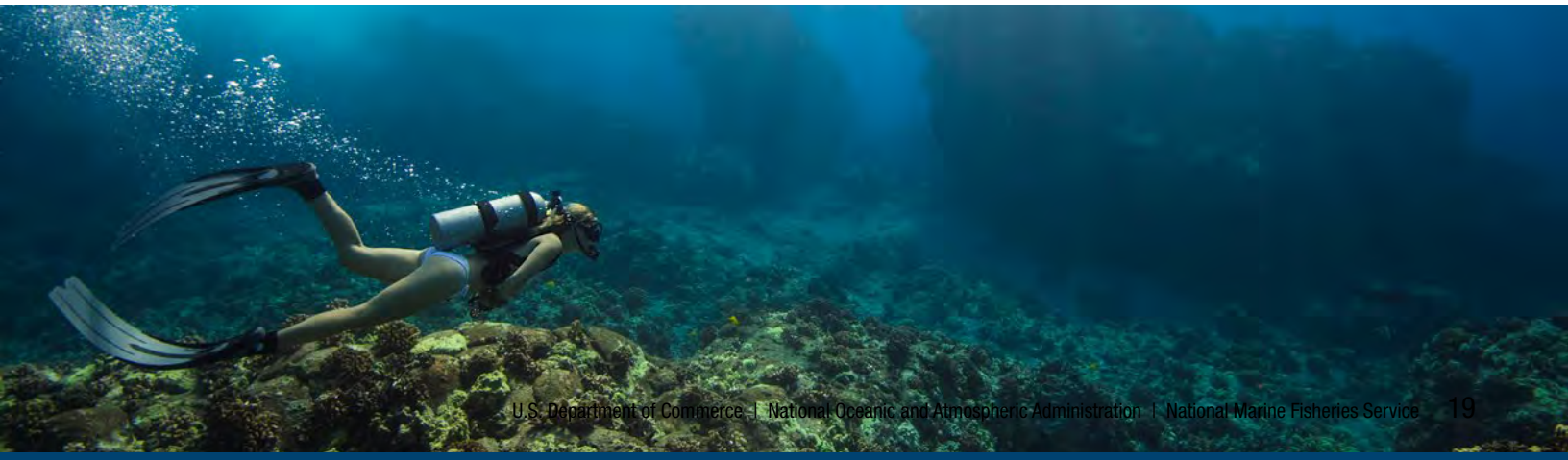


Figure 3.1. Daily sea level data from Kawaihae Harbor from 1990 to 2018 (black line). Red line represents a 12-month moving average. Horizontal lines represent the long-term mean (1990—2018; solid line) and ±1 standard deviation (dashed line). Data source: University of Hawai‘i Sea Level Center.



Long-term sea level measurements (1990–2018) from Kawaihae indicate a clear positive trend (Figure 3.1), increasing by 0.27 m (0.89 ft) in the past 28 years. Over the next 30 to 70 years, properties, infrastructure, and critical habitat located on or near the West Hawai'i's shorelines will increasingly be flooded, eroded, or completely lost to the sea. Example areas that will be exposed to chronic flooding include Ka'ūpūlehu, Kawaihae, and South Point. Portions of the Hualālai Resort in Ka'ūpūlehu, an economically important tourist destination in North Kona, would be permanently flooded with 1 m (3.3 ft) of sea level rise, which is expected by the end of this century (Hawai'i Climate Change Mitigation and Adaptations Commission, 2017). As sea level continues to rise, low-lying, populated coastal communities, such as Puakō would experience increased frequency and extent of flooding. Beaches, such as those between Kailua-Kona and Kawaihae, will increasingly be eroded and permanently lost. Native Hawaiian cultural and historical resources, many of which are located near the shoreline, will also be severely threatened and potentially lost with continued sea level rise. For more detailed information on the potential impacts of sea level rise in Hawai'i, please see the Hawai'i Climate Change Mitigation and Adaptations Commission's Report 2017 (*https://climateadaptation.hawaii.gov/wp-content/uploads/2017/12/SLR-Report_Dec2017.pdf*).

Rainfall – The Hawaiian Islands have one of the most diverse rainfall patterns on Earth. Persistent trade winds, mountainous terrain, and diel heating and cooling of the land interact to produce areas of uplift in distinct spatial patterns associated with the islands' topography. The resulting clouds and rainfall produced by this uplift lead to dramatic differences in mean rainfall over short distances (Giambelluca et al. 2012).

Rainfall patterns in West Hawai'i are somewhat unique for the Hawaiian Islands. Rainfall is principally driven by well-developed and reliable land and sea breezes owing to a combination of diel land heating and a blocking of the trade winds by Mauna Loa and Mauna Kea. This diurnal pattern is particularly strong during the summer months.

Changes in rainfall will influence groundwater and surface water transport to the marine environment, which can impact nearshore salinity and temperature, as well as suspended sediment and nutrient concentrations.

Monthly rainfall and the monthly Standardized Precipitation Index (SPI) are shown from 1975 to 2018 from three locations in West Hawai'i: Waikoloa, Opihihale (Captain Cook), and Hōnaunau (Figure 3.2). The monthly SPI was developed by the National Center for Atmospheric Research (NCAR) and represents a standardized approach to calculate monthly rainfall, facilitating the comparison of rainfall anomalies from separate regions with differing climates (Keyantash 2018). In short, SPI standardizes rainfall at a given location and can be interpreted as the number of standard deviations by which the observed anomaly deviates from the long-term mean. SPI values of 1, 1.5, and 2 above/below zero represent rainfall conditions categorized as moderately wet/moderately dry, very wet/very dry, and extremely wet/extremely dry. More information on SPI is provided by NCAR (*https://climatedataguide.ucar.edu/climate-data/standardized-precipitation-index-spi*) and by NOAA's National Weather Service, Honolulu Forecast Office (*http://www.prh.noaa.gov/hnl/hydro/pages/spi_web_page.php*).

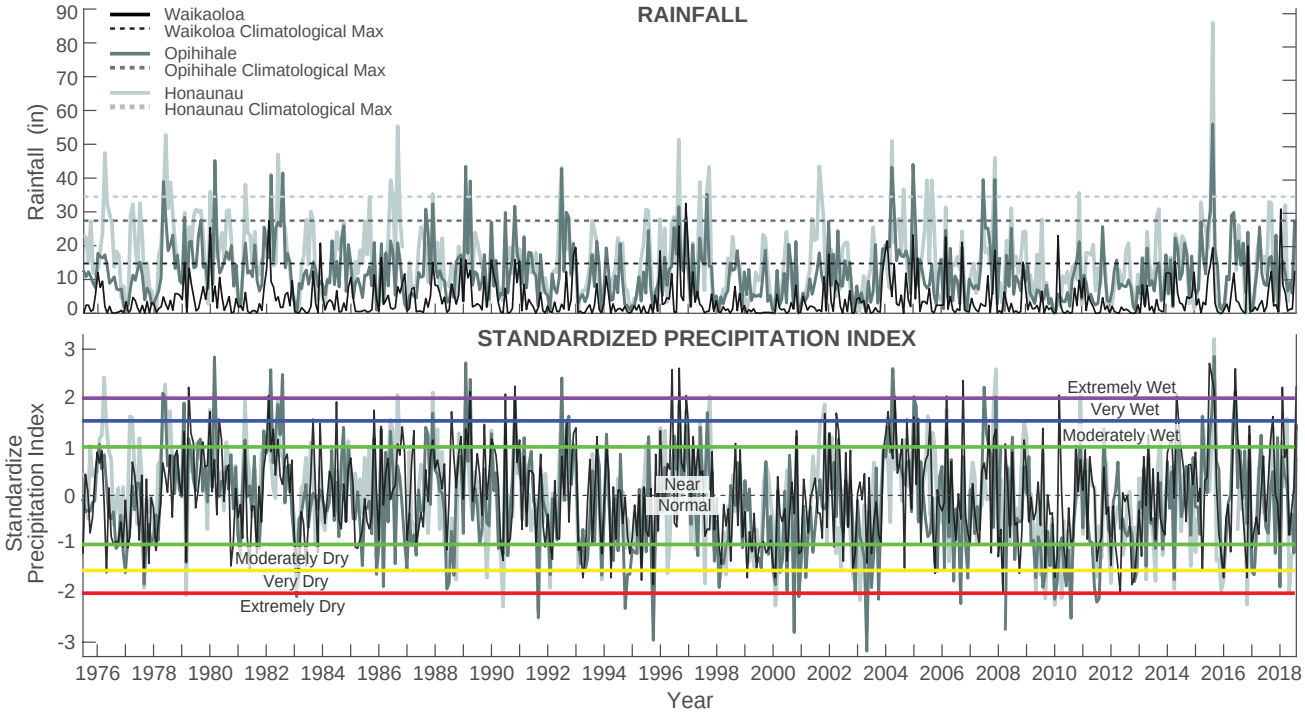


Figure 3.2. Monthly rainfall (inches solid line) and climatological monthly maximum (dashed line) from 1975 to 2018 at three locations in West Hawai'i: Waikoloa (black line), Opihihale (dark gray line), and Honaunau (light gray line) (top). Monthly Standardized Precipitation Index (SPI) for the same locations (in the same colors) as shown in *Rainfall* (bottom). The monthly SPI represents a standardized approach to calculate monthly rainfall, facilitating the comparison of rainfall anomalies from separate regions with differing climates (Keyantash 2018). In short, SPI standardizes rainfall at a given location, interpreted as the number of standard deviations by which the observed anomaly deviates from the long-term mean. The SPI provides the ability to assess rainfall patters as near normal (0, dashed line), extremely wet (2 standard deviations above the mean, purple line), very wet (1.5 standard deviations above the mean, blue line), moderately wet (1 standard deviation above the mean, green line), moderately dry (1 standard deviation below the mean green line), very dry (1.5 standard deviations below the mean, yellow line) and extremely dry (2 standard deviations below the mean, red line). For more information visit: *https://climatedataguide.ucar.edu/climate-data/standardized-precipitation-index-spi*. Data Source: Kevin Kodama, NOAA National Weather Service, Honolulu Forecast Office.

Waikoloa, Opihihale, and Hōnaunau have experienced progressively increased rainfall, with climatological monthly maximum rainfall values of 14.7 in (374 mm), 27.4 in (696 mm), and 34.5 in (876 mm), respectively (Figure 3.2, *Rainfall*). The highest rainfall event over the 42-year time series was at Hōnaunau in September 2015, when 86 in (2,183 mm) of rain was recorded in a single month. SPI values from each of the three locations show periods of *very wet* (e.g., 1980, 1989, 1997) and *very dry* (e.g., 1995, 2003 2010) conditions (Figure 3.2, *SPI*). The overarching trend over the 42 years has been a shift towards dryer conditions. The total number of months that exceeded the *very dry* threshold (-1.5) at Waikoloa, Opihihale, and Hōnaunau was 2.6, 2.3, and 1.9 times higher during the most recent 20-year time period (1997–2016) compared to the previous 20 years (1976–1996). Conversely, the two time periods were nearly similar (between 80 and 100%) with respect to the number of months that exceeded the *very wet* threshold (1.5).

Sea Surface Temperature –Surface ocean temperatures in Hawai'i can vary over a broad range of temporal scales owing to the oceanic setting and geographic location in the central-northern Pacific. Diel, intra-seasonal (e.g., mesoscale eddies), seasonal, interannual (e.g., ENSO), and decadal (e.g., PDO) forcing, as well as fluctuations in the rotational speed of the subtropical gyre all influence ocean temperatures in the main Hawaiian Islands.

Seasonal and interannual variability are readily discernible in ocean temperatures dating back to 1900 (Figure 3.3). Seasonally, ocean temperatures are coolest in March (24.8°C; 76.6°F) and warmest in September (27°C; 80.6°F). This seasonal cycle can be shifted, accentuated, or dampened over longer time scales owing to large-scale ocean-atmosphere climate phenomena. Ocean temperature in 2015 clearly stands out as the warmest on record in Hawai'i due to the confluence of local conditions and large-scale processes. We provide a generalized description of this anomalously warm year in the following section.

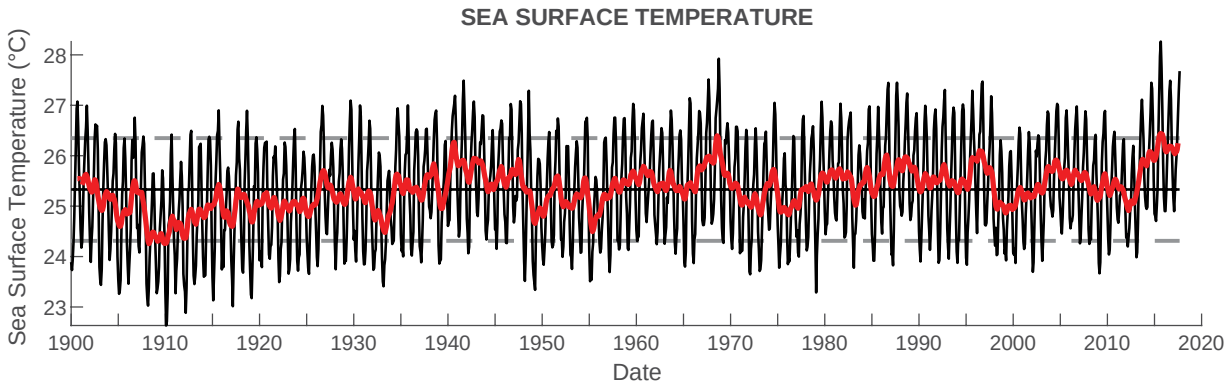


Figure 3.3. Weekly sea surface temperature for the main Hawaiian Islands from 1900–2018 (black line). Red line represents a 12-month moving average. Horizontal lines represent the long-term mean (1900–2018; solid line) and ±1 standard deviation (dashed line). Data Sources: Sea surface temperature, NOAA's Extended Reconstructed Sea Surface Temperature, version 4 (*https://www.ncdc.noaa.gov/data-access/marineocean-data/extended-reconstructed-sea-surface-temperature-ersst-v4*).

WHY WAS 2015 SO HOT IN HAWAI'I?

Sea surface temperature (SST) in the main Hawaiian Islands reached the highest recorded monthly temperature in well over a century (Figure 3.3). Temperatures in West Hawai'i were even warmer, reaching 30.3°C (86.5°F) in September of 2015 (Gove et al. 2016). These anomalously warm and prolonged ocean conditions wreaked havoc on coral reefs in West Hawai'i, causing upwards of 90% of coral bleaching and an overall relative loss of approximately 50% of coral cover across West Hawai'i (Kramer et al. 2016).

Although the dynamics governing ocean temperatures can be complex, it appears that the combination of local conditions and large-scale climate processes superimposed to produce the extremely warm temperatures observed in Hawai'i in the summer of 2015. Here, we provide a descriptive and generalized explanation of this anomaly.

One source of variation in ocean temperatures is driven by the speed of the Subtropical Gyre, a ring-link system of ocean currents rotating clockwise across the North Pacific (Figure 3.4). Ocean currents in the Subtropical Gyre transport cooler waters from the northeast Pacific to the west and south, warming as it moves to the subtropical Pacific and the vicinity of Hawai'i. Similarly, warm water from the western subtropical Pacific is transported towards Japan, cooling as it moves northward. When the rotational speed of ocean currents in the Subtropical Gyre is accelerated, cool waters from the northeast take less time to reach Hawai'i, arriving cooler than normal, while the warm water in the western Pacific arrives warmer when it reaches Japan (Figure 3.4, *Fast Gyre*). Conversely, when the rotational speed of ocean currents in the Subtropical Gyre are slowed, cool waters from the northeast take more time to reach Hawai'i and, therefore, arrive warmer than normal (Figure 3.4, *Slow Gyre*).

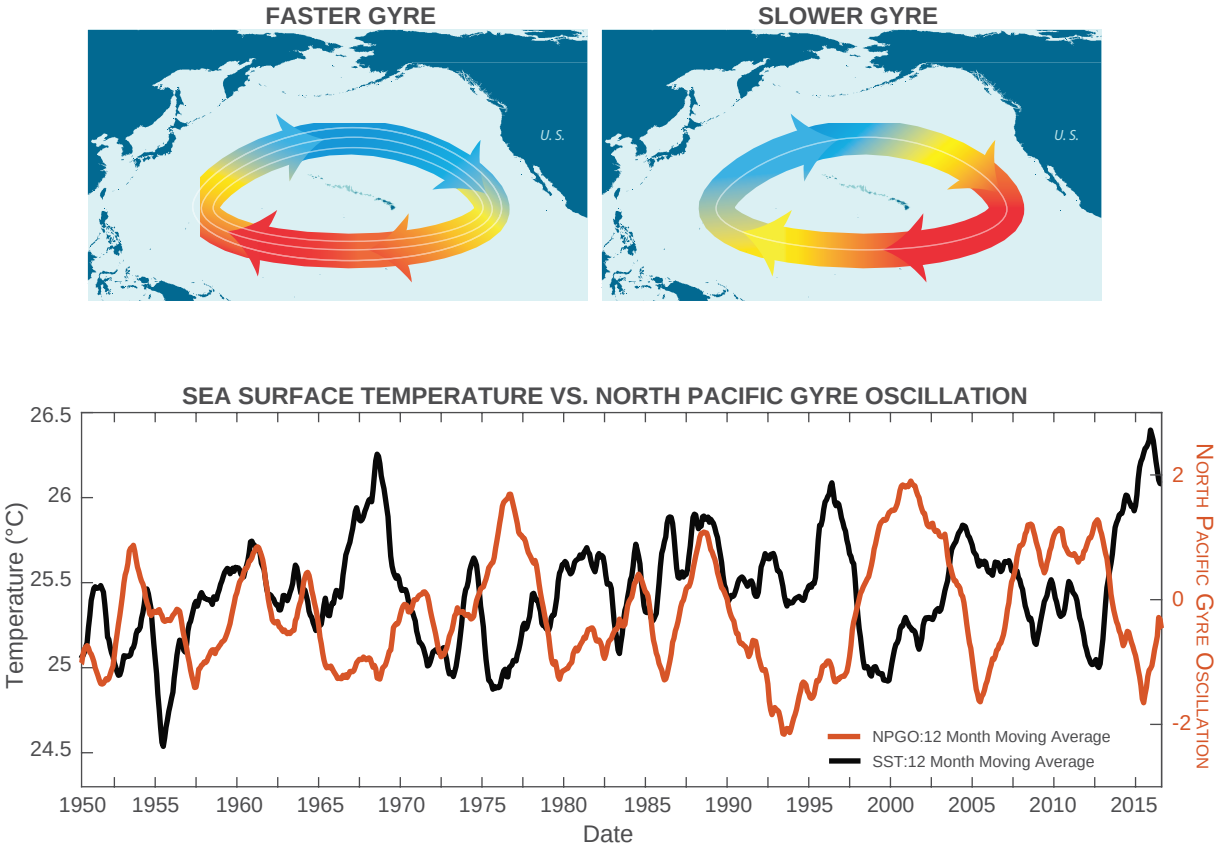


Figure 3.4. Graphical representation of the North Pacific Subtropical Gyre, with faster (top left) and slower (top right) gyre rotations and corresponding differences in Pacific-wide sea surface temperature (top) with color gradient from blue (cold) to red (hot) (top). Twelve-month moving average of sea surface temperature for the main Hawaiian Islands (black line) and the North Pacific Gyre Oscillation (NPGO; orange line) from 1950 to 2016 (bottom). Negative NPGO values indicate a slower rotation of the Subtropical Gyre, resulting in warmer ocean temperatures. Data Sources: Sea surface temperature, NOAA's Extended Reconstructed Sea Surface Temperature, version 4 (*https://www.ncdc.noaa.gov/data-access/marineocean-data/extended-reconstructed-sea-surface-temperature-ersst-v4*); NPGO index, Di Lorenzo et al. (2008). Link: *http://www.oces.us/npgo*.

The North Pacific Gyre Oscillation (NPGO) is an indicator of the variation in the rotational speed of ocean currents in the Subtropical Gyre (Di Lorenzo et al. 2008). When comparing the NPGO and sea surface temperature in Hawai'i, there is clearly a negative correlation—warmer SST is coincident with a lower NPGO, or slower Subtropical Gyre, and vice versa (Figure 3.4, *Sea Surface Temperature vs. North Pacific Gyre Oscillation*). The NPGO captures much of the decadal variation in SST around Hawai'i, including the warm temperatures observed in 2015. However, while September 2015 represented a decadal peak in SST, the NPGO alone was not sufficient to result in such anomalously warm ocean temperatures.

In addition to the rotational speed of the Subtropical Gyre, two other broad-scale climate processes can drive variation in ocean temperatures around Hawai'i. The first is the El Niño Southern Oscillation (ENSO). ENSO is an irregular (3–7 years), ocean-atmosphere climate phenomenon. El Niño represents the warm phase of the ENSO cycle, characterized by weakening of the trade winds across much of the Pacific and warming of ocean temperatures in the Equatorial Pacific (Figure 3.5). El Niño events typically last 9–15 months, with peak forcing occurring in the northern hemisphere winter. La Niña represents the cool phase and is associated with stronger than normal trade winds and the anomalously cool ocean temperatures (Philander 1990). On average, La Niña is a less extreme anomaly than El Niño but tends to last longer, approximately 1–3 years.

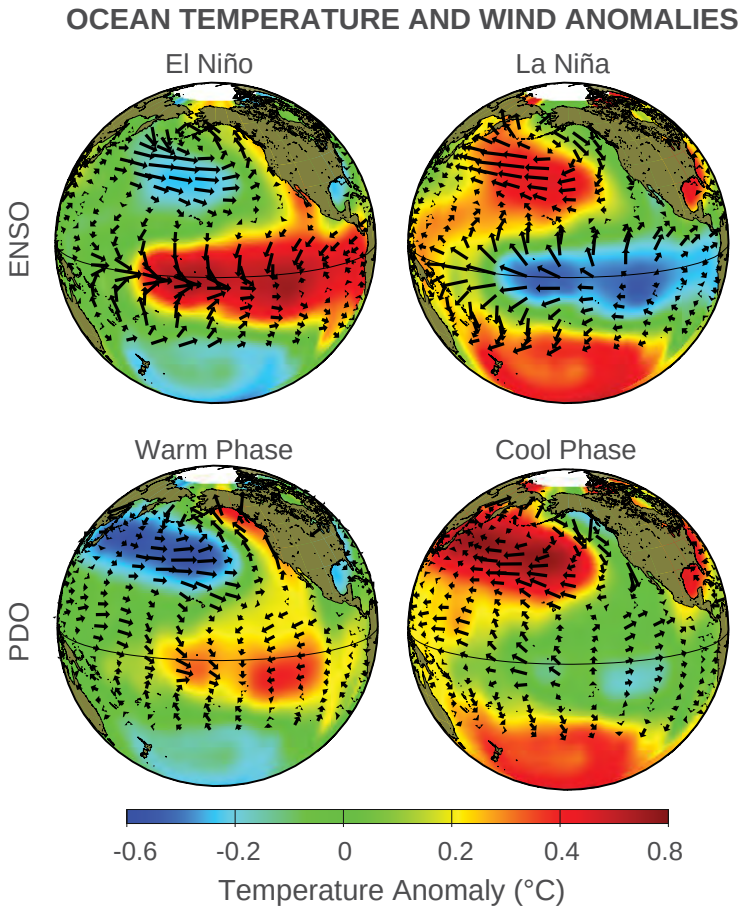


Figure 3.5. Typical sea surface temperature anomalies (color) and wind anomalies (black arrows) experienced during El Niño and La Niña (top left) and Warm and Cool Phases of the Pacific Decadal Oscillation (PDO, bottom left) across the Pacific Ocean. Graphic obtained from *http://research.jisao.washington.edu/pdo/graphics.html* and presented here with permission.

The second major climatic driver of changes in ocean temperatures in Hawai‘i is the Pacific Decadal Oscillation (PDO). The PDO is often described as a long-lived ENSO-like pattern of Pacific climate variability. As seen with the better-known ENSO, extremes in the PDO pattern are marked by widespread variations in temperature, wind patterns, ocean mixing, and biological productivity (Polovina et al. 1994). The extreme phases of the PDO have been classified as either warm or cool, defined by ocean temperature anomalies in the northeast and tropical Pacific Ocean (Figure 3.5).

In 2015, there was both a powerful El Niño and a warm phase of the PDO (Figure 3.6, *ENSO & PDO Time Series*), resulting in higher local ocean temperatures than either alone would typically produce. In 2014 and 2015, the equatorial and mid-latitude connection between the El Niño and warm phase of the PDO is thought to have been especially strong, resulting in the largest marine heat wave (i.e., “The Blob”) ever recorded in the Northeast Pacific that caused enhanced ocean warming across the Hawaiian Islands (Di Lorenzo & Mantua 2016).

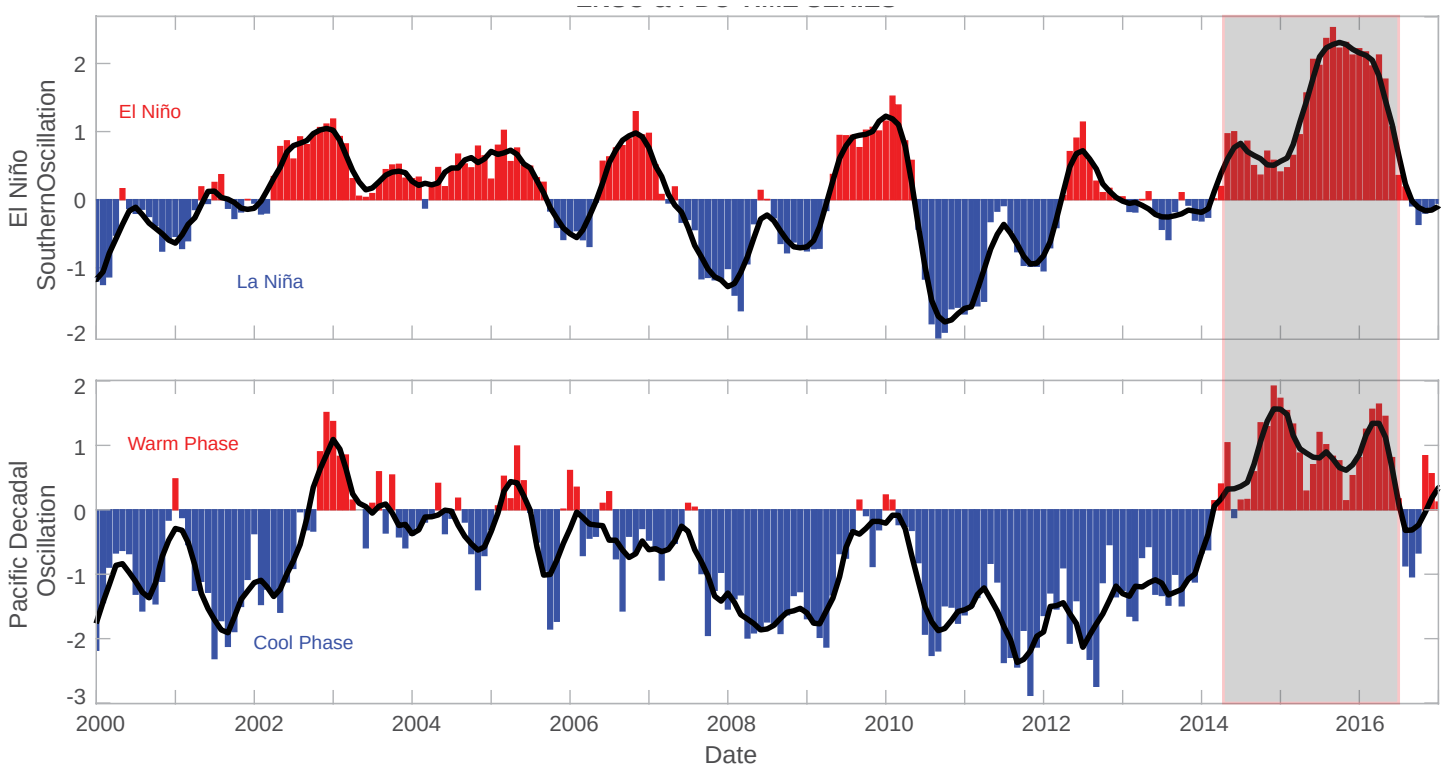


Figure 3.6: Indices representing the El Niño Southern Oscillation (ENSO), with El Niño and La Niña represented as red (positive) and blue (negative) values (top) and the Pacific Decadal Oscillation (PDO), with the warm phase and cool phase represented as red (positive) and blue (negative) values (bottom). The black line represents a 6-month moving average. The gray box is shown to highlight the relatively strong El Niño and warm phase in the PDO co-occurring in 2015. Data sources: Multivariate ENSO Index was obtained from NOAA's Earth System Research Laboratory (*https://www.esrl.noaa.gov/psd/enso/mei*). The PDO index was obtained from NOAA's Centers for Environmental Information (*https://www.ncdc.noaa.gov/teleconnections/pdo*).

On a local scale, variations in wind conditions likely exacerbated the warming induced by the large-scale climate processes previously described. When winds are weaker than normal, they decrease the intensity of ocean mixing, which reduces the amount of deeper, cooler waters reaching the surface ocean, and results in increased warming. Throughout August and early September of 2015, wind speeds were weaker than average over 80% of the time (Figure 3.7). During this same period, reef-level (10 m; 33 ft) temperatures from Lapakahi, located 16 km (~10 miles) north of Kawaihae, increased by over 2.5°C (4.6°F) (Figure 3.7). At the peak of the warming event, local wind speeds were equal to or stronger than the long-term average for more than two weeks, helping to mix the upper surface and drive down ocean temperatures, ultimately contributing to the end of the 2015 thermal stress event.

Thus, the typical seasonal cycle, reduced wind conditions, and the combination of three major large-scale climate phenomena—NPGO, ENSO, PDO—all contributed to producing the highly anomalous warm ocean temperature around Hawai'i in September 2015.

Looking toward the future, ocean temperature in West Hawai'i is projected to steadily increase as a result of climate change (Figure 3.8). By the middle of the century, average monthly SST will be about 1°C (1.8°F) warmer than present-day, and for about 6 months of the year will be warmer than the present-day average September SST (27°C; 80.6°F) (van Hooidonk et al. 2016). Further, it is likely the climate models used in these projections do not fully capture the large-scale climate variability—NGPO, ENSO, PDO—that influence SST and, therefore, may underestimate future ocean temperatures in West Hawai'i.

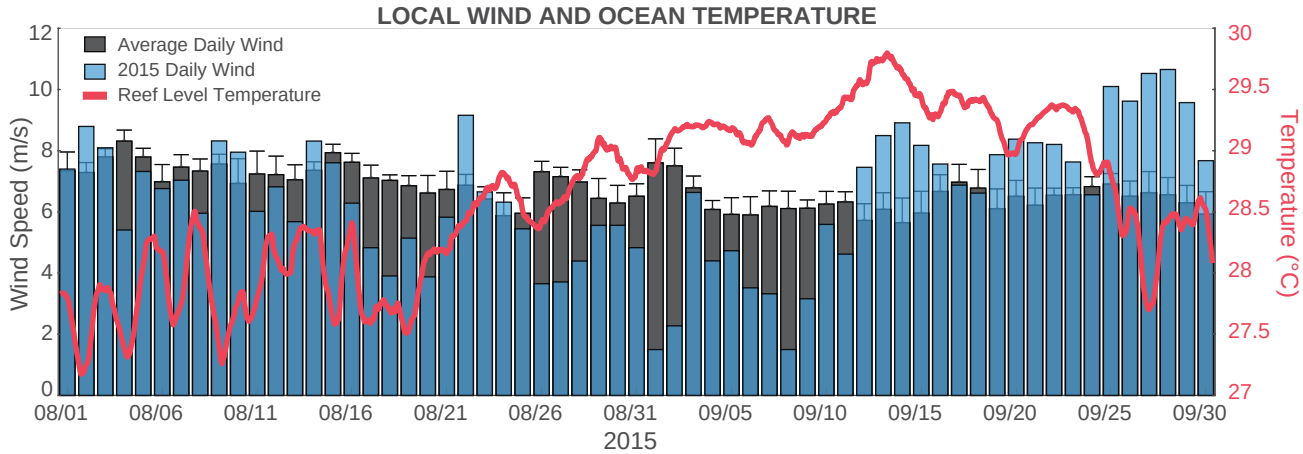


Figure 3.7. Local wind and ocean temperature observed during the 2015 thermal stress event (August–September, 2015) in West Hawai'i. Long-term (2009–2014) averaged daily wind speed (gray bars, error bars represent ±1 standard deviation), daily wind speed (blue bars), and reef-level temperature (10 m; 33 ft) at Lapakahi, located approximately 16 km (10 miles) north of Kawaihae (red line), are shown. Data Sources: Daily wind is from NOAA's ASCAT wind product, obtained from NOAA's Environmental Research Division Data Access Portal (*https://coastwatch.pfeg.noaa.gov/erddap/griddap/erdQAwind1day.html*); reef-level temperature is from NOAA's West Hawai'i IEA.

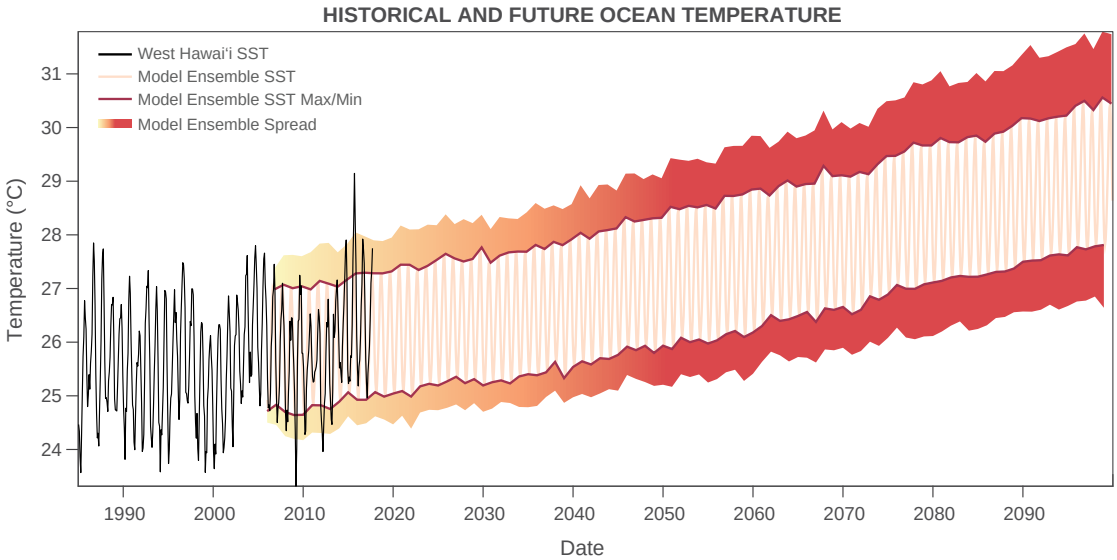


Figure 3.8. Historical and future projections of sea surface temperature for West Hawai'i. Sea surface temperature (black line) projected change in sea surface temperature (orange line) in West Hawai'i this century (from an ensemble of IPCC-approved climate models and based on business-as-usual emissions scenario RCP8.5). Data Sources: Sea surface temperature, NOAA's Ocean Watch (*http://ocean-watch.pifsc.noaa.gov*). Sea surface temperature projections are from van Hooidonk et al. (2016).

4. SOCIAL INDICATORS

Human relationships with ocean environments are diverse, incorporating social, cultural, political, economic, and environmental dimensions (Kittinger et al. 2012, Cinner et al. 2013). Humans are an integral part of ecosystems and they can be both stressors and stewards of the natural environment. Correspondingly, social data contain information on a range of human activities (e.g., distribution, practices, and interactions). Ultimately, ecosystem-based

management requires ecologically meaningful information coupled with diverse human uses and practices at operationally relevant spatial and temporal scales.

Based on outcomes from stakeholder engagement (Ingram et al. 2018) and information from social-ecological work (e.g., Kittinger et al. 2012), we have identified a suite of social indicators for West Hawai'i's marine ecosystem. Our goal was to integrate dynamic and spatially explicit data on human uses, values, and governance. Information on human dimensions and social indicators can be direct inputs into ecosystem models as well as shape the direction of ecosystem-based management. This work is ongoing; the ultimate outcome will be to improve our ability to better assess West Hawai'i's ecosystem and to provide information on current and predicted states of ecosystem integrity under different scenarios.

Population Growth – Human population growth can result in a range of pressures on marine ecosystems. As resident populations increase, so can impacts such as overuse and habitat degradation. Technological advances, management practices, engagement in stewardship, and regulatory actions can modify the status and trends of individual activities. Because historical and reliable time-series information on specific activities is often lacking, tracking resident population growth serves as a broad indicator of human activities that can either directly (e.g., fishing) or indirectly (e.g., new development) influence the integrity and function of marine ecosystems.

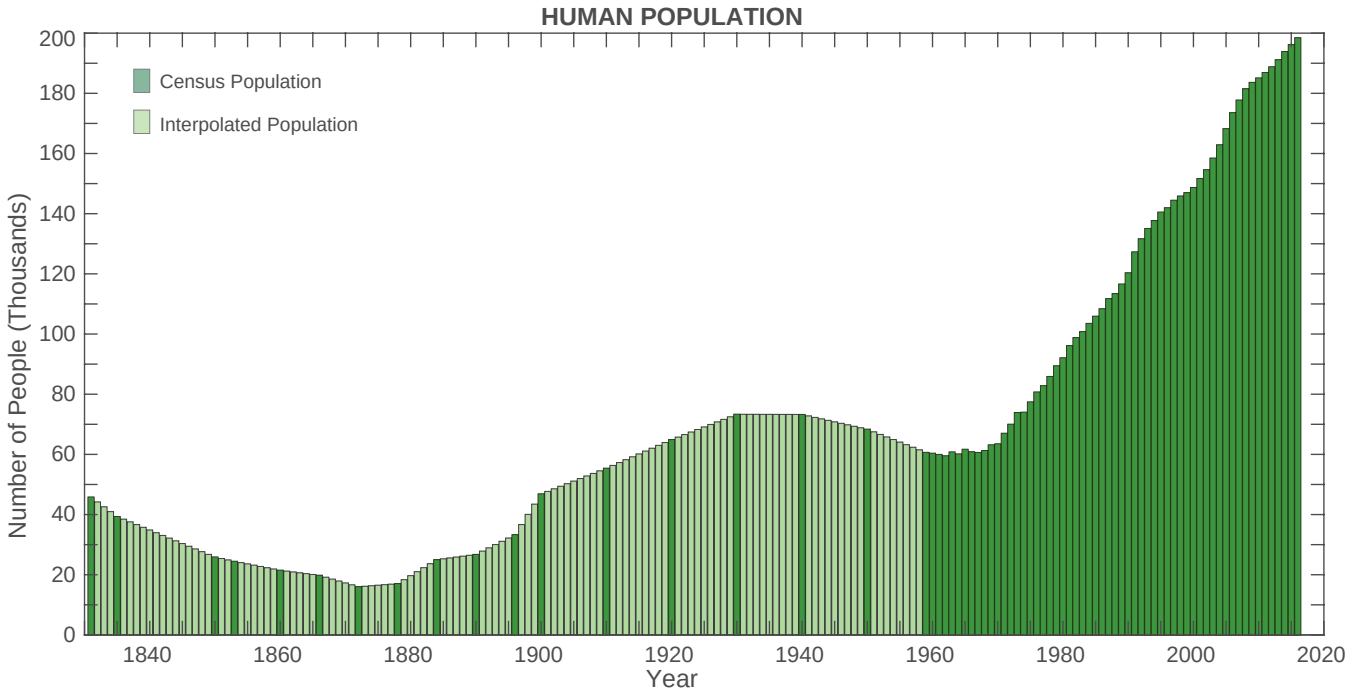


Figure 4.1. Resident human population (thousands of people) on Hawai'i Island from 1831 to 2016. Note that dark green values represent actual census population values while light green are linearly interpolated population values. Data Source: State of Hawai'i's Department of Business, Economic Development, and Tourism (*http://dbedt.hawaii.gov/economic/databook/*).

Resident population of Hawai'i Island from 1831 to 2016 (185 years; Figure 4.1) was obtained from the State of Hawai'i's Department of Business, Economic Development, and Tourism (DBEDT; *http://dbedt.hawaii.gov/economic/databook/*). In 1831, approximately 45,800 people lived on the island. That number steadily decreased over the next 40 years, reaching a minimum of 16,000 in 1872. Resident population subsequently increased until the 1940s, when it began declining to a low of approximately 60,000 residents from 1959–1968. Since the beginning of the 1970s, the population of Hawai'i Island has rapidly increased by over three-fold to nearly 200,000 residents in 2016 (Figure 4.1).

The spatial distribution of the present-day resident population in West Hawai‘i is highly concentrated along the coastline: over 25% live 1 mile or less from the coast and over 80% live within 5 miles (Figure 4.2). Areas with the highest density of residents include Kailua-Kona, Kalaoa, Waikoloa Village, and Waimea.

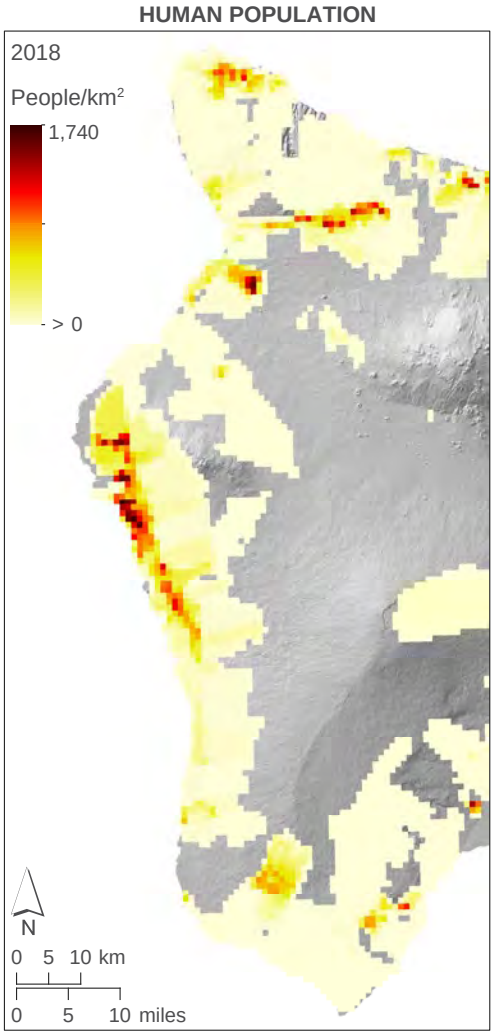


Figure 4.2. Map of West Hawai‘i indicating the spatial distribution of present day (2018) resident human population. Darker colors indicate a higher density of individuals per square kilometer. Human population is distributed over the land surface based on NASA's Gridded Population of the World (v4) dataset interpolated for year 2018. The dataset combines US Census data by census block and land use land cover data to allocate human population to land use types where humans live. Data source: NASA Socioeconomic Data and Applications Center (*http://sedac.ciesin.columbia.edu/data/collection/gpw-v4*).

Visitor Arrivals and Spending – Compared to other sectors, tourism is distinguished by both its size and share of Hawai‘i's economy. In fact, tourism expenditures represent the single largest source of economic activity in Hawai‘i (State of Hawai‘i DBEDT 2006). Moreover, many visitors spend the majority of their vacations at Hawai‘i's beaches and nearshore environment. Beach and water sports, such as swimming, snorkeling, and scuba diving, are by far the most popular recreational activities among visitors (State of Hawai‘i DBEDT 2006).

Visitor arrivals and visitor spending for West Hawai‘i was obtained from State of Hawai‘i DBEDT (Figures 4.3 and

4.4) and serve as indicators of tourism use of the marine environment and the importance of tourism to the local economy. From 1990 to 2016, visitor arrivals to Kona increased by over 30%, with approximately 992,000 arrivals in 1990 and over 1.3 million in 2016 (Figure 4.3, *Visitor Arrivals*). Between 70 and 80% of total arrivals are domestic visitors. The total number of days spent by all visitors in West Hawai'i has increased nearly twofold, from approximately 4.93 to 9.35 million days (Figure 4.3, *Visitor Days*). Further, the average length of stay has increased 42% over the last 27 years, from an average of 4.97 to 7.05 days.

Annual visitor spending in West Hawai'i increased by 62% since 2004, to nearly 2.1 billion dollars in 2016 (Figure 4.4, *Annual Spending*). Visitor spending is highly seasonal, with peaks in both wintertime (December/January) and summertime (June/July) (Figure 4.4, *Monthly Spending*). December spending, which is the highest single month of visitor spending each year, increased by 75% over the 13-year time period, from 133 to 233 million dollars.

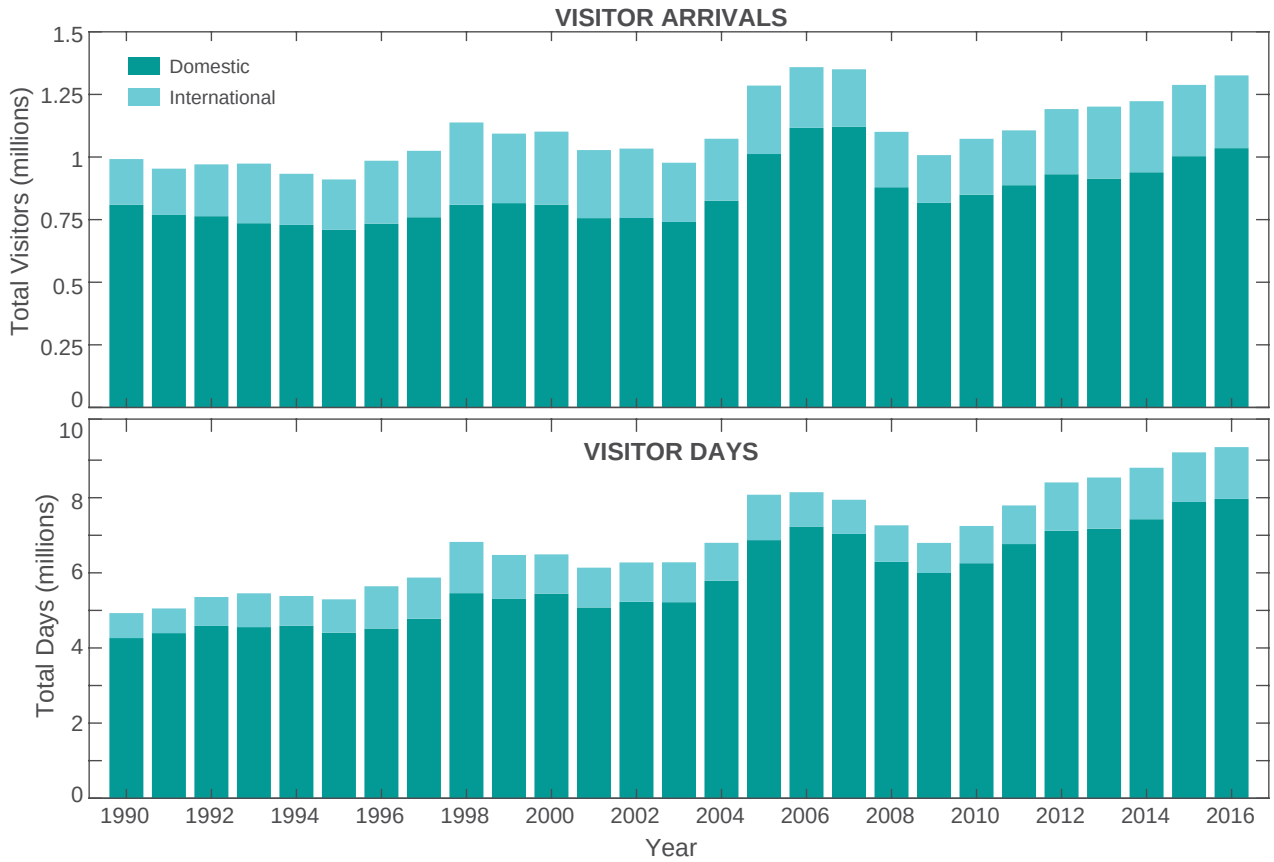


Figure 4.3. The total number of annual visitors arriving to Kona (top; millions of people), and the total number of days spent each year by visitors (bottom; millions of days) in Kona from 1990 to 2016. Visitor arrivals and days spent in Kona are by air and are split by domestic (dark green) and international (light green). Data Source: State of Hawai'i's Department of Business, Economic Development, and Tourism (*http://dbedt.hawaii.gov/*).

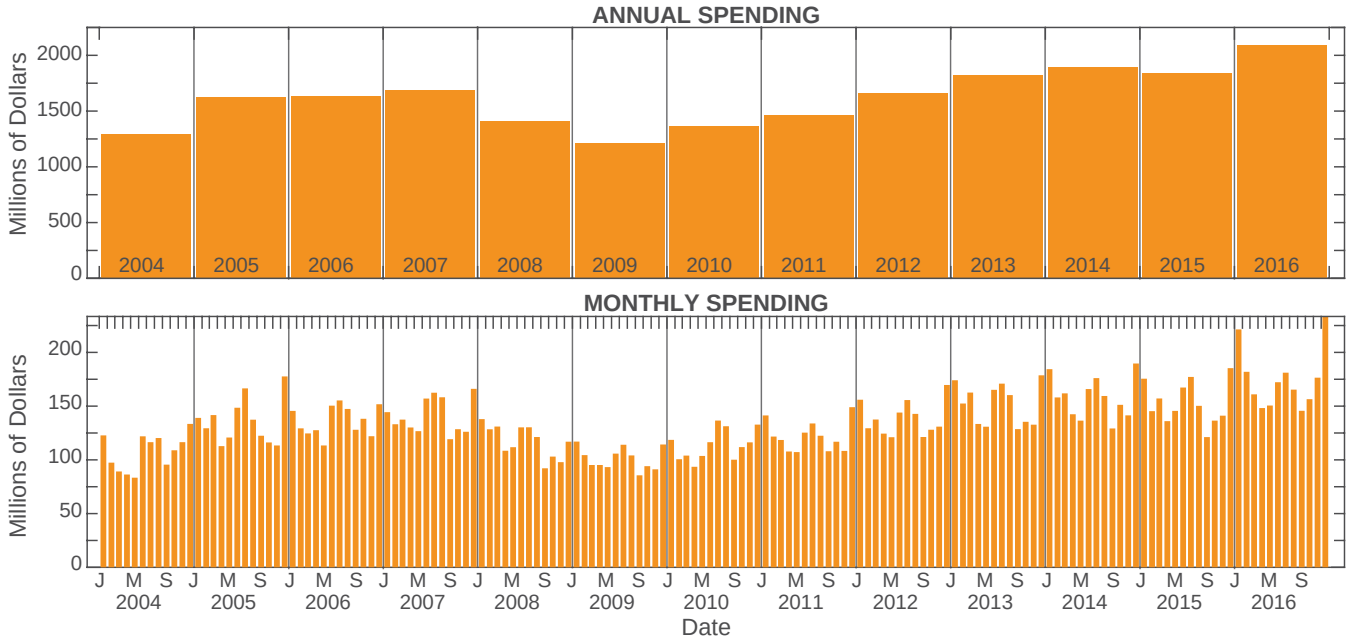


Figure 4.4. The total spending by visitors in Kona by year (top) and by month (bottom) from 2004 to 2016. Visitor spending is in millions of dollars. Data Source: State of Hawai'i's Department of Business, Economic Development, and Tourism (*http://dbedt.hawaii.gov/*).

Impervious Surfaces – Land-based development can affect nearshore coastal environments by creating impervious surfaces, such as pavement, roads, buildings, and roof tops. These man-made surfaces prevent rainwater from being absorbed into the land. The modification of natural land into impervious surfaces increases the amount of runoff from streets and sidewalks and influences nearshore ocean salinity and temperature.

We mapped the percent cover of impervious surfaces and estimated the potential runoff to the nearshore marine environment in 2017 (Figure 4.5, *Impervious Surface*) using land use and land cover data from NOAA's Coastal Change Analysis Program (*https://coast.noaa.gov/ccapftp*). The highest density of impervious surfaces and associated runoff is near Keāhole Point, Kailua-Kona, and between Puakō and Kawaihae. Overall, the total area of impervious surfaces increased by nearly 35% during 1992–2017, from approximately 81 km^2 to 109 km^2 (Figure 4.5, *Total Impervious Surface Area*).

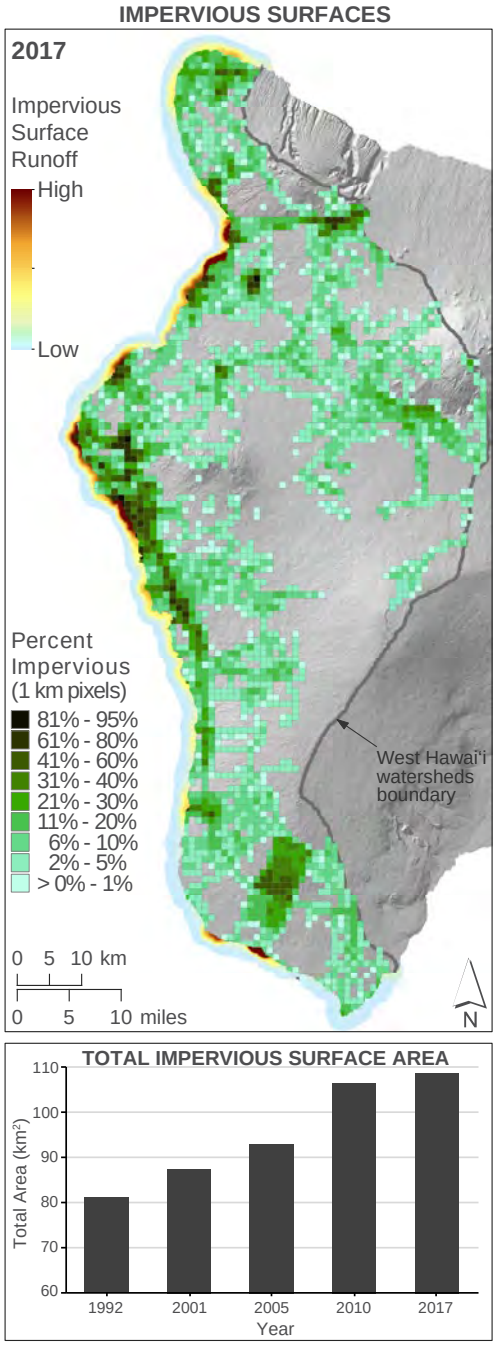


Figure 4.5 Map of West Hawaiʻi indicating the 2017 spatial distribution of impervious surfaces and potential run-off associated with the density of impervious surfaces (top). Below the map is a time series of total impervious surface area in West Hawaiʻi from 1992 to 2017 (bottom). Note the gray line in the map indicates the boundary of watersheds in West Hawaiʻi, which was used to enumerate the total area of impervious surfaces in the bar graph. Data Sources: NOAA Coastal Change Analysis Program (C-CAP; *https://coast.noaa.gov/ccapftp*) and LANDSAT satellite imagery (*https://landsat.usgs.gov*).

On-Site Sewage Disposal Systems (OSDS) – On-site sewage disposal systems (e.g., cesspools and septic tanks) and injection wells are common in much of West Hawaiʻi, where municipal sewer systems have not been constructed across a majority of the region. Nearly half of all OSDS in the state are located on Hawaiʻi Island, and nearly 85% of those are cesspools (Whittier & El-Kadi 2014), where the effluent receives no treatment prior to being released into the environment. OSDS can leach nutrients (nitrogen and phosphorus), pharmaceuticals, and pathogens into groundwater and streams that flow to the ocean. Abaya et al. (2018) performed a dye-tracer study in Puakō, a community

with homes located within a few hundred meters of the coast, and found that the travel time of wastewater to the nearshore waters ranged from 9 hours to 3 days. This runoff can result in algal overgrowth of corals, increased coral disease, and potential disease threats to humans (Anderson et al. 2002).

We have included the following indicators based on Hawai'i's Department of Health (*http://health.hawaii.gov/sdwb*) information to capture the influence of OSDS and injection wells (henceforth referred to simply as OSDS) on the marine environment: total number of OSDS, total effluent released, and total nitrogen flux (Figure 4.6). All indicators were compiled taking into account the time wastewater takes to reach the coastline. Specifically, we only included OSDS located from the shoreline to the one-year time of travel line of ground water (TOT; Figure 4.6, black line). The one-year TOT demarcation was chosen to indicate the likely intrusion of pathogens and nutrients to the nearshore, thereby capturing the potential impact of wastewater on human and ecological health (Whittier & El-Kadi 2014). It should be noted that the amount of nitrogen from wastewater that enters the groundwater is considered highly conservative and will likely reach the coast even when the source OSDS lies well beyond the one-year travel line. The values presented here are therefore a conservative estimate of the total effluent and nitrogen flux actually reaching the coastline.

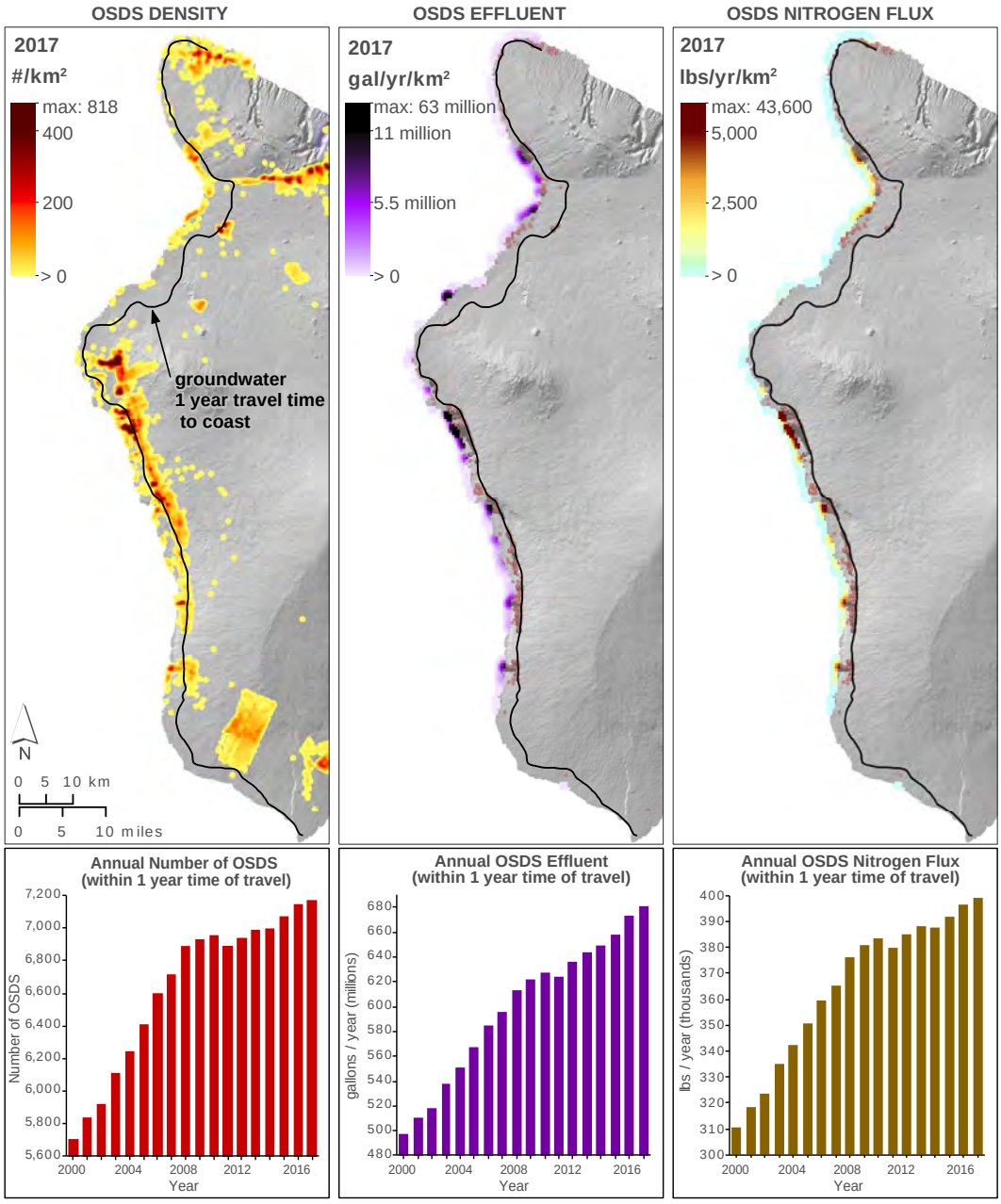


Figure 4.6 Maps of West Hawai'i indicating the spatial distribution of on-site sewage disposal systems (OSDS; top left), total effluent from OSDS into the coastal environment (top middle) and total nitrogen flux from OSDS into the coastal environment (top right). Note the black line indicates the one-year time of travel for effluent from OSDS reaching the coast. Below each map are annual values for the total number of OSDS (bottom left), total effluent from OSDS (millions of gallons/year) (bottom middle), and total nitrogen flux (thousands of lb/year) (bottom right) from OSDS within the 1-year time of travel contour from 2000 to 2017. Note these values represent a conservative estimate of OSDS numbers and associated effluent influencing marine ecosystem health. Data Source: State of Hawai'i Department of Health (*http://health.hawaii.gov/sdwb*).

The spatial distributions of all three indicators are shown from the most recent data available (2017), as well as a time series extending from 2000 to 2017 (Figure 4.6). The maximum concentration of OSDS (818 OSDS/km²) within the

one-year TOT is near Kailua-Kona. High concentrations of OSDS (400 OSDS/km²) also occur in Miloliʻi and between Puakō and Kawaihae. The total amount of effluent in nearshore waters is as high as 63 million gallons/yr/km² with a total nitrogen flux of 43.6 thousand lb/yr/km². In 2017, the total number of OSDS across West Hawaiʻi (within the one-year TOT) was just under 7,200 (Figure 4.6, *Annual Number of OSDS*). This number of OSDS released a total of 680 million gallons of effluent per year (Figure 4.6, *Annual OSDS Effluent*) and a total of 400,000 pounds of nitrogen per year (Figure 4.6, *Annual OSDS Nitrogen Flux*).

ENGAGEMENT IN FISHING

Human communities in Hawaiʻi are deeply intertwined with fisheries due to their contributions to the local economy, food supply chain, and perpetuation of cultural customs and practices (Kittinger et al. 2015, Grafeld et al. 2017, Pascua et al. 2017, Teneva et al. 2018). Nearshore fisheries, for example, provide 7 million meals to local communities annually (Grafeld et al. 2017). Multiple gear types are used to harvest reef fish and invertebrates, estuarine species, and schooling coastal pelagics (Friedlander et al. 2014). Fisheries contribute to many aspects of ecosystem services and human well-being.

In an effort to describe fishing activities, we have included total catch, annual revenue, and fisher engagement indicators that encompass both commercial and non-commercial fishing in West Hawaiʻi. For fisher confidentiality, catch records are excluded if fewer than 3 fishers reported per DAR reporting block, year, gear, and species. Therefore, the total catch presented is likely a conservative estimate of actual catch.

Reef Fish Fishing: Non-Commercial Catch – Reef fisheries have substantial social, cultural, and economic value in Hawaiʻi, yet knowledge regarding their sustainability is limited (Pauly & Zeller 2014). This is in part because coral reef fisheries are characteristically multi-species, multi-gear, and have significant non-commercial components (Kittinger et al. 2015). Non-commercial fishing plays an important social, cultural, and subsistence/consumptive role for local communities in Hawaiʻi and is estimated to be over 10 times the reported commercial catch (by weight) on Hawaiʻi Island (McCoy et al. 2018)

Total non-commercial catch was calculated by gear type from 2004 to 2013 from island-wide average annual catch estimates of Hawaiʻi Island reef fish (McCoy et al. 2018). Here, we estimated catch for West Hawaiʻi using proximity to roads and shoreline accessibility, distance to nearest harbor or launch ramp, gear-specific spatial footprints, and gear prohibitions within MPA boundaries to spatially distribute island-level catch estimates from Upolu Point to South Point (Wedding et al. 2018). Data were filtered by species to include nearshore reef-associated finfish only.

The estimated annual average catch was nearly 406,000 lb during the 2004–2013 time period (Figure 4.7 Non-Commercial Catch). A five-fold difference in the annual average catch was observed, indicating spatial differences in catch among different regions of West Hawaiʻi. Approximately 29–33 thousand pounds of reef fish were caught per year in some of the most heavily fished areas, such as between Puakō and Kawaihae and near Kailua-Kona, while 5–8 thousand pounds of reef fish were caught in areas with less fishing, such as in the vicinity of South Point. Overall, the non-commercial reef fish fishery has declined in recent years: total catch in 2013 was estimated at 265,200 lb, a roughly 50% drop from the 525,600 lb caught in 2008. Line fishing was the dominant gear type, constituting between 55 and 70% of the total catch.

Reef Fish Fishing: Commercial Catch – Commercial reef-fish catch is reported to Hawaiʻi DAR by the reporting blocks as shown in Figure 4.7. *Commercial Catch* data were filtered by species to include nearshore reef-associated finfish only.

A majority of the reported commercially caught reef fish over the 2003–2017 time period was from the reporting

block that spans from Keāhole Point to Miloli‘i, with an average annual catch of 8,400 lb (Figure 4.7, *Commercial Catch*). Total catch for all of West Hawai‘i varied over six-fold across the 15-year time period, ranging from a low of 5,500 lb in 2004, to a high of 34,400 lb in 2010 (Figure 4.7, *Annual Commercial Catch*). As with non-commercial catch, line fishing was by far the dominant gear type, ranging from 60 to 100% of the commercial reef fish catch. The dominant reef fish species caught in the commercial fishery, by weight, are ʼūʼū, or menpachi (soldierfish, *Myripristis spp.*) and uku (gray jobfish, *Aprion virescens*), which combined account for 70% of the catch. When compared to non-commercial catch, commercial reef fish fishing is a very small fraction (1/24) of the total catch from coral reef ecosystems in West Hawai‘i.

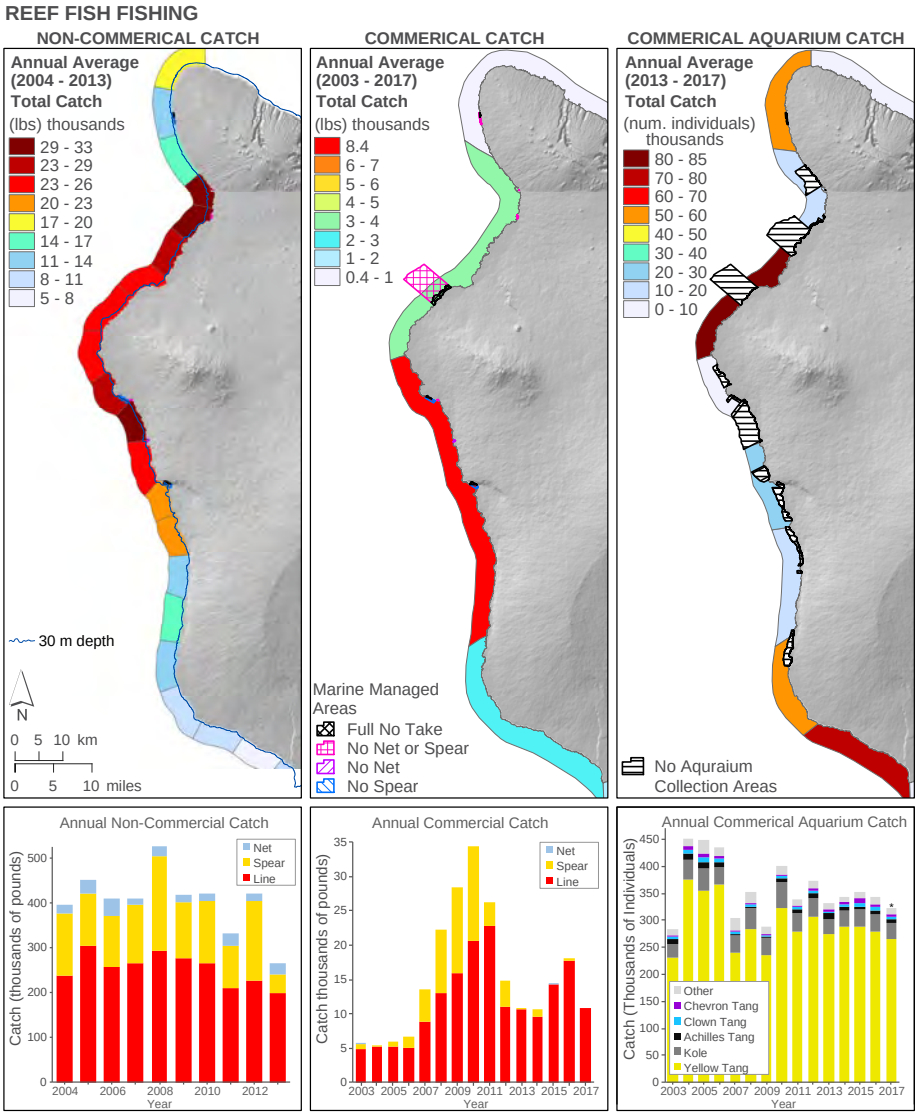


Figure 4.7. Maps of West Hawai‘i indicating the spatial distribution of average annual reef fish fishing catch, including non-commercial catch (top left), commercial catch (top middle), and commercial aquarium catch (top right). Note for non-commercial catch (top left), the 30-m contour is provided for context of areas containing reef fish. Coastal segments are shown for the purposes of visualization only, and do not represent the outward spatial extent over which catch was enumerated. Below each map are annual values for the total catch of reef fish, including non-commercial catch from 2004 to 2013 (bottom left), commercial catch from 2003 to 2017 (bottom middle), and commercial aquarium catch from 2003 to 2017 (bottom right). Data Sources: Non-commercial catch estimates from McCoy et al. (2018) and mapping methods from Wedding & Lecky et al. (2018). Commercial catch and aquarium catch from Hawaii DAR (*http://dlnr.hawaii.gov/dar*) and from NOAA Fisheries.

Reef Fish Fishing: Commercial Aquarium Collection - Aquarium collection is the live capture of ornamental aquatic organisms for sale in the aquarium industry. Commercial aquarium collection is the most economically valuable commercial inshore fishery in the state (Walsh et al. 2013). Aquarium collectors typically target juvenile fish, and catch is reported in number of individuals taken rather than by weight. As with other commercial fisheries, total catch is recorded by reporting block (e.g., Figure 4.7, *Commercial Catch*). However, in 2013, smaller reporting blocks, or subzones, were implemented specifically for aquarium collection in West Hawai'i. Here, we report annual average aquarium catch by subzone from 2013 to 2017 to provide greater spatial resolution on the take of aquarium fishes (Figure 4.8, *Commercial Aquarium Catch*); however, total commercial aquarium catch is provided, by species, from 2003 to 2017 (Figure 4.8, *Annual Commercial Aquarium Catch*).

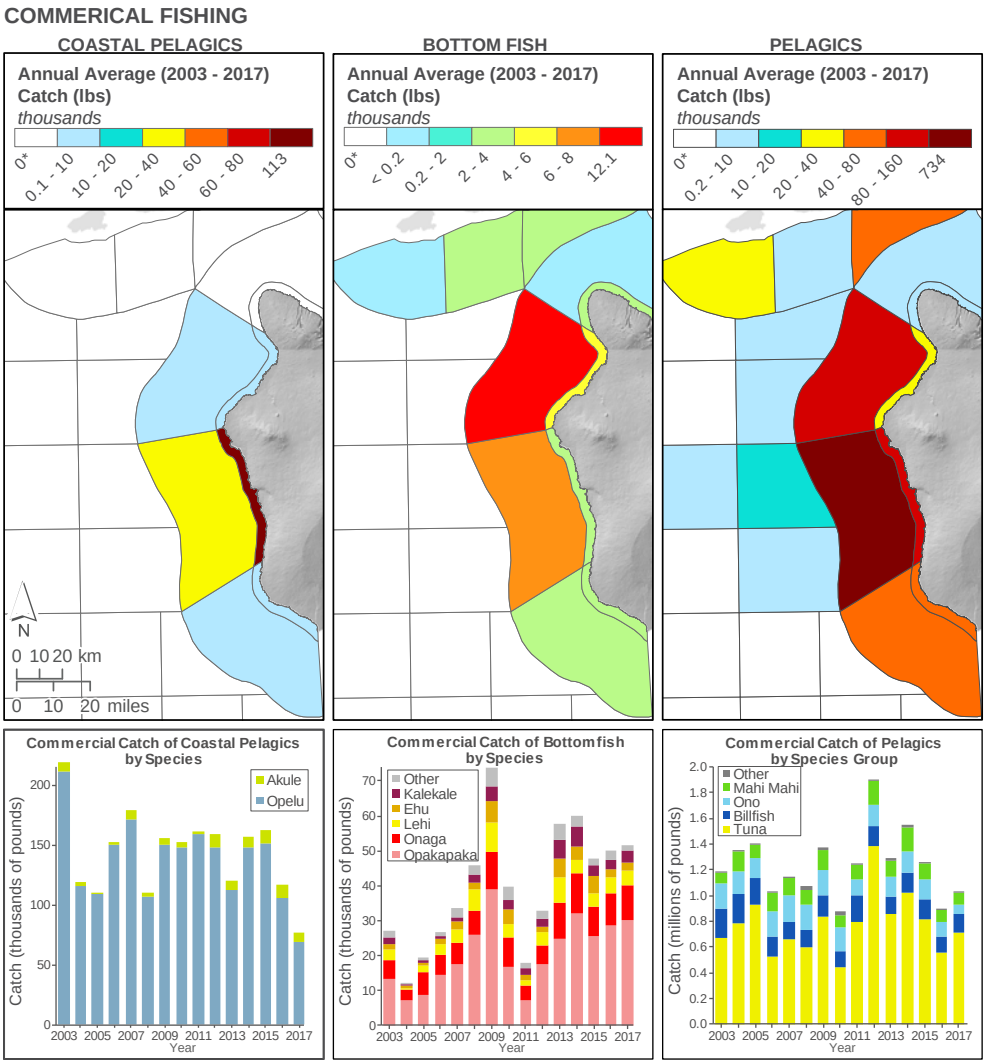


Figure 4.8. Maps of West Hawai'i indicating the spatial distribution of average annual commercial fishing catch for non-reef fishes by Hawai'i DAR reporting block, including coastal pelagics (top left), bottomfish (top middle), and pelagics (top right). Below each map are annual values for the total commercial catch of non-reef fishes from 2003 to 2017 by species, including coastal pelagics (bottom left), bottomfish (bottom middle), and pelagics (bottom right). Data Sources: Hawaii DAR (http://dlnr.hawaii.gov/dar) and NOAA Fisheries.

The average annual commercial aquarium catch differs greatly along West Hawai'i. For example, 80–85 thousand individual fish are caught per year in the reporting block that spans north from Keāhole Point to Waikoloa (Figure 4.7, *Commercial Aquarium Catch*), which comprises 25% of the total catch in an average year. In contrast, fewer

than 10,000 individuals were caught from the reporting block that spans south from Keāhole Point to Kailua-Kona. The total catch across the region from 2003 to 2017 was, on average, approximately 360,000 individual fish per year (Figure 4.7, *Annual Commercial Aquarium Total*). However, large year-to-year differences were observed, ranging from an industry maximum of over 452,000 individuals in 2004, to a minimum 288,072 individuals in 2009, a difference of more than 160,000 individuals. Laui'pala (yellow tang, *Zebrasoma flavescens*) is the most popular aquarium fish caught in West Hawai'i, accounting for 82% of average annual catch over the 15-year time period. Kole (goldring surgeonfish, *Ctenochaetus strigosus*) and pāku'iku'i (Achilles tang, *Acanthurus achilles*) account for 12% and 2.5% of average total catch, respectively, while all other species comprise less than 3% in an average year.

In July 2017, the Hawai'i Circuit Court ruled that, based upon a Hawai'i Supreme Court opinion issued on September 6, 2017, existing 'aquarium' permits for use of fine mesh nets/traps to catch aquatic life for aquarium purposes were illegal and invalid pending a full review of the fishery under the Hawai'i Environmental Policy Act. Although collecting was still allowed as long as fine mesh nets/traps were not used, total catch in 2017 would presumably have been higher if not for the ruling.

In January 2018, DLNR announced that after applying a Hawai'i Supreme Court ruling from 2017 to the existing West Hawai'i Regional Fishery Management Area administrative rule (HAR §13-60.4), no aquatic life may be taken for commercial aquarium purposes in West Hawai'i waters until an environmental review is completed. In July 2018, after review of two Final Environment Assessments (EAs) prepared by the Pet Industry Joint Advisory Council (PIJAC), Suzanne Case, the Chair of the Board of Land and Natural Resources, determined that the preparation of an Environmental Impact Statement (EIS) was required. As of the writing of this report (Nov 2018), the West Hawai'i aquarium fishery is still closed.

Commercial Fishing: Coastal Pelagics – We define coastal pelagic fishes as two species: akule (bigeye scad, *Selar crumenophthalmus*) and 'ōpelu (mackerel scad, *Decapterus macarellus*). Though they can be found seasonally in large schools proximate to shore, they are distinguished from reef fish because they principally reside in nearshore pelagic waters.

On average, nearly 80%, or 113,000 lb of coastal pelagic catch comes from one reporting block (101), which extends from Keāhole Point to Miloli'i (Figure 4.8, *Coastal Pelagics*). 'Ōpelu dominate the coastal pelagic catch, comprising greater than 95% of the average annual catch (Figure 4.8, *Annual Coastal Pelagics Catch*). During the last 15 years, the total catch has shown an overall decline, with present day total catch (77,000 lb) approximately 1/3 of the total catch in 2003 (218,700 lb).

Commercial Fishing: Bottom Fish – The most commonly caught bottomfish species, comprised of six deep water snapper species and one grouper, are referred to as the "Deep 7." The Deep 7 are more actively managed than other fisheries, including annual catch limits, vessel registration, and reporting requirements. Bottomfish are primarily caught with deep-sea hand line in depths of approximately 300–1300 ft (~100–400 m).

On average, nearly 1/3 of the total commercial bottomfish catch near West Hawai'i was reported in the block that includes North Kona and South Kohala (Figure 4.8, *Bottomfish*). However, the total catch across the region has varied considerably over the last 15 years, with a six-fold difference between the lowest catch (12,350 lb; 2004) and the highest catch (73,600 lb; 2009) (Figure 4.8, *Annual Bottomfish Catch*). The dominant species caught in West Hawai'i was 'ōpakapaka (pink snapper, *Pristipomoides filamentosus*), comprising approximately 52% of the annual catch by weight.

Commercial Fishing: Pelagics – Pelagic species include some of the most highly recognizable food fish, such as tunas and mahimahi, as well as popular sport fishing species, like marlins and swordfish. Pelagics are typically large-bodied,

fast-swimming fishes that live in pelagic waters with geographic ranges spanning much of the Pacific. Pelagics are the largest fishery in West Hawai‘i in terms of both weight caught and estimated dollar value.

In the vicinity of West Hawai‘i, over 70% of the average annual commercial catch of pelagic fishes was from the two reporting blocks off South Kona (i.e., from Keāhole Point to Miloli‘i) (Figure 4.8, *Pelagics*). Tunas, namely ahi (bigeye and yellowfin tunas, *Thunnus obesus* and *Thunnus albacare*s) and aku (skipjack tuna, *Katsuwonus pelamis*), comprise the largest proportion of catch, with an average of 62.5% over the 15-year time period (Figure 4.8, *Annual Pelagics Catch*). A‘u (striped marlin, *Kajikia audax*), ono (wahoo, *Acanthocybium solandri*), and mahimahi (*Coryphaena hippurus*) each account for a similar share of average annual catch (13%, 13%, and 10%, respectively). Across all of West Hawai‘i, the pelagic fishery averaged 1.24 million pounds of total catch per year, with a peak of 1.9 million pounds in 2012. In more recent years, the total catch has declined: the 2017 total catch was 1.023 million pounds, representing a 46% decline in just 5 years.

Commercial Fishing Annual Revenue and Fisher Engagement – The annual revenue generated and the total fishers engaged in commercial fishing activities in West Hawai‘i are shown from 2003 to 2016 in Figure 4.9. All data were obtained from the State of Hawai‘i DAR dealer reports (Walsh et al. 2013, PIFSC 2018), specifically for fishers that live in West Hawai‘i (based on fisher zip code). Revenue values were corrected for inflation to 2016 dollar amounts using the Bureau of Labor Statistics' Honolulu Consumer Price Index for all urban consumers (*www.bls.gov*). The pelagics fishery is by far the most economically important to the region, generating a total of $47.4 million or 62.3% of the total revenue from all commercial fisheries in West Hawai‘i over the 14-year time period (Figure 4.9 *Commercial Fishery Revenue*). The commercial collection of aquarium fishes was the second largest fishery in total revenue, accounting for $18.9 million, or 24.9%. Bottomfish, coastal pelagics, and reef fish constituted 5.8%, 3.9%, and 2.5% of the total revenue generated, respectively. Each of the fisheries' revenue exhibited year-to-year differences. For example, bottomfish had over a four-fold change in annual revenue in just six years, increasing from a low of $135,670 in 2011 to a high of $571,114 in 2016.

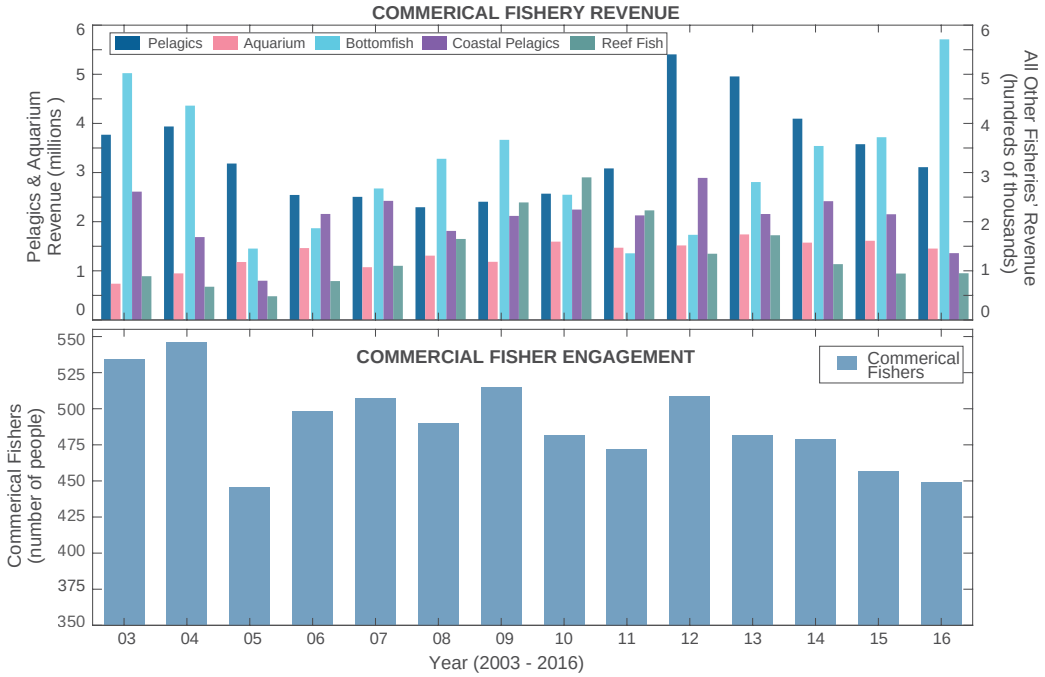


Figure 4.9. The annual revenue generated from commercial fishing activities (top) and the total fishers engaged in commercial fishing (bottom) from 2003 to 2016. Commercial fisheries include those fishing for pelagics, aquarium fishes, bottomfish, coastal pelagics, and reef fish. Note that annual revenue for the commercial pelagics fishery and aquarium fishery are presented in millions of dollars

(left y-axis) while all other fisheries are presented in hundreds of thousands of dollars (right y-axis). Annual reported revenues were obtained from the State of Hawai'i DAR dealer reports, specifically for fishers that live in West Hawai'i (based on fisher zip code). Revenue values were corrected for inflation to 2016 dollar amounts, using the Bureau of Labor Statistics' Honolulu Consumer Price Index for all urban consumers (*www.bls.gov*). Data Source: NOAA Fisheries (https://inport.nmfs.noaa.gov/inport/5610). Commercial aquarium fishery information was provided by William J. Walsh, State of Hawai'i DAR.

As with total revenue, the total number of fishers engaged in commercial fishing in West Hawai'i varied over the 14-year time period, ranging between 446 and 546 fishers (Figure 4.9 *Commercial Fisher Engagement*). The number of commercial fishers in 2016 was 446, representing an 18% decline from the peak of 546 fishers in 2004.

When comparing the total annual revenue with the total annual catch from each commercial fishery from 2003 to 2016, revenue and catch for pelagics, coastal pelagics, and reef fish were positively correlated ($R^2 = 0.71$, 0.74, and 0.91, respectively; $p < 0.05$), indicating that in general, the greater the total catch, the greater the total revenue generated for a given commercial fishery. The annual revenue and total catch from both the aquarium fishery and the bottomfish fishery were not correlated, indicating that market value is driven by external factors beyond total catch. In addition, no correlation was found between the annual number of commercial fishers and the combined annual catch from all commercial fisheries, indicating that the number of fishers were not a primary driver in year-to-year fluctuations in total catch.

5. SUMMARY AND NEXT STEPS

Ecosystem indicators provide the ability to track the status of West Hawai'i's marine ecosystem. Here, we compiled 30 individual indicators identified via a combination of community and expert opinions, region-specific research results, and our current scientific understanding of sub-tropical marine ecosystems. Ecosystem indicators presented herein span a wide range of ecosystem components including social, ecological, climatic, and oceanic drivers of ecosystem change. From this synthesis of information, a number of key findings have emerged:

Ecological Indicators

- The number of juvenile yellow tang has significantly increased between 60 and 80% in the last 14 years across all three management designations in West Hawai'i.
- The total abundance of nearshore fishes has shown a positive trend in all management areas, increasing since 2003 by 28.9%, 36.0%, and 34.9% in MPAs, FRAs, and open areas, respectively.
- The estimated annual average non-commercial reef fish catch was nearly 406,000 pounds from 2003 to 2013, representing an 11.5-, 2.7-, and 24-fold increase over the annual average commercial catch of bottomfish, coastal pelagics, and reef fish, respectively.
- Herbivorous fishes showed no change in FRAs or open areas, but increased by nearly 1/3 since 2003 in MPAs.
- Herbivores constitute about 50% of the total fish biomass in West Hawai'i.
- All reef fish indicators—total abundance and biomass, adult fish length, species richness, herbivore biomass, juvenile yellow tang—were 1.1–2 times higher in MPAs than open areas in 2017.
- The total cover of hard coral across West Hawai'i was approximately 18% in 2017, representing a relative decrease of 50% since 2003.

Climate and Ocean Indicators

- Long-term sea level measurements from Kawaihae indicate a clear positive trend, increasing by 0.27 m (0.89 ft) in the past 28 years.
- Rainfall patterns are shifting towards dryer conditions across West Hawai'i. The total number of months exceeding the *very dry* threshold was 1.9–2.6 times higher during most recent 20-year time period (1997–2016) compared to the previous 20 years (1976–1996).
- Ocean temperatures in 2015 were the warmest on record in West Hawai'i.
- As a result of climate change, ocean temperatures are projected to substantially increase in the coming decades, causing severe coral bleaching similar to that experienced in 2015 to occur on an annual basis starting in 2040 in West Hawai'i.

Social Indicators

- The population of Hawai'i Island is currently 200,000 residents. Over 25% live 1 mile or less to the coast, and over 80% live within 5 miles.
- Since 2003, the total catch from the pelagics commercial fishery was over six times the combined commercial catch (by weight) of all other commercial fisheries representing 62.3% of the total revenue generated in West Hawai'i.
- The aquarium fishery is the most economically valuable inshore commercial fishery and the second most economically valuable commercial fishery in West Hawai'i, averaging nearly $1.6 million per year over the past 5 years.
- Tourism represents the single largest source of economic activity in West Hawai'i, exceeding $2.1 billion in spending in 2016. December spending, which is the highest single month of visitor spending each year, increased 75%, or from $133 million to $233 million in the past 15 years.
- An estimated 680 million gallons of wastewater was released into the coastal environment in 2017 from on-site sewage disposal systems. The highest concentration of OSDS (>800 OSDS/km^2) is located in the vicinity of Kailua-Kona, where 125 million gallons of wastewater and 87,500 pounds of nitrogen enter the nearshore waters each year.

NEXT STEPS

We have assembled a suite of relevant ecosystem indicators to help track changes in key social-ecological processes in West Hawai'i; however, many gaps remain. Our understanding of ecosystem dynamics and the myriad of social-ecological interactions occurring in the region continues to evolve. The evaluation and synthesis of information and development of ecosystem indicators is an adaptive and iterative process that will continue to evolve beyond this publication.

In the coming years, the West Hawai'i IEA will focus on human well-being in West Hawai'i. Simply stated: ecosystems are fundamentally intertwined with human well-being and ignoring this important connection can undermine the sustainability of an ecosystem and related resource management goals (Millennium Ecosystem Assessment 2005).

Previous efforts with stakeholders in West Hawai'i identified the potential impacts of ecosystem change onto

ecosystem services (Ingram et al. 2018). Importantly, a majority of ecosystem services perceived as the most vulnerable to ecosystem change were found to be *cultural ecosystem services*, which are considered critical to human well-being. Cultural services foster and maintain a connection to place, identity, values, and experiences (Chan et al. 2012, Fish et al. 2016, Pascua et al. 2017). Cultural services are often intertwined and interconnected with other ecosystem services (Chan et al. 2011, Pascua et al. 2017). Therefore, attempting to manage a complex cultural service specifically and individually, without accounting for other services such as provisioning or supporting (Chan et al. 2012, Gould et al. 2015) is challenging. Hawai'i's non-commercial nearshore fishery is a clear example as it contributes to both subsistence (provisioning ecosystem service) and cultural ecosystem services such as knowledge transfer and social cohesion (Grafeld et al. 2017).

As part of the West Hawai'i IEA, we have begun to identify domains of cultural ecosystem services related to human well-being, associated attributes (i.e., definitions or examples) of each domain, and potential indicators of cultural services (see Appendix A). We are currently conducting interviews with community members in West Hawai'i to refine this information and ensure its validity, relevancy, and applicability for West Hawai'i. It is our intention to develop a more robust suite of indicators that track the overall status of West Hawai'i's social ecological system, including the cultural services and human well-being within the region.

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APPENDICES

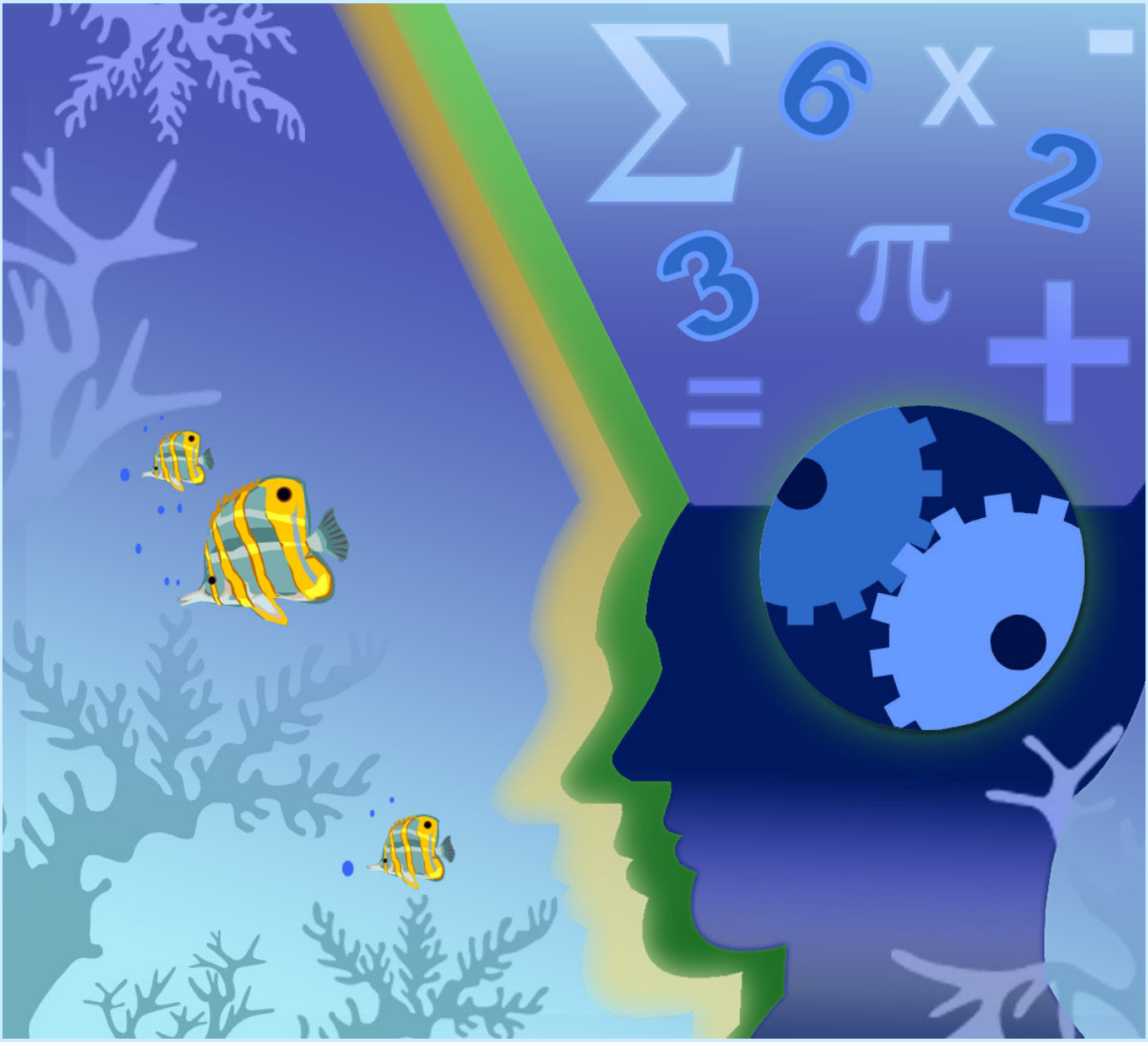
Consolidated list of human well-being domains, attributes, and cultural ecosystem services in relation to cultural ecosystem services in West Hawai‘i

DOMAINS	ATTRIBUTES	POTENTIAL INDICATORS OF CULTURAL ECOSYSTEM SERVICES
Heritage	Multi-generational interactions/connections with natural resources	Transmission of knowledge or practices around deified ancestral guardians (e.g., ‘aumakua); use or transmission of stories and verbal histories (e.g., mo’olelo); birth place and family burial sites; ceremonial practices, practices of respect, and other practices related to connection with place and resources
	Archaeological and historic sites	
	Cultural resources	
	Acceptable historical change	
Spirituality	Interacting with the landscape to perpetuate spiritual beliefs and practices (e.g., divine power)	Formal ceremonial practices (e.g., oli, pule, other cultural protocols); perpetuation of songs, chants, dances, and prayers of/for place; protocols for place-specific gathering and harvesting practices
	Presence and recognition of plants, animals, and elements that represent/symbolize deities	Creation and use of ceremonial garlands (e.g., lei); ceremonial offerings such as fresh water, rain, salt, and turmeric
	Presence and recognition of familial guardians/ancestors; resources themselves recognized as kin	Recognition of deified ancestral guardians that are cared for by and take care of specific families (e.g., ‘aumakua)

DOMAINS	ATTRIBUTES	POTENTIAL INDICATORS OF CULTURAL ECOSYSTEM SERVICES
Sense of Place & Identity	Sense of self, community, and/or home related to the coastal and marine environment	Activities on the landscape; heritage, social, and emotional connections to places
	Presence of historical place-based names which describe the past and present of the coastal and marine environment	Place names; landscape terms; species names; environmental process names (e.g., rain names, wind names); transmission of existing or creation of new cultural proverbs to describe these observations
	Engagement of families in coastal and marine resource based activities	Existence and availability of activities such as fishing or harvesting for livelihood or enjoyment
	Presence on and interaction with lands that will remain secure (formally or informally) for future generations	Presence by lease, physical access, ownership, and/or occupation; customary rights and tenure
Education	Local knowledge about the coastal and marine environment	Language and/or culture encoded knowledge of seasonal weather patterns, timing, and intensity of rain, plant/animal behavior and reproductive cycles; place-specific practices associated with storied landscapes
	Knowledge transmission (place-based, observational, formal, informal, etc.)	Scientific research, experiential, land-based education, learning from elders, culture-based education (e.g., gathering salt from natural pools and making salt in raised ponds)
	Presence of environmental signs or indicators (e.g., bioindicators) and the ability to recognize them	Species or environmental processes that signal the cycles of another plant/animal species (e.g., types of rainbows to signal events)
Social Relations	Perpetuation of practices/skills that allow individuals to provide for and share with their families and community	Goods for household, sharing, and income; jobs that require knowledge of traditional practices or the discipline required; formal and informal apprenticeships; place-based fishing/gathering practices; community fishing endeavors; acknowledgement of young leaders
	Presence of strong social ties or networks; sense of community; trust in neighbors	Network of people to share with and receive from; gifting/exchanging of goods; joint family endeavors; communal child care; community spaces
Stewardship	Ability to care for resources and environment	Contributions of time, labor, and/or monetary support towards maintenance of public or private lands or specific sites; restoration and maintenance of sacred sites (e.g., wahi pana), civic activities around public spaces
	Customary rights and responsibilities are locally known, practiced, and respected	Recognition and use of access restrictions, gathering rights, and easements related to traditional ownership or harvesting practices (e.g., kapu)

DOMAINS	ATTRIBUTES	POTENTIAL INDICATORS OF CULTURAL ECOSYSTEM SERVICES
Existence	Aesthetics	Recognition and practices around the appropriate maintenance of specific sacred sites; pride in community parks and coastal areas; beach clean-up activities
	Inspiration	Broadly circulating public discourse about collective responsibilities (e.g., caring for place or *malama 'aina*)
	Creativity	Local artistic or creative practices; moralization; poster competitions in schools
Governance & Management	Political participation and equity	Participation in marine management decision-making processes and leadership; stakeholder processes; exercising rights/interest in politics; management reflects local and traditional values
	Effectiveness of management	Perceptions of management, permits, and regulation; adequate funding and staff capacity for achieving management objectives; partners and collaboration
Health	Physical and nutritional health	Outdoor activities that promote health and strength of body and mind
	Mental and emotional health	
Safety & Security	Security and safety related to real or perceived environmental risks	Protection from threats of natural disasters (hurricanes, tsunamis, earthquakes, etc.), e.g., level of social preparedness for natural disasters; access to social nets; availability and application of traditional knowledge to mitigate environmental risks.

NOAA FISHERIES



MAQTRAC

Marine Aquarium Trade Coral Reef Monitoring Protocol

Data Analysis and Interpretation Manual

Domingo Ochavillo and Gregor Hodgson

November 2006

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MAQTRAC

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With transition matrix model for coral population trajectory analysis
by Dr. Wilfredo Licuanan

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Acronyms

CITES	Convention on the International Trade in Endangered Species of Wild Flora and Fauna
CPUE	catch-per-unit-effort
ELEFAN	Electronic Length-Frequency Analysis
FiSat	FAO-ICLARM Fish Stock Assessment Tools
MAC	Marine Aquarium Council
MAQTRAC	Marine Aquarium Trade Coral Reef Monitoring Protocol
MSY	Maximum sustainable yield
SC	size class
SPR	Spawning Stock Biomass Per Recruit
TAC	Total allowable catch
VPA	Virtual Population Analysis
YPR	Yield-per-recruit

Background .....

chapter 1

The ornamental trade is a rapidly expanding industry that sources a high percentage of organisms from the often overfished and degraded coral reefs of the Philippines and Indonesia. There is a potential threat for collection to drive local populations to unviable levels. If the trade is to be sustainable, catch limits constitute an important management strategy in addition to the establishment of no-take marine protected areas and other coral reef rehabilitation activities.

This Data Analysis and Interpretation Manual of the Marine Aquarium Trade Coral Reef Monitoring Protocol (MAQTRAC) is an accompanying volume to the MAQTRAC Field Operations Manual. This manual has been developed as a guide for scientists to be able to analyze ornamental fisheries with limited historical data and to set total allowable catch limits for targeted ornamental populations. The concept of total allowable catch (TAC) is a new concept for the ornamental fishery in both the Philippines and Indonesia.

Total Allowable Catch as a Reference Point

'Reference points' such as total allowable catch are used to manage a fishery. A reference point is defined as a value derived from technical analysis to manage a stock (Caddy 1998). Reference points are largely based on models that are mathematical conceptualizations of the populations of target species. In practical terms, these reference points may have a poorly-defined level of error. The determination of reference points to manage fisheries has been difficult even in developed countries that have invested substantial time and finances on research. The difficulties have been largely due to errors at different levels: (1) process errors due to nature's variability; (2) measurement error; (3) model uncertainties; and (4) estimation error due to combinations of the above factors. For example, due to the cryptic nature of various

ornamental species it can be assumed that MAQTRAC surveys produce conservative estimates of stock abundances therefore giving conservative estimates of population abundances. Even among highly visible ornamentals, the physical complexity of coral reefs provides hiding places further leading to underestimates of abundance.

Developing technical reference points for the aquarium trade is challenging because it is a multi-species fishery, and there is very little information regarding historical catch and effort and on the ecology of the target species. The development of reference points for the ornamental trade requires a combination of traditional fisheries models, practical guidelines and most importantly, empirical experience, that can de derived from an adaptive management approach.

Total allowable catch developed for the aquarium trade can be used to provide interim reference points that will be subsequently refined as more data are gathered. Annual target population surveys are required as part of the Ecosystem and Fisheries Management standard under the MAC certification program.

Determining Total Allowable Catch for Fish and Invertebrates Other than Corals .....

chapter 2

In cases where long-term catch records are not available, total allowable catch can be estimated from natural mortality rates. In cases wherein catch records are available, yield-per-recruit analysis can be used. Both methods can also be used to estimate a range of catch limits. (See Appendix 1 for a review of fisheries models and their applicability to ornamental fisheries). The following is a diagram of the flow of analysis and the subsequent determination of total allowable catch.

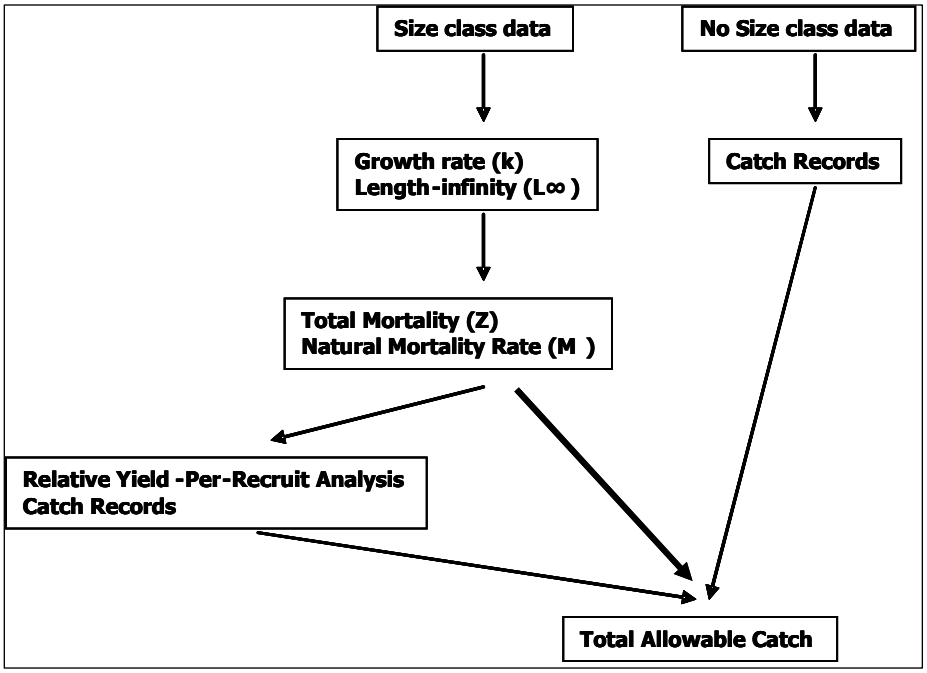

Figure 1 Flow of data analysis for ornamental fish and invertebrates

2.1 Natural mortality and Yield-per-recruit case studies (central Philippines data)

Population parameters (growth, mortality and relative yield-per-recruit estimation) were derived for various species that had representative size class data using FiSat software. (The FiSat software can be downloaded free of charge from the website http://www.fao.org/fi/statist/fisoft/fisat/downloads.htm.) To be representative, the analysis requires size class data from recruits, juveniles and adults of a minimum of 150 individuals. Typically, it is NOT possible to obtain this number of observations from a single population of aquarium fish species such as the Emperor Angelfish, therefore other methods must be used. But for naturally abundant species such as Green Chromis, these data provide a view of the population growth trajectory which is the basis for this type of stock assessment. Length-at-first capture data (the smallest size of the species collected in the trade) were obtained from catch records of collectors. The latter data are important in relative yield-per-recruit analysis.

A step-by-step list is given below regarding how to calculate natural mortality and analyze relative yield-per-recruit for fish and invertebrates (except corals) using FiSat software. Corals require a different approach.

1. Obtain size class data for a species including recruits to adults with a total of 150-200 individuals. The data are input to the FiSat software for the following steps.

2. Divide the size data into several classes. We recommend a 1 cm interval for damselfish size classes and for other fishes that have a maximum size of around 5 to 6 cm; 2 to 3 cm size class intervals for anemonefishes; 3 to 4 cm size class intervals for butterflyfishes and other fishes that have a maximum size from 15 to 20 cm; and 5 cm groupings for the bigger angelfishes (e.g. *Chaetodontoplus mesoleucus*) and other fishes with maximum size more than 20 cm. (Encode data in the necessary query in FiSat.);

3. To estimate the growth coefficient k and L-infinity, go to (a) Assess query; (b) to direct fit of length frequency data; (c) to ELEFAN 1; and then (d) k scan;

4. To estimate total mortality rate (Z), go to (a) Assess; then to (b) Mortality Estimation; then to (c) Z from steady-state sample; then to (d) Length converted catch curve; and then to (e) Catch Curve;

5. To estimate the natural mortality rate (M), go to (a) Assess; then to (b) Mortality Estimation; then to (c) Natural Mortality; and then to (d) Pauly's M equation. Use 28^0C for temperature in tropical situations. The inverse of the natural log of natural mortality M is a provisional catch limit estimate, and is expressed as a percentage of the standing stock.

For a fishery with historical catch records proceed to yield-per-recruit analysis:

6. Calculate separately the ratio of M/k and l_c/L-infinity. The number l_c (length-at-first-capture) is the smallest size collected for that species in the ornamental trade.

7. For relative yield-per-recruit analysis, go to (a) Assess; then to (b) Beverton-Holt Y/R Analysis; then to (c) Knife-edge; and then (d) fill-in the value M/k and l_c/L-infinity.

8. Note the reference point E-10, the exploitation rate reference point.

Natural mortality (M) rates in relation to stock abundance were derived for several ornamental target fish and one invertebrate (the blue sea star) in the central Philippines using growth rate (k) and L values using the FiSat software (Table 1). These natural mortality rates in relation to the population can be used as species-specific reference points. When data are lacking, the natural mortality rate of one species can be used as an estimate for other similar species from the same families and/or ecologically-similar species with inadequate size class data.

In general, the results indicate trends of relatively smaller fish species (based on $L\infty$ comparisons) having higher growth rates (k) than relatively larger ones (e.g. *Amphiprion clarkii* versus *Chaetodontoplus mesoleucus*) (Figure 2). These smaller-sized fish species also have higher natural mortality rates.

Table 1: Natural mortality rates (M), growth rates (k) for eight fish and one invertebrate.				
Species	**Group**	**k**	**L-infinity (cm)**	**M**
Premnas biaculeatus	*Fish*	1.3	17.85	2.45
Amphiprion ocellaris	*Fish*	1.6	6.83	3.67
Amphiprion clarkii	*Fish*	1.8	13.13	3.3
Dascyllus aruanus	*Fish*	1.3	6.83	3.2
Bodianus mesothorax	*Fish*	1.4	23.1	2.39
Chaetodontoplus mesoleucus	*Fish*	0.92	27.3	1.65
Cheilodipterus quinquelineatus	*Fish*	1.5	9.98	3.16
Chelmon rostratus	*Fish*	1.4	20.48	2.47
Linkia laevigata	*Invert.*	1.3	39.9	1.96

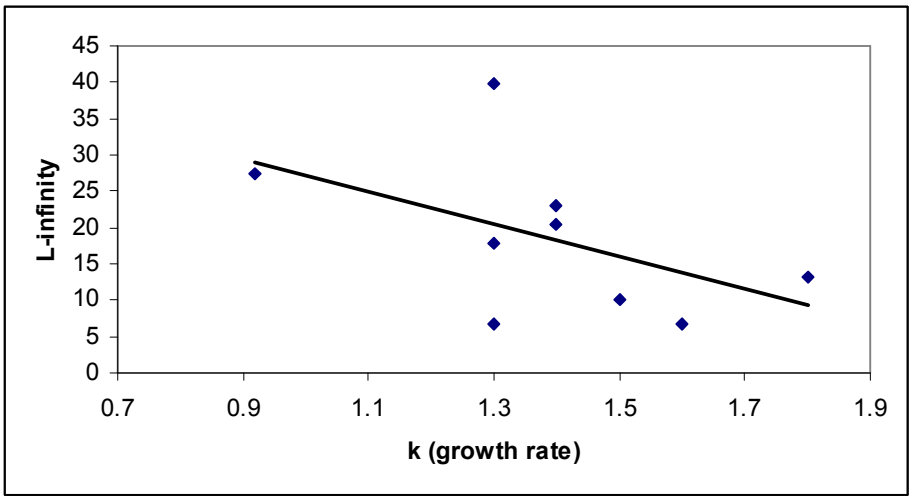

Figure 2 *Inverse relationship between growth rate (k) and L-infinity.*

The results below indicate that the total allowable catch based on natural mortality rates roughly reflect the relative abundance of these target ornamentals in coral reefs (Table 2). The results shown in Table 3 results indicate a good rule-of-thumb of collection limits. However, mortality rates may vary with specific areas so growth rates and L-infinity should still be determined whenever possible.

Table 2: Relative abundance of four fish families for four collection areas surveyed in the Philippines.

Family	Common name	% relative abundance
Pomacentridae	Damselfishes	80
Labridae	Wrasses	13
Chaetodontidae	Butterflyfishes	5
Pomacanthidae	Angelfishes	2

Table 3: Proportion of populations of ornamentals suggested as sustainable collection levels based on estimated natural mortality rates.

Species	Common Name	TAC As % of Pop.
Amphiprion clarkii	African Clownfish	25
Amphiprion frenatus	Tomato Clownfish	25
Amphiprion ocellaris	False Percula Clownfish	25
Amphiprion perideraion	Pink Skunk Clownfish	25
Balistoides viridescens	Titan Triggerfish	10
Bodianus axillaris	Axilspot Hogfish	10
Bodianus diana	Diana Hogfish	10
Bodianus mesothorax	Coral Hogfish	10
Centropyge vroliki	Halfblack Angelfish	5
Chaetodon adiergastos	Panda Butterflyfish	15
Chaetodon baronessa	Baroness Butterflyfish	15
Chaetodon bennetti	Bennett Butterflyfish	15
Chaetodon melannotus	Blackback Butterflyfish	15
Chaetodon octofasciatus	Eight Banded Butterflyfish	15
Chaetodon rafflesi	Rafflesi Butterflyfish	15
Chaetodon speculum	Ovalspot Butterflyfish	15
Chaetodon trifasciatus	Melon Butterflyfish	15
Chaetodontoplus mesoleucus	Queen Angelfish	5
Cheilio inermis	Cigar Wrasse	10
Cheilodipterus quinquelineatus	Fivelined Cardinalfish	20
Chelmon rostratus	Chelmon Butterflyfish	10
Coris gaimard	Red Wrasse	10
Dascyllus aruanus	Three Damselfish	20
Dascyllus reticulatus	Reticulated Damselfish	20
Dascyllus trimaculatus	Domino Damselfish	20
Gomphosus varius	Green/Brown Bird Wrasse	10
Halichoeres chloropterus	Green Wrasse	10
Halichoeres hortulanus	Marble Wrasse	10
Hemigymnus melapterus	Black Eye Thicklip	10
Heniochus acuminatus	Black & White Heniochus	10
Heniochus chrysostomus	Brown Heniochus	10
Heniochus varius	Fake Heniochus	10
Pomacanthus sextriatus	Sexbarred Angelfish	5

Pygoplites diacanthus	Regal Angelfish	5
Thalassoma lunare	Moon Wrasse	10
Zanclus cornotus	Moorish Idol	10
Zebrasoma veliferum	Sailfin Tang	10

The following tables show the results for natural mortality estimation and the relative-yield-per-recruit analyses for several ornamental target fish species in Batasan Island and nearby reefs, Bohol province, central Philippines:

Table 4: Population parameters, extraction rates and TACs for various ornamentals in central Philippines.

Species	k	L∞	M	E	E-10	Maximum Recorded Annual Catch	TAC
Premnas biaculeatus	1.3	17.85	2.45	0.16	0.307	5129 (in 2002)	9841
Amphiprion ocellaris	1.6	6.83	3.67	0.31	0.361	613 (in 2005)	712
Chaetodontoplus mesoleucus	0.92	27.3	1.65	0.23	0.413	560 (in 2002)	998
Chelmon rostratus	1.4	20.48	2.47	0.26	0.402	1850 (in 2004)	2846

Ideally, relative yield-per-recruit analyses are derived from numerous annual surveys. Total allowable catch is estimated from these analyses together with catch records. If annual catch records are available, the numbers corresponding roughly to the extraction rates at E-10 would be the total allowable catch (assuming linear relationships). Relative yield-per-recruit analyses assume populations at equilibrium. This is a constraint given the dearth of historical catch data in the aquarium trade. What is currently indicated as unsustainable extraction rates may be due to collection levels several years before especially in a target species that is relatively long-lived.

The exploitation rates were then compared to the maximum recorded annual catch from 2002 to 2005. The estimates of total allowable catch based on the relative yield-per-recruit analysis are shown in Table 4. The TAC was derived from proportional relationships of exploitation rate (E), maximum catch, and E-10. For example, the clownfish *Premnas biaculeatus* TAC was estimated in relation to E-10 (the sustainable exploitation rate) and to the proportion of E to maximum recorded catch.

TAC for the clownfish *P. aculeatus*:

$$TAC = (5129 * 0.307) / 0.16$$

In this case, the TAC for *P. aculeatus* was calculated as 9841.

Catch-Per-Unit Effort (CPUE) Data .....

chapter 3

Ornamental fishing is a highly targeted activity. Each week, fish buyers will send a list of their fish orders to the fishermen. This will be a subset of a long list of available target species. Fishermen only catch what is ordered and in specific quantities. However, some species are always high in-demand so these will be collected routinely during a typical fishing trip.

The catch-per-unit-effort (CPUE), usually expressed in number or weight of fish per unit time spent fishing per fisherman, is a useful indicator that can be used to manage a fishery. If a fishery is overfished, and the efficiency of the fishermen is constant, then over time, the CPUE would be expected to decline as it takes increasing amounts of time to catch the same number of fish. CPUE is thus a proxy estimator of species abundance. However, in cases where very low numbers of fish of a given species are ordered, the use of CPUE may be misleading due to relatively few data.

CPUE is an important monitoring tool in MAC certified collection areas due to the relative ease with which data can be collected. It is a complementary tool to compare with changes in temporal abundance as determined from MAQTRAC surveys. It is the primary tool for very cryptic species that are not recorded during MAQTRAC surveys. Under MAC certification, coordinators are required to maintain a log of the number organisms caught during a recorded period of time in a particular collection site. In practice fishermen may be reluctant to reveal exactly where they were fishing.

Assessment of the collectors' CPUE over time (over multiple reproductive periods) should provide a reasonable metric from which the status of the fishery can be gauged. Sudden or significant declines in CPUE may indicate potential overexploitation that can be assessed with additional MAQTRAC surveys. It is important to note that CPUE will vary widely between collectors, locations and perhaps seasonally. **As a practical management tool, a decline in CPUE should be used to trigger a recommendation for a proportional reduction in exploitation rates. For example, a decline of 30% in the CPUE of an ornamental target should lead to a decrease in fishing effort by 30% until CPUE can be stabilized.**

3.1 CPUE case studies (Batasan Island and nearby reefs, central Philippines)

CPUE, defined as the number of fish collected per hour by a collector, was determined for three species based on logbook data from Batasan Island, Municipality of Tubigon, Province of Bohol, Philippines for several months in 2002 and inter-annually from 2002 to 2005. The number of individual fish as recorded in the logbook was divided by three hours (the average fishing period in the village). Each collector had individual catch records so CPUE was expressed per unit fisherman. CPUE was determined for one of the most commonly caught fish, the butterflyfish *Chelmon rostratus*. This is a species that is always in high demand. The intra-annual trends in catch-per-unit effort constitute an important guideline as to whether collection can still continue in the short term. The inter-annual trends in catch-per-unit effort are important indications of total allowable catch especially for highly cryptic species like the mandarinfish *Synchiropus splendidus* and the banded shark *Chiloscyllium puntatum*. The latter is collected as juveniles and eggs.

The CPUE trends within 2002 for the chelmon butterflyfish are shown in Fig. 3. There were high levels of CPUE during May to June, September and during December in 2002. These trends may be due to increased abundance of these target ornamentals (following known recruitment periods from March to April and from August to September in the Philippines) and/or increased orders from markets in Europe and the U.S. Traditionally, trade trends indicate higher orders during winter months from these markets.

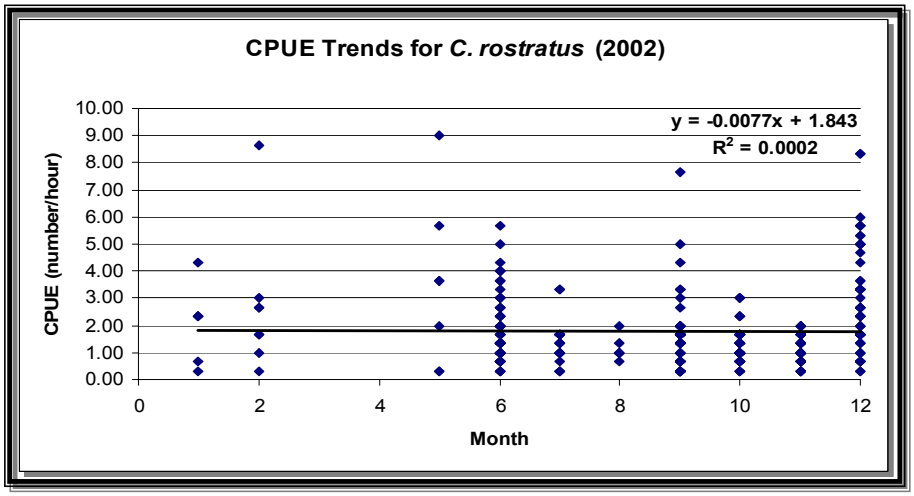

Figure 3 CPUE trends for the butterflyfish *C. rostratus* in Batasan, Bohol, Philippines

Inter-quarterly analyses of means should also be used for CPUE analysis for resource management decisions at a secondary level. The third and fourth quarter data were selected for analysis for this example because of the availability of several data points. In this analysis, the means between the two quarters actually increased so the collection continued. On the other hand, any significant decline between quarters should lead to a proportionate decrease in fishing effort (e.g. number of chelmon to be collected) for the next quarter. For instance, any significant 50% decline in the mean CPUE analysis should result to the decrease of number of chelmon butterflyfish that can be collected by 50% in the next quarter.

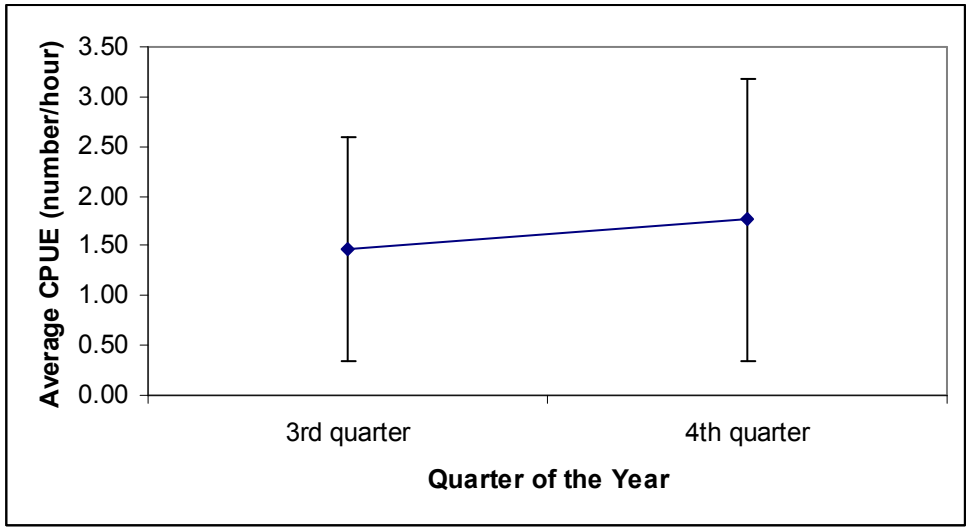

Figure 4 Inter-quarterly mean CPUE analysis for *C. rostratus* in Batasan, Bohol. The analysis did not indicate any decline so collection was allowed to continue.

CPUE as estimator of TAC for cryptic species

Inter-annual trends in catch-per-unit effort together with historical catch records can be used as rough estimates of total allowable catch for highly cryptic species. The figures below show large annual variation, but no declining trend for any species over the four-year period. Therefore, it appears that these exploitation rates are sustainable, and the mean of annual catch has been chosen as the provisional TAC. The banded shark (both juveniles and eggs) was used as an example here because sufficient data are available. However, this species should be assessed on its suitability for trade given the shark's low fecundity and inappropriate size for most aquarium keeping.

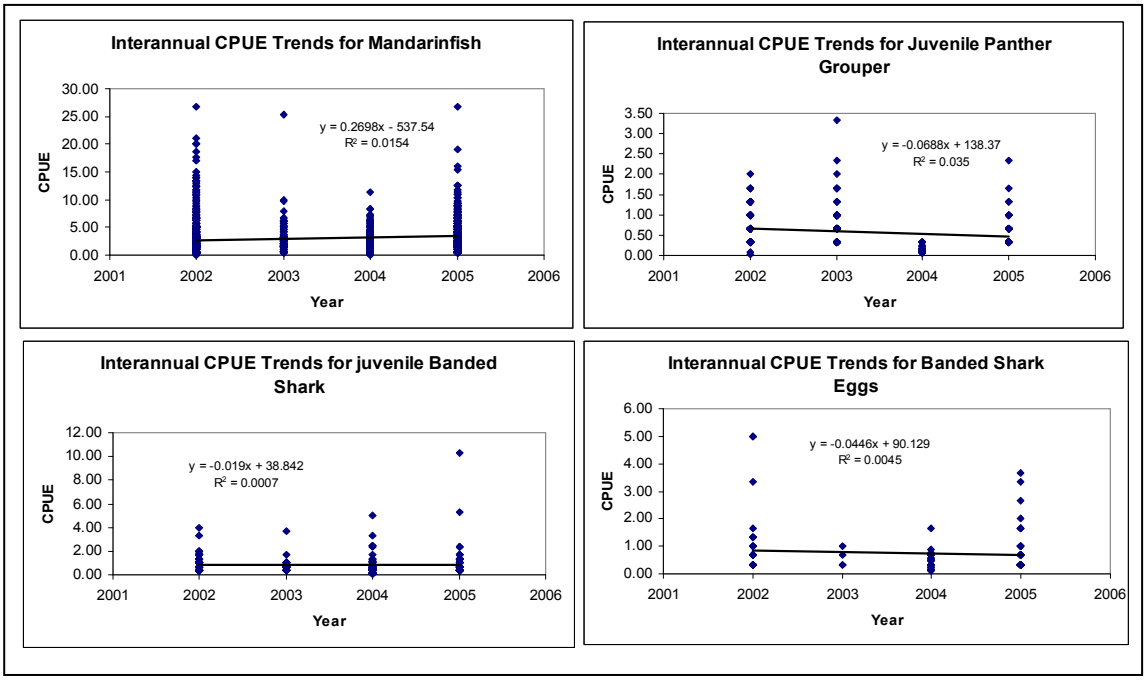

Figure 5 Inter-annual trends in catch-per-unit effort for various ornamentals in central Philippines.

Based on the above data and historical catch records, we have the following recommendations for annual TACs specifically for the reefs in Batasan island and the vicinity:

1.) For the highly cryptic mandarinfish *Synchiropus splendidus*, we recommended total annual catch to be 5000 individuals based on catch records and trends in CPUE for the Batasan reefs with an area of 24 km^2.

2.) For the juvenile banded shark *Chiloscyllium punctatum*, we recommended TAC at 350 individuals per year based on catch records and trends in CPUE. We recommended collection of eggs at 100 per year based on no significant decline during 2005. However, we have also recommended that this species be assessed regarding its suitability for collection. Banded sharks are targeted as juveniles and eggs, a practice that might lead to growth overfishing. This shark

also has low fecundity and grows to a size that cannot be easily maintained by hobbyists in home aquaria.

3.) For the panther grouper *Cromileptis altivelis*, we recommended annual collection of 300 based on intra- and inter-annual trends in catch-per-unit effort. This ornamental is targeted as a very young juvenile and adults are not commonly recorded. High collection might cause growth overfishing. The CPUE data indicated a decline in 2004 (see Figure 5). In hindsight, collection should have decreased in the early quarter of 2004 following the relatively higher mean in 2003. Fortunately, CPUE increased again in 2005.

Matrix Population Models & Coral Collection

chapter 4

Coral reefs are subject to a range of natural and man-made disturbances, from blast fishing to coral bleaching. As an added disturbance and as a fishery, coral collection should be managed in order not to aggravate the effects of these disturbances on reefs. Coral collection should not be allowed on reefs that have experienced bleaching events and/or heavily impacted by other disturbances such as storms, blast fishing and crown-of-thorns starfish infestation. Collection levels should also be set to make sure that at least the local population has the capacity for replacement and regeneration. This is important since many corals targeted by the aquarium trade are slow-growing.

Unlike other exploited stocks such as cod or salmon, few analogous fisheries models have been applied to corals as a management tool. A few of the traditional fisheries models were applied only to a limited extent to corals (e.g. mushroom corals). For example, Ross (1984) used yield-per-recruit analysis to determine the ecologically sustainable size of *Pocillopora damicornis* coral that is collected in the aquarium trade. The dearth of tools for coral fisheries is understandable because their collection does not have a long history unlike temperate fish stocks such as cod and haddock. Countries faced with developing quotas have used a variety of methods to try to derive them. In Indonesia, coral quotas are estimated mainly from trade data.

Matrix models, as a predictive tool, may be applicable to the coral ornamental trade management as a population-based framework especially in setting catch limits. Matrix models provide opportunities to project short-term and long-term changes relevant in coral populations under different mortality (with or without collection), growth and

recruitment rates and thus provide basis for estimating sustainable collection levels. These models also incorporate individual shrinkage rates in these modeled populations. This is critical since size in corals does not necessarily approximate age due to interactions (that can lead to shrinkage) with other potentially space-limited and relatively immobile organisms (e.g. Hughes 1984). Modeling the effect of collection is analogous to the studies of Done (1987, 1988) that predicted the effects of natural disturbance (e.g., *Acanthaster planci* infestation) on the populations of *Porites* spp.. Coral collection for the ornamental trade is an additional disturbance and can be factored in as increased mortality rate.

Operationally, the transition matrix defines the probability that colonies in a particular size will grow into a larger size class, remain in the same size class, die, or shrink/break into a smaller size class. The probabilities in the diagonal of the size-classified matrix are the likelihoods of individuals in a given size class to remain in the same size class; below the diagonal are probabilities of growth to larger size classes; and those above the diagonal represent shrinkage to smaller size classes. Contribution to total recruitment of reproducing size classes are indicated and included in the first row of the matrix (see Table 7). The transition matrix is multiplied by the vector that is the observed size frequency distribution in the population under study.

4.1 *Anacropora matthaii* case study in Lampung, south Sumatra (Indonesia)

The changes in the populations of *Anacropora matthaii* in Lampung, south Sumatra in Indonesia were modeled to estimate sustainable levels of collection. The data were collected during MAQTRAC surveys conducted in 2004. Lampung is an important source of corals in Indonesia for international and local trade. For the data analysis, coral colonies were grouped according to size categories used by the ornamental trade: small (5.0 cm), medium (5.1 to 15.0 cm), large (15.1 to 25.0 cm) and extra large (> 25.0 cm.).

Ideally, the transition matrix should have probabilities of shrinkage, growth, and non-growth and estimates of contribution of each colony to recruitment (sexual and asexual), all of which are empirically-derived. However, in most cases such data are lacking. For

the Lampung case study, we estimated probabilities of survivorship based on observed distribution of size classes. This assumes a steady-state condition for the population. In addition, we estimated contribution of each colony to recruitment by assuming that all corals in the smallest size class were products of the adults in the area

The following are the data used for modeling population changes for *A. matthaii*:

Table 5: Size class data of *A. matthaii* in Lampung, Indonesia.

Category	Size class	Number
SC 1	≤5 cm	121
SC 2	5.1 to 15 cm	125
SC 3	15.1 to 25 cm	4
SC 4	> 25 cm	0

The data for *Anacropora matthaii* indicated that there were 121 colonies that were 5.0 cm and smaller (SC1); 125 colonies that were between 5.0 and 15.0 cm (SC2); 4 colonies between 15.0 and 25.0 cm; and no colonies above 25.0 cm.

Assumptions:

1.) Corals of sizes 5 cm and smaller are the recruits to the population (e.g. Chiappone and Sullivan 1996, Edmunds 2000).

2.) Colonies within size classes SC2 and SC3 contribute equally to recruitment (e.g. Chiappone and Sullivan 1996, Edmunds 2000). This assumes a degree of closure in the population population in the absence of data on how much the local and external populations are contributing to recruitment. Chiappone and Sullivan (1996) showed evidence of possible self-recruitment of both brooding and broadcast spawning corals in the Florida Reef Tract.

The following is a step-by-step guideline in using matrix models for *A. matthaii* data:

1.) Calculate the contribution of mature colonies to recruitment (first row of the matrix):

a.) Transform all data to natural logarithm. Take the sum of the log-transformed data for the sexually mature size classes (SC2 and SC3). Calculate the ratio of the log-transformed abundance of size class SC1 (recruits) to this sum.

2.) Calculate survivorship rate:

a.) Derive the slope of natural log-transformed abundance data by imposing a trendline in the graph option of any spreadsheet program. This slope is the instantaneous mortality rate. The inverse of this number is the mortality rate in %. The complement of this number is the survivorship. For example, the instantaneous mortality rate was 1.7 or 6% in *A. matthaii.* The survivorship was estimated at 94%.

b.) Derive size-specific (of the target size category 5 to 15 cm to the next size class) survivorship rate separately from the slope of the log-transformed data of the size classes of interest (SC2 and SC3) as described above. The rate of survivorship from SC2 (the target coral size) to SC3 was estimated to be 68 % (comprising both natural and fishing mortality).

3.) Calculate the probability of growth to the next size class:

a.) In this case, the probability of growing from SC1 to SC2 was 100%; from SC2 to SC3 was 66% growth probability based on data from Gomez et al. 1985.).

The following table is a rough guide for growth probability values for fast and slow-growing corals:

Table 6: Recommended probabilities of growth to next size classes in scleractinian corals (based in Gomez et al. 1985).

I. Fast-growing corals (e.g. *Acropora* spp.)				
	SC1	**SC2**	**SC3**	**SC4**
SC1	***			
SC2	1	***		
SC3	***	0.66	***	
SC4	***	***	0.66	***

II. Slow-growing corals (e.g. *Goniopora* spp.)				
	SC1	**SC2**	**SC3**	**SC4**
SC1	***			
SC2	0.8	***		
SC3	***	0.3	***	
SC4	***	***	0.3	***

4.) Calculate the probability of growing and surviving to the next size class:

a.) The probability of growing to the next size class is a combination of the probability of survivorship and the growth rate of the coral species. These were estimated from steps 2 and 3. In this case, the probability of growing to the next size class was estimated at 94% from SC1 to SC2 with growth probability at 100% and survivorship at 94%; 45% from SC2 to SC3, based on 68% survivorship rate and 66% growth probability based on data from Gomez et al. 1985.).

Table 7: Derived transition matrix for the *A. matthaii* population in Lampung, Indonesia.

	SC 1	**SC 2**	**SC 3**
SC 1	0.000	0.700	0.700
SC 2	0.94	0.000	0.000
SC 3	0.000	0.45	0.000

5.) Run the transition matrix model. For *A. matthaii,* the model indicates that the collection level is not sustainable given 68% survivorship of the targeted size (SC2) to the next size class (SC3) and with growth probability at 66%.

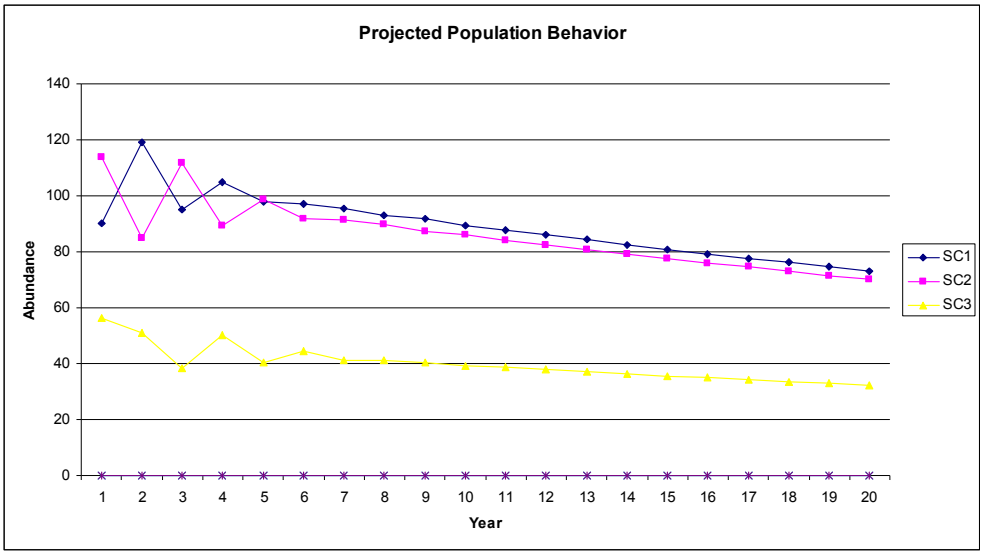

Figure 6 Population trajectory analysis for *A. matthaii* using the matrix transition model.

6.) Calculate TAC as % of the population by successively decreasing (from 100%) the probability of survivorship until the lambda, λ, (the index of the ability of the population to replace itself) gets to less than 1 at 20 years period. For example, in *A. matthaii* at 85% survivorship of the target class SC2 to SC3, λ is 1. At lower survivorship, λ is below 1. Therefore, 15% of SC2 abundance is the TAC for *A. matthaii* in Lampung. This absolute number can be derived from the average density (with upper limit) and estimated coral reef area. There is a caveat to this TAC as % of the population. This assumes that what is collected as TAC already incorporates the natural mortality rate. Simply, you collect including those what were supposed to die.

Operationally, the transition matrix is multiplied to the size classes iteratively and the changes in population are predicted. The predicted changes of the *A. matthaii* population in Lampung based on the size-class data and assumptions on its vital statistics are shown below. The results indicate that harvesting 15% of the abundance of the size class SC2 of *A. matthaii* in Lampung still maintains the population's ability to

replace itself. Therefore, TAC as % of the population has to be below 15%. In this case we recommend 10%.

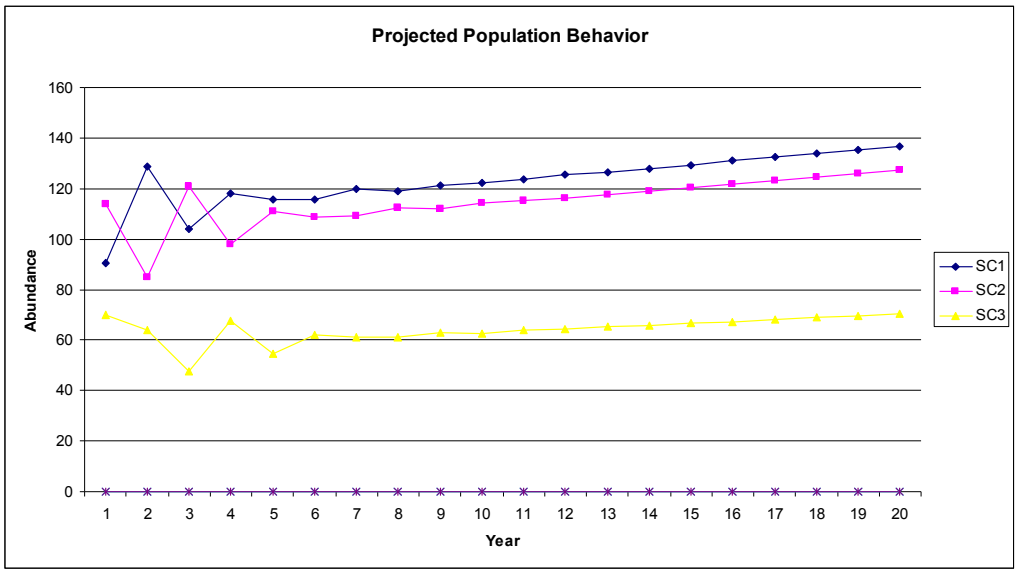

Figure 7 Predicted changes in the population of *A. matthaii* at a level to sustain stock abundance (15% total mortality in the target size).

Ideally, catch records should be available indicating what this level of collection is in terms of colonies collected annually and as a proportion of the local population. Rough estimates of this collection level can be determined by interviewing the area's local collectors and the exporters in the capital.

With resurveys, more data on the vital statistics of coral population being exploited should become available. Growth (including shrinkage and non-growth) mortality and recruitment rates will be more refined. The predicted changes in the population can also be verified during these resurveys.

Similar to the situation in the fish surveys, size class data and therefore matrix and transition models can only be generated from several species of corals out of a long list. We recommend using matrix models for species with good data (range of size class from recruits to adults and ideally at least 100 data recorded). Ideally, matrix models

should be done at the minimum for slow and fast-growing species and these numbers applied to other species with similar ecologies and growth rates.

Fisheries-dependent monitoring of species-level catch statistics

As noted, CPUE is an additional tool that can be used to help manage coral collection. This is more critical for coral species or species groups that are not recorded during the fisheries-independent surveys. Fisheries-dependent data include catch statistics recorded by coordinators, on the total number of corals collected, the site of collection, the period of collection (e.g. number of hours) and the rates of wastage. Rates of wastage should also be tracked ideally up to the importer level. The latter information is critical in tracking which corals have low survivorship during transport and therefore should be considered to the list of unsuitable for collection.

Other Relevant Research Issues

For long-term management strategies, the collection of key ecological data that are species-specific is important. For corals, there is a need to collect area-specific data on growth rates and mortality rates through tagging of targeted ornamental species. For fish, there is a need to collect growth rates using age-based techniques. Since fish age-based fisheries assessment techniques are relatively expensive, such studies should prioritize highly collected species (e.g. the butterflyfish *C. rostratus*, the clownfishes *P. biaculeatus* and *A. ocellaris*, and the mandarinfish *S. splendidus*). For both fish and corals, there is also a need to collect information on size-at-first reproduction to help develop size limits to prevent growth overfishing.

Conclusion .....

chapter 5

Most countries with a marine ornamental industry do not have a national plan or framework for its management. The certification program under the Marine Aquarium Council facilitates the local management of ornamental fisheries. A critical aspect of the certification program is the formulation of the Collection Area Management Plan. This management plan requires the establishment of no-take marine protected areas and the setting-up of total allowable catch for currently collected species and those that have potential for the trade. Setting reference points such as collection limits is just one of the management strategies being developed by Reef Check for the certification program under the Marine Aquarium Council. Other activities include the establishment of no-take marine protected areas.

Determining reference points entails the use of traditional fisheries models that have been originally developed for slow-growing temperate species. Most of these models are data intensive and have been facilitated through long-term data collection in the fisheries of developed countries. Most developing countries don't have the means for such expensive research programs. Fisheries in the latter countries are also multispecies in nature and landings are typically diffuse and difficult to track. Therefore, these models have limited applications to the fisheries situations in developing countries. There is a general consensus that under these data-less fisheries, ecosystem management approach such as the establishment of no-take zones, seasonal fishing and size limits may be more appropriate. However, application of seasonal and size limits requires a high degree of government involvement that is impractical in developing countries.

The establishment of total no-take zones has particularly become popular and important since they also preserve the habitats and the multispecies ecological relationships in a collection area. There are indications that total no-take zones can accomplish what they were established to do. However, the establishment of no-take zones usually takes several years given the need to consult various stakeholders and ensure meaningful buy-in for their long-term sustainability. Therefore, using output controls such as total allowable catch is also deemed an important management tool.

Under the MAC program, output controls may be easier to enforce because demand can be regulated through the order system. The input control is probably more challenging because of internal (by non-MAC certified local collectors) and external poaching. In addition, the phenomenon of roving collection seems to be prevalent wherein fishermen collect outside their municipal waters. In most areas, collection sites are often remote so poaching cannot be monitored. This also makes the rotation of collection sites inapplicable as a management strategy due to their remoteness from monitoring.

Output control means determining reference points usually derived from traditional fisheries models. Obviously, these models have to be modified, verified and their results reset in an adaptive approach to management. Based on the review of fisheries models, the yield-per-recruit analysis and recent catch records have some application in the ornamental trade. The use of natural mortality rates as F_{MSY} can be a verification tool to this approach or as a separate tool when catch records are not available. Some rough generalizations can be made about the relationship of M and F_{MSY} and it is important that these be verified in the aquarium trade situation. Furthermore, size limits should be set because they have biological and trade bases for non-collection and avoiding wastage. Another output control is the development of a species list that prevents unnecessary collection of organisms from coral reefs that will certainly die in captivity due to some specific ecological requirements.

Equally challenging is the determination of the total allowable catch for corals. For some countries such as Indonesia, there is active collection and international export of corals. There are catch limits but these approaches have not taken into account specific collection area size-class distribution and growth and mortality parameters. We have put forward a general model and theoretical approach in setting total allowable catch for

corals. Obviously, this model will be more refined especially with more empirical and species-specific data available for some parameters.

Summary

The aquarium trade is a rapidly expanding industry and there is a threat of overcollecting target species especially since most of these organisms come from the wild. Many of the target organisms are also particularly vulnerable to overharvesting since they possess complex life history characteristics, limited and highly specific habitat requirements and high economic value when traded live. The establishment of marine protected areas, preferably as total no-take zones, is an important strategy in the management of the aquarium trade. It is also important to set sustainable collection limits. Traditionally, total allowable catch (TACs) limits have been based on fisheries models. However, these traditional fisheries models are highly data intensive. Therefore, traditional fisheries models have to be modified in these situations by adding general rules-of-thumb and empirical approach. We have put forward methods for managing the aquarium trade and we envision more refinements as more empirically-derived data become available.

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Appendices .....

Appendix 1. Fisheries Models and their Applicability to the Ornamental Trade

There is a significant literature in fisheries management and the models developed to derive reference points (e.g. Hilborn and Walters 1992). One of the earliest models is the concept of sustainable catch as 50% of virgin stock populations. However, there are few unexploited coral reefs to derive such reference points.

Surplus production models are used to determine what fishing pressure is offset by population growth. This is the maximum sustainable yield (MSY) and used to be the 'holy grail' in fisheries science. Operationally, this involves long-term time-series data on catch and effort. The assumptions of these models include logistic population growth. The maximum biomass of the population is the carrying capacity of the environment. Populations in the wild, however, fluctuate wildly so this is easier to assume in theory than in practice. These models also assume density-dependent processes whereas population fluctuations may be driven by changing levels of recruitment (reviewed in Doherty 2002). The other disadvantage of surplus production models is that they ignore age structure and other demographic parameters.

Catch data are critical in determining surplus production. In reality, catch rates change as the fisheries mature due to increasing efficiency. Sadovy and Vincent (2002) also argued that surplus production models are inapplicable for the aquarium trade because of low opportunity and investments costs and the inherent characteristic of the trade that puts high premium (and price) on rare species. The latter argument implies that decline in abundance will still be profitable due to increasing price with rarity and low operation costs.

Like the derivation of MSY, the latest fisheries models require a level of data that is not usually available in the aquarium fishery. With good data on the present and past status of the targeted stocks, Virtual Population Analysis (VPA) can project what is the population's sustainable catch limits. VPA uses the current cohort size and works

backwards. However, the analysis requires data on population sizes, and annual natural and fishing mortality rates.

The analysis of the spawning stock biomass per recruit (SPR) ratios is an important tool to determine recruitment overfishing. Basically, the analysis can infer how much spawning biomass is needed for populations to persist. However, the analysis requires data on fecundity, stock-recruitment relationships, age-at-first maturity, and mortality rates. In addition, this model has been postulated to be inapplicable especially to hermaphroditic reef fishes (Cole et al. 1999).

Sustainable exploitation of fisheries needs to balance reproduction, body growth, fishing mortality and natural mortality. Yield-per-recruit (YPR) models, in a way, are superior to surplus production models because they separate these components in stock assessment analyses. Yield-per-recruit models approximate what fishing mortality is sustainable given population growth parameters and mortality rates that are inferred from age structure data and length-at-first capture data.

The fundamental yield-per-recruit model assumes a steady state, i.e. that recruitment is constant, and hence the age structure of the population is the same if we followed a single cohort through time. Hence, yield is measured 'per recruit' (Beverton and Holt 1957). There is evidence that age structure is far from constant in reef fish populations (reviewed in Doherty 2002).

Because of equilibrium assumptions, yield-per-recruit analyses only predict long-term effects. For example, a decrease in fishing effort as shown to be optimal in this analysis does not immediately translate to increased catch. The duration of the predictions also depend upon the longevity of the fish species and length of its exploitation. The duration of the transition period can be several years for fish of high longevity and shorter for short-lived fish. For very short-lived fish, the distinction between short- and long-term effects does not even apply because the stock is never at equilibrium (Froese and Pauly 2000). The distinction between short-lived and long-lived species has not been clearly defined.

Estimates of natural mortality rates are necessary in yield-per-recruit analyses. Pauly's empirical equation is commonly used in estimating natural mortality rates. Estimates

using this approach, however, do not have confidence intervals making yield-per-recruit estimates less reliable. The potential effect of fishing mortality on the spawners and on future recruitment is also ignored in yield-per-recruit analyses. This is critical since there is evidence of population self-recruitment in reef fish populations (Swearer et al. 1999 Jones et al. 1999). Overfishing of spawning adults may mean lower recruitment in the future.

The relationship between Natural Mortality (M) and F_{MSY}

Caddy and Csirke (1983) presented data on the relationships between M and F_{MSY}. Their data indicated that F_{MSY} ranges from a third to five times the value of M and they suggest that M = F_{MSY} is not a common situation. These wide-ranging estimates also suggest that there is a need to accumulate empirical information on the relationship between reference points such as F_{MSY} and biological criteria such as M. However, Patterson (1992) has showed some useful generalizations that are relevant to high mortality tropical species. He examined a large number of stocks of small pelagic fish with high natural mortality rates. He showed that mean exploitation rates over 0.4 (F = 2/3 M) consistently caused stocks to decline, while exploitation ratios below 0.33 (F = ½ M) have generally allowed stocks to increase in size. (This is another reference point for the yield-per-recruit analyses.) Several researchers have also agreed that F_{MSY} is larger than M (Francis 1974, Deriso 1982 and Beddington and Cooke 1983). This is certainly the case for those fisheries where recruitment is largely independent of stock size (e.g. coral reef fishes) and where most of the landings are from the previous year's recruits.

Determining Catch Limits for Ornamental Corals

The international trade in corals is regulated under the Convention on the International Trade in Endangered Species of Wild Flora and Fauna (CITES) agreement. The requirements under the CITES agreement include the provision that the exports are identified to the species level but this is impractical due to the recognized complexities of coral identification. The provision also includes that collection will not be detrimental to the species. One approach to meeting the "no-detriment" requirement of CITES is to set export quotas for a trade country. This has presented complications for Indonesia, where quotas are largely based on existing practices without adequate scientific

evidence for ecological sustainability. The major coral taxa collected in the ornamental trade are the colorful, large-polyped species such as *Euphyllia* spp., *Goniopora* spp., *Catalaphyllia jardinei,* and *Trachyphyllia geoffroyi*. There is also little ecological information available on many of these species to provide a basis for sustainable collection limits.

The use of models that predict population changes is an attractive tool for coral 'fisheries' management. For instance, matrix models have been used in understanding the dynamics of biological systems (Caswell 1990). Transition matrices have been used to predict changes in the population dynamics of invertebrates and vertebrates. These matrix models variously use age-, size- and stage-classified data and transition matrices to predict long-term population changes. The projected population changes using these models have been corroborated in the observations of organisms such as the corals *Agaricia agaricites* (Hughes 1984), and *Porites* spp. (Done 1987, 1988), the bryozoan *Cellepora pumicosa* (Hughes 1990) and a brown alga (Ang and De Wreede 1990). Hughes (1984) showed that a size-classified matrix model from field data and a transition matrix that incorporates vital processes such as mortality, growth and recruitment could be functional tools in measuring and predicting coral population density under non-perturbed or perturbed (e.g. severe storm) conditions at time scales that are otherwise impossible to measure at the time of study. Done (1987, 1988) also used a similar population model to evaluate the damage of the crown-of-thorn starfish *Acanthaster planci* outbreaks on *Porites* populations.

There is little available empirical information on population vital statistics of corals and especially those species under ornamental exploitation (Harriott 2003). Nievales (1993), in an unpublished thesis, empirically determined growth, reproduction, recruitment and mortality rates of *Pocillopora damicornis*. She used these vital statistics to construct a size-classified transition matrix in predicting the population size and structure of *P. damicornis* for the next twenty-five years under different scenarios. This coral species is collected for the ornamental trade and its vital statistics can be used as a starting point in modeling the effects of collection on other species until information are available for these corals.

The monitoring sub-group in the "Proceedings of the International Workshop on the Trade in Stony Corals: Development of Sustainable Management Guidelines (April 9 to 12, 2001 in Jakarta, Indonesia)" (Bruckner 2002) formulated the following guidelines concerning quotas:

1.) Quotas are meant to be conservative;
2.) Quotas are ideally set for particular species;
3.) Any type of disturbance (e.g. bleaching) should trigger a new stock assessment that will modify quotas if appropriate;
4.) Quotas are set for whole colony collection not just the removal of fragments; and
5.) There is a need to track wastage and rejections as well since these affect estimates of current collection levels.

Setting 'sustainable' collection limits should be only a part of suite of management strategies for coral collection. Sustainable collection also implies protecting sites from the trade through the establishment of no-take zones. This maintains a source of adult corals that can provide larvae for replenishing the area's collection sites. Coral harvesting should also be sited away from recreational areas such as dive sites where a greater economic and social value can be gained through maintaining the quality of the resource.

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The future for Hawai'i's marine aquarium fishery: A cost benefit analysis compared to an environmental impact assessment

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ABSTRACT

Conflict has surrounded Hawai'i's commercial marine aquarium fishery since its inception in the late 1940s. In 2019, the Hawai'i Supreme Court requested that an environmental impact statement (EIS) analysing the ecological and cultural impacts of Hawai'i's marine aquarium fishery be completed for Hawai'i Island (Big Island) and O'ahu. The costs and benefits associated with the fishery and their distribution across stakeholder groups was however not addressed in the EIS. This paper presents a cost-benefit based analysis of four policy scenarios using existing secondary data for Hawai'i's marine aquarium fishery. From the analysis, a state-wide collection ban was the option that yielded positive annual net benefits and negatively impacted the fewest stakeholders. In contrast, the EIS recommends ten permits for fishing off the coast of Big Island be issued.

1. Introduction

Some view the marine aquarium fish trade as a path to expanding the conservation of reef environments based on the assumption that owning aquarium fishes cultivates awareness and interest in the conservation of their source habitats [46,6,31,47]. While conservation groups have promoted the aquarium trade as a means of enhancing livelihoods in developing countries, others are concerned that the profit motive of commercial fishers serves as an incentive to overharvest species commonly found in marine aquariums [37,39,59]. If marine aquarium fisheries are not properly regulated and the regulations are not promulgated, a common-pool resource dilemma will result in economic profitability prevailing over long-term sustainability – a tragedy of the commons scenario [43].

Hawai'i's commercial marine aquarium fishery has been a source of debate among various stakeholder groups including aquarium fishers and hobbyists, marine scientists, Native Hawaiians (Kānaka Maoli), resource managers, policy makers and community members [2,36,46]. The fishery's costs and benefits are distributed differently among these stakeholders, resulting in years of conflict. As has been observed in many fisheries around the world, fishers in Hawai'i under report their catches and mortality rates [23,48,52,56], which further exacerbates conflicts. The fishery is comprised of two geographically distinct zones. The first is the West Hawai'i Regional Fishery Management Area (WHRFMA) that extends the length of the west coast of Hawai'i Island (Big Island) from Ka Lae, Ka'u¯ (South Point) to 'Upolu Point. The second encompasses North Kohala, and the main Hawaiian Islands excluding all zones that are designated as Marine Protected Areas (MPAs) [57].

Residents and Native Hawaiian cultural practitioners have pushed to ban aquarium fishing in Hawai'i citing the lack of sustainable and humane harvesting methods, inadequate enforcement, inaccurate catch reporting and poor alignment with Kānaka Maoli ideals of resource management [23]. In 2017, the Hawai'i Supreme Court placed a moratorium on aquarium fishery permits, citing a need for a Hawai'i Environmental Policy Act (HEPA) review [15–17]. The court concluded that the permitted use of fine mesh nets involves the public's use of state land and therefore requires discretionary approval from the state [15–17]. The court's request in 2019 for an environmental impact statement (EIS) analysing the ecological and cultural impacts of the marine aquarium fishery came after Environmental Assessments (EA) for Big Island and O'ahu were submitted by the Pet Industry Joint Advisory Council (PIJAC) and deemed insufficient by the State's Department of Land and Natural Resources (DLNR) Chair Suzanne D. Case [15–17]. The final environmental impact statement (EIS) funded by PIJAC and conducted by a consulting firm, which concluded that DLNR should issue permits to ten commercial aquarium fishers in the WHRFMA, was unanimously rejected by the Board of Land and Natural Resources (BLNR) after concluding that the EIS did not adequately disclose the potential environmental impacts of the proposed action [14]. PIJAC appealed BLNR's decision to the Environmental Council who affirmed BLNR's rejection of

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Table 1
Description of policy scenarios analysed in CBA.

Scenario	Characteristics
A. Status quo (2019)	AQ Permits void and fishery continues without use of fine mesh nets on O'ahu, Big Island and no collecting in WHRFMA Voluntary catch report data Majority of catch is exported Unknown impacts to other fisheries, the environment, cultural resources and on-reef tourism State funds monitoring and management of fishery Potential for non-compliance Provides industry income Provides tax and fee revenue to state
B. Permitting system (2016)	Administrative rules and bag limits apply across the State Voluntary catch report data Majority of catch is exported Unknown impacts to other fisheries, the environment, cultural resources and on-reef tourism State funds monitoring and management of fishery Potential for non-compliance Provides industry income Provides tax and fee revenue to state
C. State-wide collecting ban	No aquarium species from Hawai'i state waters can be collected Collection exemptions possible for research, educational institutions and managers Wild-captured aquarium exports banned No impacts on other fisheries, the environment, cultural resources or on-reef tourism State avoids costs associated with managing the fishery Potential for non-compliance Loss of industry income Loss of tax and fees revenues to state
D. Captive breeding collection	Permits issued to fishers with facilities for captive breeding Opportunity to export from Hawai'i Unknown impacts on other fisheries, cultural resources, the environment and on-reef tourism State funds monitoring and management of fishery Potential for non-compliance Provides income opportunity for industry Provides tax and fee revenue to state

the EIS [27].

The 2019 state-wide moratorium allows commercial aquarium fishing to continue without commercial aquarium permits, as long as fine-mesh net equipment is not used and fishers possess a commercial marine license (CML), whereas, all collection has been outlawed regardless of gear-type for the WHRFMA [20]. A November 2020 order from Hawai'i's First Circuit Court requires environmental review for issuance of new or renewed annual CMLs to be used for aquarium fishing purposes, allowing aquarium collecting by CML holders to continue until their CML expire one year after issuance [18,21]. A January 2021 order from the same court further strengthened the November 2020 order by issuing an injunction to halt aquarium collection under existing CMLs, completely banning commercial aquarium fishing in the State of Hawai'i pending environmental review by the industry [13].

Many U. S. government agencies use cost benefit analysis (CBA) in addition to or in place of environmental impact assessment to assist in management decision-making. The U.S. Environmental Protection Agency [54] concluded that cost benefit analyses used to determine environmental regulations increased net benefits to society and "provide the balance required in complex regulatory decisions." International non-profit organizations also rely on CBAs in managing natural resources. Verdone [55] used CBA to analyse landscape forest restoration in Rwanda for the International Union for Conservation of Nature and Natural Resources.

This paper presents a cost benefit (CBA) based analysis using published information and existing data to provide evidence to assist decision makers considering the future of this fishery. Four policy scenarios were developed, the relevant costs and benefits for each scenario are described and/or estimated and their distribution across stakeholder groups are assessed. The CBA results are compared to the EIS recommendations and conclusions in order to determine how the two differ and which one provides a more accurate appraisal of maintaining the aquarium fishery.

2. Methods

Four past, current or proposed scenarios for managing this fishery are described (Table 1) in order to identify the associated costs and benefits, along with stakeholders impacted. Scenarios A and B assume that the aquarium fishery continues, though the number of fishers in the industry is not mandated in either one. Scenario A involves maintaining the 2019 status quo that restricts the use of fine mesh nets and no collecting in the WHRFMA. Scenario B assumes that the 2016 bag limits would be applied across the State. These were considered here because they both attempt to limit the catch. Scenario C involves a state-wide ban, which has been suggested by many stakeholders who do not benefit from the fishery. Scenario D allows the fishery to continue only to facilitate the establishment of captive breeding operations. This option is considered as one that protects wild fish in the long run, while also encouraging an industry that cultivates awareness and interest in the conservation of their source habitats by producing aquarium fish. The environmental impact statement (EIS) funded by PIJAC recommends limiting the number of permits, rather than limiting the catch.

The stakeholder groups who were identified in each scenario are described (Table 2) and the acronym used for the group throughout the

Table 2
Codes and descriptions for stakeholder groups.

Code	Stakeholder Group Description
S1	Native Hawaiians
S2	Residents of Hawai'i
S3	Tourists
S4	Collectors and wholesalers from O'ahu
S5	Collectors and wholesalers from Hawai'i Island excluding the WHRFMA
S6	Collectors and wholesalers from the WHRFMA
S7	All collectors and wholesaler in the State
S8	State government agencies

paper is identified. Previous research [2,23,36,46], various media reports, hearings and litigation surrounding the ongoing conflict in this fishery provided details about the stakeholder groups. A description of the methods used to estimate or describe each cost/benefit and their expected sign follow. While CBA normally involves discounting to ensure that net present value of costs and benefits are calculated, annual point estimates are used in this CBA. Since the estimates do not vary over time, discounting adds nothing to the analysis.

2.1. Cost and benefit estimates and descriptions

2.1.1. State management costs

Since both Scenarios A and B involve limiting the industry's catch and require voluntary reporting, the State will have to enforce these regulations. Therefore, to estimate this cost, DAR personnel in DLNR were contacted and asked to estimate DAR's 2019 management cost for Hawai'i's marine aquarium fishery including salaries of employees who work directly with the fishery, aquarium fish surveys and any other costs associated with the fishery that DAR funds. DAR officials provided a low estimate of USD 300,000 annually covering the time spent by 20 or more individuals in the aquarium fishery along with their supplies and equipment. Their high estimate of USD 500,000 annually includes costs, such as fringe benefits that are not included DAR's annual 2019 budget, but are found in DLNR's overall budget. For Scenario C, these management costs should be eliminated overtime. Scenario D would likely involve management costs, which could be reduced as the policies and regulations that support this scenario are refined.

2.1.2. Tourism value

According to the Hawai'i Tourism Authority [29], the State's economy relied on tourism for its largest source of private capital. Spalding et al. [50], estimated the "on-reef" tourism value for the entire state of Hawai'i at USD 550.8 million per year. Spalding was contacted and estimated, using the existing data base the annual "on-reef" values for O'ahu and Hawai'i Island to be approximately USD 442,496,000 and USD 16,921,000 respectively, for an annual upper bound of USD 459,417,000. This was inflated to 2019 USD for a total annual value of USD 478,891,356.77. Cesar and Beukering [7] estimated the value of tourism to be USD 304 million and inflating this value to 2019 USD yields a low estimate of approximately USD 442.1 million.

This estimated tourism value between USD 478,891,356.77 and 442,100,000 USD represents the direct and indirect market value of on-reef tourism to the State in 2019. Maintaining this value over time is partially contingent on maintaining the health and beauty of Hawai'i's reefs. The aquarium fishery may reduce this over time as fish are removed from the reefs in Scenarios A and B because the limits are not calculated based on the productivity of the fishery and are difficult to enforce. Evidence also suggests that catches are underreported. Therefore, if the fishery continues, overharvesting of this public resource will likely occur and as a result, the value of tourism will decrease. Uncertainty exists as to how quickly this decline will occur. Researchers predict that unmitigated bleaching events could lead to the loss of shallow coral cover in Hawai'i by the year 2050 [35], which indicates that a 30 year time frame could be considered in making marine resource management decisions and would result in an extremely large total cost of continuing this aquarium fishery by 2050.

2.1.3. Industry income

In order to determine the market value of the aquarium fishery in Hawai'i, the methods used by Dierking [22] were updated with recent data to conservatively estimate 2019 gross revenue for the industry. Unpublished 2019 catch report summary information, unpublished 2019 dealer purchase information, unpublished 2019 individual catch reports, and unpublished permit lists from 2015 to 2018 were obtained from DAR. The 2019 price and cost information from dealer websites, retail price lists on websites, and industry structure information provided the data used for the estimation. The lower bound for total revenue accruing to fishers was calculated by multiplying the "diver price" for each species by the number sold to estimate annual revenue of USD 1,676,982 in 2019.

Wholesale revenue could not be estimated due to the lack of price information among local fishers who are also wholesalers. In order to estimate the upper bounds, the 2016 catch report data for "number sold" was used with retail prices on the website of a Hawai'i based fisher retailing fish. The "number sold" on the 2016 catch report for each of 12 species was multiplied by the 2019 retail price listed by the primary collector/retailer. The total revenue across all the species represents the upper bounds of USD 8,343,896, which includes the value of the fish after they were exported.

2.1.4. License fees

The State does collect license fees for the aquarium fishery. Commercial aquarium permits are USD 50 and recreational aquarium permits have no cost [20]. Commercial aquarium collectors must also purchase USD 100 commercial marine fishing licenses annually from DAR. Scenario A, which represents the status quo in 2019 only accounts for the cost of the commercial marine fishing license since all commercial aquarium permits are void. Scenario D assumes that a permit is required to collect for captive breeding. This scenario explores an option that would raise the permit cost to USD 500 and cap the number of permits issued at 100 state-wide.

2.1.5. Export values

The industry values also include the value of fish exported, which were investigated to determine how much of this value accrues to the State. Catch reports for 2016 are the most recent, complete annual data set and thus are used to estimate exports. Twelve species commonly targeted in Hawai'i's marine aquarium fishery (*Table a1*, appendix) were included. The data for six out of the twelve species discussed in this study (*Naso lituratus*, *Forcipiger flavissimus, Chaetodon multicinctus, Zanclus cornutus, Centropyge potteri, Coris gaimard)* indicated that the fish sales on initial catch reports by licensed fishers was lower than numbers of fish reportedly purchased by licensed dealers from licensed fishers on dealer sales and export reports. This suggests that a percentage of the catch was not reported on catch reports or was sold to dealers by fishers who do not report their catch to the state.

Dierking [22], reported that roughly 95% of the aquarium fish caught from the West Hawai'i fishery were exported. Two criteria were used to identify retailers from which price information was obtained. The first criteria requires that the species' primary and sole collection origin had to be Hawai'i, and the second requires the species be one of the 12 species described in this study, not including captive bred fish. Retail prices for 2019 were collected from 11 online aquaria retailers with 10 on mainland U.S.A. and one from Hawai'i. Species name, price, retailer name, city of operation and website information were used to generate an average out-of-state retail price for each of the 12 species and were compared to online retail prices offered by the local aquarium fishers/retailer. Retail price differences were 1.5–5.1 times higher in mainland markets compared to the local market.

The profits made on the mainland and the taxes on the value added accrues to the area in which the fish is retailed. Since these profits and taxes occur from the sale of a Hawai'i public resource, a negative impact occurs in comparison to keeping the fish in the reef to ensure that the State's tourism sector and/or residents continue to benefit from these fish. This is consistent with a 2019 decision by the Hawai'i Supreme Court that "all public natural resources are held in trust by the State for the common benefit of Hawai'i's people and the generations to come" ([8], p. 1150).

2.1.6. Environmental costs

Hawai'i's marine aquarium fishery almost exclusively targets herbivores and corallivores. The development of a State Coral Bleaching

Table 3
Cost and benefits associated with each scenario.

Scenario	Impacted Stakeholder Groups	Annual Estimates (USD)	
		Low	High
A. Status Quo (2019)			
- State management costs	S8	-300,000.00	-500,000.00
- Tourism value	S2, S3, S8	-442,105,806.46	-478,891,356.77
+ Industry income	S4, S5	1,784,936.43	8,343,896.00
+ License fees	S8	17,400.00	17,400.00
Total valued net benefit		-440,603,470.03	-471,030,060.77
Costs/benefits not valued			
- Losses from exports	S2, S8		
- Environmental costs	S1, S2, S3, S7, S8		
- Social costs	S1, S2, S8		
- Other fisheries' indirect costs	S1, S2, S7, S8		
- Captive breeding costs	S4, S5		
B. Permitting System (2016)			
- State management costs	S8	-300,000.00	-500,000.00
- Tourism value	S2, S3, S8	-442,105,806.46	-478,891,356.77
+ Industry income	S7	1,784,936.43	8,343,896.00
+ License fees	S8	26,100.00	26,100.00
Total valued net benefit		-440,594,770.03	-471,021,360.77
Costs/benefits not valued			
- Losses from exports	S2, S8		
- Environmental costs	S1, S2, S3, S7, S8		
- Social costs	S1, S2, S8		
- Other fisheries' indirect costs	S1, S2, S7, S8		
- Captive breeding costs	S7		
C. Statewide AQ Collection Ban			
+ Tourism value	S2, S3, S8	442,105,806.46	478,891,356.77
- Industry income	S7	-1,784,936.43	-8,343,896.00
- License fees	S8	-26,100.00	-26,100.00
Total valued net benefit		440,294,770.03	470,521,360.77
Costs/benefits not valued			
+ Environmental costs	S1, S2, S3, S7, S8		
+ Social costs	S1, S2, S7, S8		
+ Other fisheries' Indirect costs	S1, S2, S8		
D. Captive Breeding Collection			
- State management costs	S8	-300,000.00	-500,000.00
- Tourism value	S2, S3, S8	-442,105,806.45	-478,891,356.77
+ Industry income	S7	1,784,936.43	8,343,896.00
+ License fees	S8	50,000.00	50,000.00
Total valued net benefit		-440,570,870.03	-470,997,460.77
Costs/benefits not valued			
- Losses from exports	S2, S8		
- Environmental costs	S1, S2, S3, S7, S8		
- Social costs	S1, S2, S7, S8		
- Other fisheries' indirect costs	S1, S2, S8		
- Captive breeding costs	S7		

Recovery Plan, in collaboration with the National Oceanic and Atmospheric Association (NOAA), DLNR, and DAR concluded that the establishment of a combination of Marine Protected Areas (MPAs) and Herbivore Fishery Management Areas (HFMAs) across the main Hawaiian Islands ranked among the most preferred actions to address the State's coral reef recovery from climate change induced bleaching events [19]. The State's decision to employ spatial herbivore management, highlights the importance of herbivores as a critical tool for reef recovery and resiliency, thus increasing their value and importance in Hawai'i's coral reef ecosystems.

Past studies have indicated that climate change impacts coupled with local, human-induced stressors can retard coral reef resilience, resulting in regime shifts from coral to algal turf dominated systems if left unchecked [1,8,9,26,30]. Herbivores have been found to play critical roles in resisting these regime shifts [26]. While the long-term impact of the aquarium fishery on herbivore management is uncertain, the potential exists for the fishery to prevent the State from realizing its reef recovery goals.

2.1.7. Social costs

A 2017 survey of Hawai'i residents concluded that 90% of respondents support further regulation of Hawai'i's marine aquarium fishery, and that 83% of respondents support ending the trade altogether [4]. From the fishers' perspective, Stevenson et al. [51] found that 20.7% of all fishers disliked the bureaucracy and 17.2% disliked the poor reputation of the West Hawai'i aquarium fishery.

No secondary information about the overall social impacts is available. However, the Pet Industry Joint Advisory Council [44] did summarize several interviews in a Cultural Impact Statement found in Appendix A that describes the contentious nature of the fishery and its lack of alignment with Native Hawaiian values and fishing/management views/traditions [44].

While the impact of the fishery on the long-term social well-being of State's residents is uncertain, the majority appears to conclude that continuing to operate this fishery reduces their social well-being.

2.1.8. Indirect costs for other fisheries

While some studies have indicated that fish populations have increased in open areas and Fish Replenishment Areas (FRAs) where no aquarium collecting occurs, other studies have argued that many marine aquarium fish stocks in Hawai'i are still relatively data poor [41]. The Hawai'i Supreme Court has adopted a precautionary principle associated with the public trust with a ruling concluding that "where (scientific) uncertainty exists, a trustee's duty to protect the resource mitigates in favour of choosing presumptions that also protect the resource" ([32], p. 466)).

Overfishing is the primary driver of reef fish declines across the main Hawaiian Islands and the populations of food-fish species that overlap with some commonly collected aquarium species are particularly affected [24]. Specific concern regarding the sustained abundance of some commonly targeted food-fish species in the West Hawai'i aquarium fishery exists due to some species exhibiting declining populations [57]. Concern regarding the aquarium fishery's impact on the commercial and recreational nearshore reef fisheries has arisen due to overlap in target species [46,57]. This concern supports the conclusion that the aquarium fishery is likely to have negative impacts on other fisheries in the long-run.

2.1.9. Captive breeding costs

Scenario D involves allowing the aquarium fishery to continue in order to support captive breeding efforts. In order for this scenario not to have negative impacts on Hawai'i reefs, a detailed policy and supporting regulations would be required. Descriptions of the costs paid by wholesalers and collectors by Dierking [22] can be used to infer the cost categories associated with local collection and wholesale business operations. Captive breeding and husbandry would result in similar costs

Table 4
A comparison of procedures and recommendations for the CBA to those for the 2020 Hawai'i Island EIS.

Cost Benefit Analysis	Big Island 2020 EIS[a]
Explores four policy alternatives, including a ban.	Rejected considering a ban since it did not meet PIJAC's purpose. Considered three scenarios that involved no permit limits and one with a permit limit.
Provided evidence-based recommendations based on impact estimates, descriptions, and the distribution of them among stakeholder groups.	Provided a recommendation based on direct market benefits of the industry.
Recommends a statewide ban on the collection and export of marine aquaria. Suggests that captive breeding collection might hold potential if properly managed.	Recommends reducing the number of permits to ten across the State.
Completed as a student project using existing secondary data and not funded by any industry, government agency or non-profit organization.	Funded by the PIJAC.

[a] [44]

as wild collection, along with some additional costs to accommodate more technologically advanced equipment required to stimulate spawning [40,58].

Marine ornamental species can be categorized as demersal spawners or pelagic spawners. Most demersal spawners produce clutches of eggs in nests or on substrates and tend to form strong breeding pairs, often displaying parental care which makes them the preferred choice for captive breeding aquarists [40]. The specialized knowledge and equipment required for rearing marine aquarium fish that are pelagic spawners will make them more expensive to produce compared to wild collection [49]. This increase in costs would primarily impact those that purchase these captive bred fish. Currently, nearly all of these people live outside of the State and therefore likely have no particular interest in protecting the public resources of residents. Rhyne [49] also argues that promoting access to breeding information could result in more successful ornamental rearing and help conserve populations of wild aquarium fish.

3. Results and discussion

The results indicate that Scenario C, a state-wide ban on aquarium collecting, is the only scenario that produced positive net benefits (Table 3). Because point estimates in 2019 USD were the only quantitative data presented here, this conclusion is based on one annual estimate of costs and benefits. The stakeholder groups negatively impacted by a state-wide ban include a small group of local fishers, wholesalers, and dealers that comprise Hawai'i industry while benefits accrue to larger populations of stakeholders.

The status quo policy in Scenario A would allow collection to continue with methods other than fine-mesh nets. In the WHRFMA, where all permits are now void, poaching has been observed, resulting in vessel, aquarium gear and fish take seizures [5]. Thus, monitoring costs may increase if this scenario occurs. Scenario B, which represents what took place in 2016 does not put a cap on the issuance of permits, though it does provide for the collection of fees by the State. Overall, market benefits would still accrue only to aquarium collectors and wholesalers, though the distribution of net benefits between these industry members varies between Scenarios A and B because Scenario A excludes fishers in the WHRFMA.

Scenario D allows collection for captive breeding with a permit similar to DAR's Special Activity Permit system which allows research, education or management institutions to collect marine organisms with specific gear restriction exemptions [18,21]. However, all existing permit holders can claim to be engaged in breeding. Further research may be needed to identify potential regulatory and enforcement solutions for Scenario D. Fishers could be required to prove their capacity to captive breed species and stricter live-fish export regulations could be developed. While this would increase costs, the potential indirect and non-market benefits associated with not removing fish from the reefs in the long-run would also increase and provide the positive benefits associated with consumers having access to aquarium fish. Militz et al. [38] found that 90.5% of consumer respondents were willing to pay more for fishes that were certified as harvested in an environmentally sustainable way. This type of certification could be considered for captive bred fish to create a mechanism that convinces the customers to absorb some of the costs associated with switching to a sustainable practice [38]. In addition, captive breeding facilities could become attractions for residents and visitors. If captive breeding attractions included educational content designed to inform people about protecting fish and the surrounding reefs, the carrying capacity of Hawai'i's near shore ecosystems may increase.

A comparison of this CBA with the PIJAC funded EIS found that the procedures and overall recommendations were significantly different (Table 4). Both the CBA and the EIS relied on existing data to complete the analysis and the market benefits of the industry estimated by the CBA and the EIS are similar. The EIS did not consider a ban because it did not meet PIJAC's purpose to continue fishers' livelihoods [44]. The EIS considered three scenarios that involved unlimited permits and one that limited permits on the Big Island to ten. The costs for Native Hawaiians and other stakeholder groups of continuing to operate the fishery were considered negligible and no justification is provided as to why this decision was made [44]. No recommendations on compliance enforcement relative to the proposed bag limits or oversight to prevent poaching were included. No caveat was included that oversight and enforcement expenses might increase if permits were limited [44]. One individual who was allegedly named as one of the proposed permit holders [45] was also cited in a February 2020 poaching incident (R. Umberger, personal communication; [5]) which indicates the need for such a caveat. Overall the EIS puts forth a recommendation that supports the industry.

Because Hawai'i's Supreme Court reaffirmed that all public resource are to benefit Hawai'i's people [32] and that private or commercial use should receive a "high" level of scrutiny, the size of the stakeholder groups is also of interest. The resident population, including Native Hawaiians, was 1,415,872 in 2019 [53] and Pet Industry Joint Advisory Council [44] indicates that their preferred plan would directly benefit ten resident fishers with permits and their employees. Visitors, which numbered 10,424,995 in 2019 [28], will also likely pay a cost if marine aquarium fish are removed from the State's reefs. Tourists can also decide to travel elsewhere should the reefs become degraded, which will result in significant market costs for Hawai'i in the long-term.

4. Conclusion and recommendations

The analysis presented here determined that a state-wide ban on collection is likely to produce impacts of positive annual net benefits. The EIS funded by PIJAC recommended that collection permits be limited to ensure that the fishery remains in existence. Relying on EIS recommendations that aim to support one group of stakeholders at the expense of others to determine policy could be considered biased. CBA is used globally for evidence-based decision-making.

When considering the "sustainability" of any system, distributional and equity issues over a long-time frame must be considered [10]. The CBA presented in this paper explores these distributional issues that this fishery poses to a variety of stakeholder groups and the environment using the available evidence. While modern economic systems often

focus on gross domestic product to track economic progress and guide policy, tracking environmental and social indicators has been identified as important to ensure sustainability in certain economic sectors specific to Hawai'i [42].

Other fisheries, which pose similar environmental problems [3,11,12,25,33,34], should consider employing CBA in order to inform decision-making. Relying on an EIS funded by an industry stakeholder group is likely to produce a document aimed at justifying the position of the funder. Stakeholders that receive cultural ecosystem services from resources that are also being harvested for market benefits often include relatively large populations of disadvantaged minorities and indigenous populations. Businesses interested in protecting their market benefits likely have an advantage if an EIS is the only source of management recommendations. Sustainable management requires that the costs and benefits accruing to all stakeholder groups be investigated to ensure that policies are equitable.

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CRediT authorship contribution statement

Siena Schaar: Investigation, Formal analysis, Writing - original draft. **Linda J. Cox**: Conceptualization, Methodology, Supervision, Writing - review & editing.

Declaration of Competing Interest

none.

Data availability

The majority of data used for this research came from secondary sources. Relevant pricing data was collected from public websites and catch data was retrieved by UIPA from the Hawai'i Department of Aquatic Resources (DAR).

Appendix

See Tables A.1–A.3.

Table A.1
The 12 common marine aquarium species included in this report.

Common Name	Scientific Name	Hawaiian Name
Yellow Tang[b]	*Zebrasoma flavescens*	Lau'ipala, Lauī pala, or Lā'ī pala)
Goldring Surgeonfish[a]	*Ctenochaetus strigosus*	Kole
Achilles Tang[b]	*Acanthurus achilles*	Paku'iku'i
Orangespine Unicornfish[b]	*Naso lituratus*	Umaumalei, Kala, Ume, Mahaha, Pakala, Pakalakala or 'Ohua
Chevron Tang[b]	*Ctenochaetus hawaiiensis*	n/a
Longnose Butterflyfish, (Forcepfish)[b]	*Forcipiger flavissimus*	Lau wiliwili nukunuku 'oi'oi
Multiband (Pebbled) Butterflyfish[a]	*Chaetodon multicinctus*	Kikākapu, Kapuhili
Fourspot Butterflyfish[b]	*Chaetodon quadrimaculatus*	Lauhau
Tinker's Butterflyfish[b]	*Chaetodon tinkeri*	n/a
Moorish Idol[b]	*Zanclus cornutus*	Kihikihi
Potter's Angelfish[a]	*Centropyge potteri*	n/a
Yellowtail Coris Wrasse[b]	*Coris gaimard*	Hinalea 'akilolo

[a] Indicates endemic species
[b] Indicates native species

Table A.2
Average retail prices (U.S Mainland) compared to average retail price (local collector/seller) of 12 common aquarium species, and price difference (%).

Common Name	Scientific Name	Avg. Retail Price (U.S Mainland) n = 10	Avg. Retail Price (Local collector/ seller) n = 1	Mark-up (%)
Yellow Tang	*Zebrasoma flavescens*	$74.41	$16.00	465.1
Goldring Surgeonfish	*Ctenochaetus strigosus*	$71.88	$14.00	513.4
Achilles Tang	*Acanthurus achilles*	$392.32	$150.00	261.5
Orangespine Unicornfish	*Naso lituratus*	$152.71	$37.50	407.2
Chevron Tang	*Ctenochaetus hawaiiensis*	$233.11	$150.00	155.4
Longnose Butterflyfish	*Forcipiger flavissimus*	$46.00	$15.00	306.6
Multiband Pebbled Butterflyfish	*Chaetodon multicinctus*	$35.37	$10.00	353.7
Fourspot Butterflyfish	*Chaetodon quadrimaculatus*	$78.99	$40.00	197.5
Tinker's Butterflyfish	*Chaetodon tinkeri*	$699.99	$350.00	200.0
Moorish Idol	*Zanclus cornutus*	$49.98	$10.00	499.8
Potter's Angelfish	*Centropyge potteri*	$108.06	$30.00	360.2
Yellowtail Coris	*Coris gaimard*	n/a	$30.00	n/a

Table A.3
Comparison of specimens reported sold on licensed aquarium collectors' detailed catch reports (2016) versus specimens reported bought from licensed fishers by licensed dealers, on licensed aquarium dealers' personal sales and export reports (2016).

Common Name	Scientific Name	No. Sold (AQ detailed catch report)	No. Bought (AQ dealer pers. Sale/ export report)	% (no. bought/ no. sold)
Yellow Tang	*Zebrasoma flavescens*	322,651	284,784	88.26
Goldring Surgeonfish	*Ctenochaetus strigosus*	45,765	44,106	96.37
Achilles Tang	*Acanthurus achilles*	6787	5758	84.84
Orangespine Unicornfish[a]	*Naso lituratus*	9966	10,338	103.73
Chevron Tang	*Ctenochaetus hawaiiensis*	5126 (B.I only)	4135	80.67
Longnose Butterflyfish[a]	*Forcipiger flavissimus*	1329	1507	113.39
Multiband Pebbled Butterflyfish[a]	*Chaetodon multicinctus*	314	666	212.10
Fourspot Butterflyfish	*Chaetodon quadrimaculatus*	480	448	93.33
Tinker's Butterflyfish	*Chaetodon tinkeri*	293 (B.I only)	218	74.40
Moorish Idol[a]	*Zanclus cornutus*	805 (B.I only)	970	120.50
Potter's Angelfish[a]	*Centropyge potteri*	6708	8726	130.08
Yellowtail Coris Wrasse[a]	*Coris gaimard*	866	993	114.67

(B.I only) indicates collection and reporting on detailed catch report only from Hawai'i island
[a] Indicates sales or export reporting over 100% of what was reported on initial detailed catch report.

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SIERRA CLUB
HAWAIʻI ISLAND GROUP

April 6, 2021

TO:
Pet Industry Joint Advisory Council (PIJAC)
Via Jim Lynch 206-370-6587
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FROM:
Deborah Ward, Executive Committee Chair,
Hawaii Island Group Sierra Club
P.O. Box 1137 Hilo HI 96760

RE:
Revised DEIS WHRFMA Commercial Aquarium Permits 2021-02-23

GENERAL COMMENTS

These comments are prepared by the Conservation Committee of Sierra Club, Hawaii Island Group, on behalf of the 27,000 members and supporters of the Sierra Club that reside in the Hawaiian Islands.

Sierra Club strongly believes that the No Action Alternative regarding open-ocean aquarium collecting is the best and only acceptable alternative, and we support research to develop and sustain captive breeding for species used in the aquarium trade.

Under the No Action Alternative, the court order would remain in place, and no Aquarium Permits would be issued for the **entire** island of Hawai'i and the taking of aquarium fish or other aquatic life in the WHRFMA for commercial aquarium purposes would be prohibited. In addition, the changes to CMLs would remain in place, and CMLs could not be used to collect aquarium fish for commercial purposes in East Hawai'i. Therefore, no commercial aquarium collection would occur on the island of Hawai'i under this Alternative. The No Action Alternative meets the DLNR's objectives to ensure an applicant's actions do not lead to degradation of fish populations and the habitats in which they occur in the context of commercial aquarium collection alone.

The objective of the proposed action is for the Department of Land and Natural Resources (DLNR) to issue 7 Aquarium Permits and 7 corresponding Commercial Marine Licenses for the WHRFMA, revise the White List from 40 to 8 species, and implement individual catch quotas for the 8 species remaining on the proposed Revised White List.

HRS §343-5 Trigger: Trigger 1 (use of state lands) and Trigger 2 (use of conservation districts). Review of an Environmental Assessment (EA) prepared in 2018 determined an EIS was required based on Significance Criteria #1, #2, #3, #4, and #8. Review of a previous EIS prepared in 2020 resulted in non-acceptance by the Board of Land and Natural Resources (BLNR), and the Environmental Council concurred with decision. (Environmental Council's Amended Findings of Fact, Conclusions of Law, and Decision and Order Nunc Pro Tunc to August 13, 2020)

Regarding biological resources, this Revised DEIS focuses primarily on the effects of aquarium fishing on wild populations of White List Species, as it is at the population level that DAR measures changes in White List Species and makes management decisions.

Species of Greatest Conservation Need (SGCN) are identified in Hawai'i's State Wildlife Action Plan (SWAP) but are not threatened, endangered, or otherwise legislatively protected species. However, recognizing the need to take action to protect endemic species, the DLNR identified Hawai'i's indigenous SGCN in Exhibit 1 of Hawai'i Administrative Rules Chapter 124. The SWAP (2015) addresses these species and identifies the following actions to ensure the species conservation and sustainability:
1)Conservation Actions: The goals of conservation actions are to not only protect current populations, but to also establish further populations to reduce the risk of extinction. …
In addition to common statewide and island conservation actions, specific actions include: Restoration of habitat; and, Maintaining healthy populations with appropriate fishing regulations and education.
2) Monitoring: Continue to survey for populations and distribution in known and likely habitats.
3) Research Priorities: Improve understanding of factors affecting the species population size and distribution; and, Support aquaculture research to develop captive breeding for species used in the aquarium trade.

We concur and uphold DLNR's mission to 'Enhance, protect, conserve and manage Hawai'i's unique and limited natural, cultural, and historic resources held in public trust for current and future generations of the people of Hawai'i nei, and its visitors, in partnership with others from the public and private sectors.'

The legislature has decreed it the "policy of the State" that DNLR and other agencies must "[c]onserve natural resources . . . by preserving or augmenting natural resources, and by safeguarding the State's unique natural environmental characteristics . . . ."[1] The Agency must also "[e]ncourage management practices which conserve . . . all natural resources," and encourage all individuals "to fulfill the responsibility as trustees of the environment for the present and succeeding generations."[2] In enacting HEPA, the State legislature found "that the quality of humanity's environment is critical to humanity's well-being, [and] that humanity's

[1] Haw. Rev. Stat. § 344-3(1).
[2] Haw. Rev. Stat. § 344-4(2)(A), (10)(A).

activities have broad and profound effects upon the interrelations of all components of the environment . .

We have reviewed the revisions to the EIS prepared in 2020, however, we find that this RDEIS still fails to provide adequate baseline data from which to analyze the risks posed by cumulative factors, such as unregulated collecting, under-reporting of catch, non-reporting of dead and disposed fish, failure to monitor and take enforcement actions when violations occur, changes to habitat from natural and human perturbations historically, and the effect proposed alternative(s) would have on traditional fishing practice and diminishment of our clean and healthful environment. The RDEIS fails to offer appropriate mitigation for anticipated impacts, regulation and reporting of all collection, sales records and export data, and it fails to address the cruelty to which the collected animals are exposed.

The complier of this RDEIS failed to adequately consult with citizen groups and communities who are affected, and dismissed the significant input provided by those with whom it did consult. The RDEIS did not sufficiently address our specific issues and concerns raised in the earlier environmental assessments, nor did it appropriately disclose adverse effects to the biological and cultural resources that are part of the public trust the State of Hawaii has the responsibility to protect.

Future serious cumulative impacts to the coastal near-shore habitat due to climate change, ocean acidification, coral bleaching, run-off and pollution are largely ignored in this document, and the proposed action alternatives do not address mitigation for the anticipated loss of coastal habitat. A recent DAR announcement appealed to subsistence and recreational reef fishers to refrain from taking herbivorous fish off the reefs. This tacit recognition of the vital symbiotic service they perform in this delicate coral reef ecosystem is overdue and yet completely absent in the RDEIS. The 'preferred alternative' in the document would allow takes by unidentified permittees of many of these same important organisms. Any declines whether driven by, or contributed to, by the trade are simply not justified by the logic and necessity of sustainability.

The RDEIS preferred alternative proposes to exploit a public resource for the economic benefit of a few, (some of whom have been non-compliant with past rules and regulations), at the expense of the subsistence communities, the resident public, the visitors, and the health of the state as a whole. Absent the documentation needed for a complete and accurate analysis, we ask that at the very least, a No Action Alternative be implemented.

4.1 Socioeconomic Resources

Significance Criteria #3 - Does the take of aquarium fish conflict with the state's long-term environmental goals?

<u>Comment:</u> The current RDEIS now under consideration sets out a history of 'user conflicts' associated with this 'trade' from over half a century. To some degree it documents the evolution of commercially driven practices that are acknowledged to have become reviled in society as its

attention, ecological awareness, and concerns over diminished resources have taken on larger dimensions in the political affairs of our modern state.

Credible recent polling indicates that 84% of residents are opposed to aquarium collecting from the ocean. (Anthology Research, 2017: Hawaii Resident Study)

'Soft costs' associated with the subversion of public trust, poaching, legal and enforcement administration, are difficult to calculate and therefore scarcely reasoned with in the study. (And most if not all of the 'soft cost' factors weigh in on the negative side of the industry balance sheet.) 'Hard' socio-economic impacts are somewhat easier to derive and should be weighed in as part of this process. Not cited in the RDEIS is new research from our own University of Hawaii, in a breakthrough paper made public within the last six months titled:

Managing Near-shore Fisheries in Hawai'i: A Policy Analysis of the State's Marine Aquarium Fishery (Siena Schaar May 2020).

This study is a cost-benefit analysis of four different policies regarding collection of marine aquarium fish from the West Hawai'i Regional Fishery Management Area. The policy scenarios included the status quo, a permit system, a complete ban, and a limited permit system for stakeholders equipped with captive breeding facilities. Management costs, impacts on tourist appeal, and environmental and social costs were all included. Benefits included income to collectors and permit fees to the state. **The complete ban resulted in the greatest net benefits. Under any permitting system, the benefits flow primarily to the collectors, while costs are borne primarily by the local community and the environment.**

The author uses 'cost benefit analysis' to conclude:
"The results of this CBA indicate that the closed trade policy scenario, which was described in this report as a statewide aquarium collection ban, is the most equitable and efficient option. It also was the only option that yielded a net positive NPV, and negatively impacted the fewest overall stakeholders." The analysis further states: "Only a small number of stakeholders directly involved in the fishery, including collectors, divers, wholesalers, and dealers, receive the market benefits of this fishery while the other stakeholder groups pay the indirect and non-market costs."

The Schaar report with its implications, as direct and substantive as it is, was not included or similarly addressed in the RDEIS. Instead, a more simplified one-sided extrapolation of economic benefits, profits to the trade generally, were given, implying a net positive impact. Nothing could be farther from the truth.

<u>RDEIS</u> : The graphic representation of the various management choices offered in a table on page 167-168 of the RDEIS claims that the Preferred Alternative would remove 1.2 million fish over a five year period while under the 'NO ACTION' option, a likely benefit to recreational users would be 'greater viewing opportunities (fish and wildlife) of 32 species (removed from 'White List') for visitors and residents.'

Elsewhere in their analysis is juxtaposed the outsized dimensions of what's at stake economically speaking:

"Much of the state's economy is based on the island's coastal and marine resources. Tourism accounts for the majority of the state's economy, with a significant portion of the tourist activities associated with beaches and marine wildlife (DLNR 2015). Coastal development and land values have both increased with the growth in tourism. In 2002, the Hawaiʻi Coral Reef Initiative funded a study regarding the economic valuation of the coral reefs of Hawaiʻi, where the value of coral reefs to the Hawaiʻi economy was estimated to be about $380 million dollars per year (DLNR 2015). In 2001, Cesar et al. documented the annual recreational value of the coral reefs of the Hawaiian reefs for snorkelers and divers was estimated to be $281 million and $44 million, respectively. (page 34)

Meanwhile, "The Preferred Alternative would add an estimated $2.5 to $10 million over the 5-year analysis period (range of $499,416 to $2,022,686 per year), and another five times this value in indirect economic benefits. Loss of the fishery would result in the loss of income, tax revenue, and jobs."

Comment: The information not specifically identified in the RDEIS includes the amount of income the Preferred Alternative would provide the proposed collectors, the criteria proposed for selection of the permittees, the tax revenues anticipated and previously reported by each of the 10 reported permitted collectors (Table 5.2). Based on the analysis in this document, the balance of economic costs appears to weigh heavily against the residents including cultural practitioners and visitor industry in contrast to the benefits for a select few collectors.

Since, on Page 97 of the RDEIS, it states ..

> "Additionally, the 10 fishers who would receive Aquarium Permits under the Limited Permit Issuance Alternative, including the 7 fishers who would receive permits under the Proposed Action, waived their right to confidentiality, so all data from these 10 fishers were released for analysis in the EIS for the WHRFMA and East Hawai'i from 2000 through 2017. "

…the statistics should be readily available and transparently presented.

The economic valuation of the recreational value of coral reef reported by the Hawaii Coral Reef Initiative (above) in 2001 at $325 million (unadjusted for 2020), compared to the total ex-vessel value for the ten fishers reported in 2001 (page 99) of $14,000, calls into question accuracy of the data reported.

On page 37, the RDEIS reports:
"Since 2000, the commercial aquarium fishery within the WHRFMA on the island of Hawai'i has averaged annual landings valued at approximately $1.5 million, with a low of approximately

$738,568 (inflation- adjusted 2020 dollars) in 2001 and a high of $1,965,381 (inflation-adjusted 2020 dollars) in 2014 (Table 4- 2; DAR 2018a). "

In either case, the reported economic value of aquarium collection is less than one percent of the recreational value reported.

4.2/5.3 CULTURAL RESOURCES and Relevant parts and Sections of the RDEIS related to Cultural Resources as referenced prior to each comment, respectively

Significance Criteria #1: does not involve an irrevocable commitment or loss or destruction of any natural, historic, or cultural resource.

Significance Criteria #4 - To what extent does the take of aquarium fish impact cultural practices in the state?

> *"Why should people take our fish just for pleasure?" – Chuck Leslie, cultural practitioner*

RDEIS, Applicant Publication Form, Project Purpose:
"The purpose of the Applicant's action is to ensure that commercial aquarium fish collection allows for the lawful, responsible, and sustainable commercial collection of 8 aquarium fish species from nearshore habitats of the West Hawai'i Regional Fishery Management Area (WHRFMA), where collection is currently limited to 40 "White List" species of fish."

Comment: If permitted, it is state approvals that will "allow for" the action and "ensure that commercial aquarium fish collection is lawful, responsible, and sustainable. The purpose of the action should be to perform the lawful, responsible, and sustainable commercial collection of aquarium fish, if the Board of Land and Natural Resources ("BLNR") finds the proposed action is in fact lawful, responsible, and sustainable. However, with respect to cultural resources and traditional and customary practices, we believe the only lawful, responsible, and sustainable alternative is only the No Action Alternative.

> *"It is a cultural value not to waste fish." - Damien Kenison, cultural practitioner comment from Cultural Impact Statement ("CIA")*

RDEIS, page ii, Executive Summary:
"The Preferred Alternative does not involve an irrevocable commitment or loss or destruction of any natural or cultural resource."

Comment: The Cultural Impact Assessment (Appendix 1) on page 135 states, "No matter how or why these fish are extracted, their removal constitutes an irrevocable loss of bio-cultural

resources that could potentially have an adverse effect on the overall health and sustainability of the fishery."

Irrevocable loss = irreparable harm. Irreparable harm is harm or loss that would not be adequately compensated by monetary damages. Deprivation of constitutional rights is an example of irreparable harm.

The Hawai'i Supreme Court has ruled that traditional and customary Hawaiian rights are a part of the public trust. It along with the state legislature have taken the position that, pursuant to the precautionary principle, where there are present or potential threats of serious damage to natural resources, the lack of full scientific certainty should not be a basis for postponing effective measures to prevent environmental degradation. In addition, where uncertainty exists, the State's duty to perform as a public trustee requires a presumption in favor of public resource protection.

The precautionary principle should also be applied when there are present or potential threats of serious damage to cultural resources, which include traditional and customary Hawaiian rights and practices.

The state Supreme Court has also ruled the applicant bears the burden of proof that their proposed activity does not result in harm or loss to the public trust. By rejecting the applicant's Final Environmental Impact Statement, the BLNR has exercised its affirmative duty to act as a trustee of the public trust and applied the precautionary principle.

> *"The rights of indigenous people include the ability to sustain [the resources] in a way that makes sense for them, not the way that makes sense for someone else. That requires the state to really back up a little bit and trust in the process of our traditions…." – Malia Akutagawa, Esq.*

<u>RDEIS, page iiii, Executive Summary:</u>
"The Cultural Impact Assessment (CIA; Appendix A) concluded that cultural impacts would occur if issuance of Aquarium Permits under an alternative would cause a significant decline in the population of a White List Species considered to be a cultural resource, either directly through the collection of fish or indirectly through habitat impacts. It is noted, however, that some believe that collection for aquarium purposes, regardless of impact or sustainability, is a violation of traditional beliefs. While seven of the eight species on the proposed Revised White List have a known cultural use for food, medicinal, religious or ceremonial purposes, it is assumed a cultural impact could occur if populations of any of the eight species were impacted. As detailed in Section 5.4, populations of the eight species on the proposed Revised White List are not anticipated to substantially decline under the Preferred Alternative. However, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, the Preferred Alternative may impact cultural practices, but the extent of the impact is unknown. Under the Preferred Alternative, cultural impacts in the WHRFMA would be less than the other action alternatives which include commercial aquarium collection in the WHRFMA due

to implementation of the proposed Revised White List (32 species would not be collected at all in the WHRFMA) and individual catch quotas for the remaining 8 species. No cultural impacts would occur under the No Action Alternative, and cultural impacts under the CML-only Alternative would be limited to East Hawai'i."

Comment: In general, as in the Executive Summary, the RDEIS studiously avoids using the word "negative". For instance, the sentence should be, "The CIA concluded that [negative] cultural impacts would occur…". The paragraph acknowledges "that collection for aquarium purposes, regardless of impact or sustainability, is a violation of traditional beliefs" and "is contrary to cultural practices". This wording avoids using the legal phrase "traditional and customary practices" contained within Article XII, Section 7 and within state Supreme Court precedent rulings. A more appropriate and relevant statement would be "the collection for aquarium purposes is a violation of traditional and customary practices. " The paragraph states, "the Preferred Alternative may impact cultural practices, but the extent of the impact is unknown". This statement is incorrect. The consultations contained within the CIA make it clear the Preferred Alternative will impact cultural practices and the extent of the impact is in fact known. It is a known violation of traditional and customary practices. The only acceptable remedy for this violation is the No Action Alternative and denial of aquarium fish collecting permits. These permits should become kapu, especially given the increasing systemic stresses being caused by climate change.

RDEIS, page 9, Introduction, BLNR Fact and Reason 13:
"The FEIS failed to sufficiently consider cultural impacts. The FEIS improperly concluded that the impacts to cultural resources under any of the proposed alternatives would be less than significant based on the flawed premise that cultural impacts would only occur if the proposed action would cause a significant decline in the population of a White List Species considered to be a cultural resource. A number of testimonies expressed misgivings from a cultural standpoint with the proposed activity itself, regardless of impact on resources, and this was not adequately considered in concluding no significant impact.

- This concern has been addressed through edits to Section 5.3."

Comment: We have reviewed the edited text of RDEIS Section 5.3 and we do not think it adequately addresses our concerns for the following reasons:.

Paragraph 136 of the Environmental Council's Amended Findings of Fact, Conclusions of Law, and Decision and Order Nunc Pro Tunc to August 13, 2020 states, in part, "Accordingly, the [original] EIS does not propose or even discuss mitigation measures specific to reducing cultural impacts that are not ecological in nature."

The RDEIS does not propose mitigation measures specific to reducing cultural impacts that are not ecological in nature, other than to admit the No Action Alternative is the only alternative with no cultural impact. **We disagree, and believe 1) the No Action Alternative has an intrinsic**

positive cultural impact, and 2) all other alternatives have inherently negative cultural impacts.

Rather than referring to specific statements made by cultural practitioners consulted in the CIA, RDEIS Section 5.3.1 refers to studies by research scientists. These studies are indirect sources of information by authors who are not cultural practitioners. They should not be used as references in determining the intrinsically negative cultural impact of aquarium fish collecting. It is important to note the CIA lists consultations with individuals who are not cultural practitioners, including aquarium collectors, commercial fishers, charter boat operators, and researchers, who do not have expert working knowledge and understanding of traditional and customary practices.

The only references to the impact of the proposed activity in Section 5.3.1 are the statements:

1)"However, some interviewees expressed the belief that collection for aquarium purposes, regardless of impact or sustainability, is a violation of traditional beliefs (see Appendix A)", and 2)"However, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, all six action alternatives may impact cultural practices. No cultural impacts would occur under the No Action Alternative."

The expert testimonies given by the cultural practitioners in the CIA make it clear all action alternatives, except the No Action Alternative, will impact traditional and customary practices and that impact will be negative.

In section 5.4.2.1, the consequence of the No Action Alternative does not even mention the benefit to cultural practitioners of reduced extraction of reef fishes and habitat health on the native Hawaiian communities that depend on the reef.

The RDEIS does not otherwise propose or discuss mitigation measures specific to reducing cultural impacts that are not ecological in nature.

Section 5.3.2 contains the statement, "However, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, any aquarium collection could have a cumulative impact, though that impact cannot be quantified at this time."

Again, aquarium collection ***has had*** and ***will have*** a cumulative impact and that impact will be negative.

Traditional and customary practices occur within a belief system in which ecology, environment, and culture are inseparable. This is the most serious flaw in the good intentions behind the requirement for Environmental Impact Statements and Cultural Impact Assessments. Biological, Socio-economic, Physical, and Cultural Resources and traditional and customary practices are inseparable, which is why the impact on resources and traditional and customary practices cannot be "quantified" and any harm or loss is therefore considered irreparable.

Final Comments on Cultural Resources:
We would like to highlight the following excerpts from consultation interviews contained with the applicant's Cultural Impact Assessment (Appendix A):

Bimo Akiona: When asked if the proposed project could result in any potential cultural impacts, Bimo did mention that aquarium collecting methods can have a damaging effect on the reef, which in itself, is considered a valued cultural resource.

Pelika Andrade: Pelika believes that the proposed project would lend to adverse impacts to the community and is not aligned with traditional fishing practices. She went on to explain that with aquarium collection, "there's no tending process, only lawe iʻa." She argued that modern aquarium collection practices negatively impact fisheries and disrupts traditional knowledge systems, because there is no input or contribution to maintaining the very resource that the industry is dependent upon.

Kehau Springer: Kehau shared from her experience and observation that the influx of ocean activities, including aquarium fishing, has caused a major disruption to fish behavior. With the increase in boat traffic and people, she has seen a change in fish aggregation patterns and thus has seen the differences in the natural patterns of ocean wildlife.

Nohealani Kaʻawa: She described aquarium collectors as just another group that comes to K aʻū to take its resources and lamented that "it's hard to watch." Nohea added that many people come to Kaʻū just to take its resources and that these people do nothing to give back to these resources. She expressed that seeing these kinds of extractive practices have significantly altered her family's fishing practices to the point that today, she and her family "rarely go holoholo at the kai because there's just too much taking and the balance is not in place anymore."

Mike Nakachi: With respect to the aquarium industry, Mike disclosed that in the past, he has been approached by several individuals to participate in this industry, but affirmed that he has never participated in it because it never felt right in his naʻau (guts, moral nature). He expressed that the feelings that come with taking fish to be sold outside of Hawaiʻi to be placed in someone's tank never felt appropriate to him nor does it contribute to the health of the ocean. He acknowledged knowing several Native Hawaiians that have participated in this industry but stated that many of them have left after learning about the workings of the industry. Mike lamented that in some smaller Hawaiian communities, especially in South Kona where traditional methods of harvesting fish are still practiced, the aquarium industry has created serious discord and tension amongst its members, which he feels is very sad and unfortunate.

Wilford Kaupiko, Ka'imi Kaupiko, and Greg Asner: Kaʻimi added that Miloliʻi was always known for its abundance and is one of the last places to maintain traditional Hawaiian fishing practices, which is why Kaʻimi and his father have played a key role in developing educational programs for the ʻohana and youth of Miloliʻi. When asked about the types of educational programs they

offer, Kaʻimi stated that they focus on teaching the keiki about traditional ʻōpelu feeding, net making, developing fluency in traditional Hawaiian fishing related terminology, seasonal changes, Hawaiian moon calendar, and other pono ways of fishing. Uncle Willy and Kaʻimi expressed that many of the kupuna and fishing practitioners have passed away but there are "plenty kamaliʻi" in the village. They described a pressing need to teach the next generation about the cultural traditions unique to Miloliʻi so that they can makaʻala (remain watchful) and mālama (care for) these traditions, place, and resources into the future. Kaʻimi stated that today, the Miloliʻi community and its ocean resources are in a "vulnerable state" and expressed that the seasonal patterns are off, which creates challenges for their subsistence lifestyle.
While all four interview participants were aware of the Miloliʻi FRA, which prohibits that taking of reef fish for the aquarium industry, they noted that in the adjacent Pāpā Bay, aquarium collection is allowed. Uncle Willy stated that while growing up, he learned that Pāpā Bay is where the fish are born. Greg Asner, who has been diving and conducting coral and fish surveys at Pāpā Bay for the past twenty-three years highlighted some of his research findings.

Greg explained that the science he has been conducting puts numbers to what people like Uncle Willy grew up learning and knowing. Greg described a phenomenon known as "bio slicks" which are visible from land as glass-like, meandering streaks that appear on the ocean surface. Greg explained that these drifting slicks contain larvae fish and invertebrates, algae, and debris and serve as an important habitat during the early growth stages of these organisms. Greg stated that these slicks are common in and near Pāpā Bay but are not generated within Miloliʻi Bay. He emphasized that coastal areas share important biological connections and from his research, he has learned that fish migrate to different areas to live out their life cycle. He went on to explain that Pāpā Bay and Miloliʻi share important biological connections because some of the larvae fish that are carried on these slicks are deposited into adjacent bays. Greg stressed that what happens at Pāpā Bay impacts Miloliʻi and other areas. Both Greg and Gail confirmed fish population crashes at Pāpā Bay and have recorded collectors walking on and damaging coral, which they expressed is key to maintaining a healthy marine ecosystem. The group stated that they have seen aquarium collectors day after day collecting fish from the same areas and feels that this intensive harvesting does not give the fish and the ecosystem a chance to recuperate from previous biological removals. Greg believes that the destructive methods used by certain aquarium collectors are dismantling this integrated system. Additionally, Kaʻimi and Greg described other events, one of which included the 2015 mass coral bleaching which devastated the corals in West Hawaiʻi. Uncle Willy recalled that after this bleaching event, the ʻōpelu were missing.

Comment: When comparing the Western Management System to the Traditional Hawaiian Management System, as offered in Table 1 below, the differences between Western culture and Hawaiian culture are profound. The harvesting of fish for aquariums for pleasure and the manner in which the activity is performed is absolutely contrary to traditional and customary practices. The only positive cultural impact is the No Action Alternative with all other alternatives having negative impacts with irreparable harm to native Hawaiian rights.

Marine Resource Management in the Hawaiian Archipelago:
The Traditional Hawaiian System in Relation to the Western Approach

Excerpted from article in Journal of Marine Sciences, authored by
P. L. Jokiel, K. S. Rodgers, W. J. Walsh, D. A. Polhemus, and T. A. Wilhelm

Table 1 - Comparisons between major aspects of "Traditional Hawaiian" and "Western" management systems in Hawai'i for inshore reef fisheries.

Management component	Western management system	Traditional Hawaiian management system
(1) Authority	Federal, state, and local laws and regulations implemented by various agencies or departments.	*Ali'i* (chiefs)
(2) Access rights	Reef held in common, equal access to all.	Inhabitants of the ahupua'a (district) in consultation with *Ali'i* . Limited access by permission from chiefs and local villagers.
(3) Managers-stewardship	Trained professionals in multiple government agencies with responsibilities defined by law.	*Konohiki* (district manager) appointed by *Ali'i*.
(4) Enforcement	Generally weak and inconsistent due to concern for "due process" and rules of evidence.	Authority in the hands of *Ali'i* . Punishment is immediate and can be severe. Conservation ethic reinforced by ingrained cultural rules of social behavior and spiritual principles.
(5) Management focus	Commercial as well as recreational fishery, economic development, conservation, endangered species, environmental protection, sustainability, and maintain biodiversity.	Limit take to only what is needed by inhabitants to insure sustainable yield. Focus entirely on plants and animals used for food, medicine, selling and trade.
(6) Management theory	Established western science of management (e.g., Catch Per Unit Effort)—Accepted theory and practice subject to revision with new information.	Traditional management practices that were developed and applied locally over many generations of trial, experimentation, study, application and observation.
(7) Knowledge base	Published reports, records, data bases, documents, objective measurements and observations, and quantitative analyses of data.	Oral transmission with restricted access to information—knowledge generally kept within family lineage.
(8) Primary fishery management tools	"Regulated inefficiency" to reduce harvest. Restrictions on gear type, number of fishing days, and marine protected areas.	Intermittent complete reef closures of reefs as indicated with *Kapu* (forbidden take) of certain species at certain times.
(9) Fishery management target	Generally single species. Increasing focus on ecosystems.	Generally entire reef ecosystem with species specific *kapu* at certain times.
(10) Resource monitoring	Infrequent quantitative surveys of environmental parameters and stocks, direct underwater observations. Perception of "insufficient data" required for decisive management actions.	Continuous daily interaction with reef resources, perception that accurate knowledge of resource is held by the local master fishermen (*po'o lawai'a*) , elders (*kūpuna*), and *hoa'āina* of that place.

4.0 BIOLOGICAL RESOURCES
4.4.5 Reef Habitat

Significance Criteria #2 - To what extent does the take of aquarium fish curtail the use of the environment, including: Aquatic invasive algae control, Tourism industry, Integrity of diverse aquatic ecosystems

Member Bill Coney is a co-founder of Legacy Reef Foundation, and the group runs a coral restoration lab at the NELHA marine facility in Kona, Hawaii. The mission is the restoration and conservation of coral reefs in Hawaii and around the world and to ensure critical food security for future generations. He provided the following:

<u>Comment:</u>
Our evaluations of West Hawaii coral health and comments on AQ DREIS

Our opinion is that both the state and AQ DREIS only look at limited and selective data. Our scientist, staff and the local diving community all agree that what has been stated by the state and AQ industry does not tell the complete story. We have people in the water almost every day and what has been reported to us over the last ten years or more, up until the AQ fishing ban, has indicated a steady decline with our reef fish, particularly the herbivories that are critical to coral health. In some areas we have seen an almost complete depletion of the key reef fish.

It is important to understand the relationship between reef fish and coral health. In the natural balance of coral reefs, the herbivores feed on the algae that is constantly growing on our reefs. Without the reef fish the algae take over and smothers the coral reefs. This balance is critical to coral health. In every case we see in areas that have been heavily fished, the coral is greatly

diminished or has completely died off. Coral cannot survive without a proper balance of herbivores.

Our coral reefs have a number of stressors they have to deal with, both manmade and natural stressors have reduced living coral in many areas to near extinction levels. If the trend continues, we will see large areas of coral reefs die off completely. We are limited on what we can do to reduce global warming, run off and sewage outfall to an impactful level that will keep the coral healthy, but we can reduce or eliminate the removal of our coral marine life that the coral depends on. This alone may be the only thing between our coral dying off completely or surviving.

The most telling fact is that within months of the AQ ban we saw, in areas the poachers were not still frequenting, the coral began to grow and now is on its way to pre AQ fishing level. Although this may take decades to return to healthy levels it is proof the trade has a negative impact on coral health in Hawaii. Today we see our reefs and the marine life regaining a foothold and giving us hope they may return. Certainly, allowing the AQ trade to return will put all of our reefs in Hawaii in jeopardy.

Further, the success or failure any coral restoration work done in Hawaii will be dramatically impacted by the outcome of this issue. Any future restoration work done will be at risk if the AQ industry is allowed to remove the essential herbivores that keep the algae in check. In our case we are already looking at moving our restorative efforts to more favorable locations in Florida and the Caribbean. For Legacy Reef Foundation the cost / benefit / risk is just not favorable in Hawaii at this time.

Conclusion and recommendations – It is the opinion of our scientist, staff and the local water community that the ban on aquarium collecting should remain in place indefinitely. History has shown that the state can't police the trade effectively, so a ban seems the only effective option. We believe the answer to this issue is to support land-based aquaculture to raise the fish desired for the aquarium trade. This option protects our reefs and marine life and allows the aquarium collector to make living without harming Hawaii's coral reefs.

4.4.7 Aquarium Fish Population Estimate Data

<u>Revised DEIS comments</u> <u>on data analyses and results</u>
Dr. Asner and colleagues provided very thorough and sound analyses of the Draft EIS-Nov 2019 and of the Final EIS-Apr 2020. They appropriately pointed out several scientific inadequacies in their first analysis of the DEIS that were not corrected or adequately addressed in the FEIS. In their analysis of the FEIS, Dr. Asner and colleagues emphasized the areas that required correction and were not addressed, particularly in the areas of inaccurate calculation of fish species population estimates, inadequate statistical analyses, and insufficient presentation of the impacts of herbivorous fish harvest on ecosystem function and coral community health.

Although several important scientific topics, including species population and catch estimates, have not been adequately addressed in the Revised DEIS, a large criticism is that EIS population and catch estimates were provided at the entire island scale. Reef fishes have very high site fidelity, and most reef fish species have very small home ranges. Several factors influence the local site abundance of reef fishes, including wave exposure, habitat complexity, larval recruitment, among numerous others, so local removal of numerous fishes can have long-term negative effects on local fish abundance. Population and catch estimates should be calculated at the smallest scale and statistically analyzed and compared among sites, in order to derive best management practices from local (site) to larger (coast, island) scales. Human population density has been shown to negatively correlate with fish abundance (e.g., Williams et al. 2008), so management agencies must consider socio-economic factors when establishing harvest management strategies for reef fishes in Hawai ‘i. Obviously, local depletion of resources around tourist and population centers can negatively influence tourism and local resident recreation.

A few additional points should be emphasized. As presented by Dr. Asner and colleagues, the DAR and NOAA data were incorrectly analyzed and presented for the purposes used in the RDEIS. Both data sets should have been analyzed using more robust statistical methods in order to provide proper trends and developing the population estimates. As stated by Dr. Asner and colleagues, fish abundance and biomass data collected using the DAR and NOAA sampling methods have large variance. Trend analysis of these type of monitoring data require data for several years with at least annual sampling frequency to conduct defensible analyses of population trends. Statistical comparisons between two years (or short periods) at the same site are not statistically appropriate in most cases because of variance and autocorrelation in the data. Another large inaccuracy stated was the population estimates made from non-random data.

Our scientific advisors and Sierra Club Executive Committee members have reviewed the DEIS, FEIS, and the analyses of Dr. Asner and colleagues, and we support the criticisms and conclusions of Dr. Asner and colleagues.

<u>Recommendations for revision of the Revised Draft EIS:</u>

-Re-analysis of data for population size, catch, and total allowable catch estimates for each species on the White List should be conducted. Ideally, this would be conducted using all available data and various statistical models, such as generalized linear mixed models, as suggested by Asner and colleagues, and spatially explicit population models for each species (for those species with sufficient data). Other datasets, such as the NPS I&M program data for Kaloko-Honokohau NHP, would provide addition data for trend analysis for species in a protected management area.

-Improved analysis on herbivorous fishes by species, feeding guild, and as a functional group should be conducted to provide results addressing the impacts of herbivore removal and potential impact on ecosystem function.

-Provide unbiased results and conclusions from relevant literature suggested by Asner and colleagues and other commenters. This should include literature on the effects of commercial fishing on reef fishes, which is important regardless of the estimated proportion of harvest conducted by aquarium trade collectors.

-Any commercial collection alternative should provide a list of species that should have no allowable catch, including species that have a statistically significant negative trend and those species that are uncommon in commercial catches. The latter could be a proposed simple rule of exclusion of species that are uncommon in fisheries dependent and independent datasets (based on frequency of occurrence analysis). There are numerous 'fish watchers', similar to 'bird watchers', who spend hundreds of hours to complete their 'life list' or 'annual counts' and believe that the harvest of uncommon species abhorrent.

5.4.2 Indirect Effects: Mortality of Post-Harvest Fish

Significance Criteria #3 - Does the take of aquarium fish conflict with the state's long-term environmental goals?

Significance Criteria #4 - To what extent does the take of aquarium fish impact cultural practices in the state?

Comment: This environmental review concerns a resource extraction industry that involves many consequences beyond the removal of fishes from their natural habitat. It involves the holding and transportation of fragile wildlife requiring scientific, ecological and humane practices to maintain the health and welfare of the animals extracted from their reef ecosystem. It is well known that many of these creatures succumb to deleterious practices from the point of capture on the reef to the well-intentioned (though often ignorant) hobbyist's tank thousands of miles from Hawai'i. Many captured fishes are unnecessarily lost on this torturous journey to destinations as far away as Russia leading to over-collection of our precious fishes. Concerns about the over-collection of many fish species arise from the fact that the aquarium trade is largely untraceable. No centralized global database exists for tracking how many fish are scooped from reefs—or even how they're captured.

We ask that the applicant address the practices of the trade during all phases of capture, transporting and warehousing of our reef fishes. We find that the RDEIS does not adequately address the animal welfare issues and unacceptable high mortality rates which can be considered cumulative effects of the actions proposed.

The RDEIS states: "The purpose of the Applicant's action is to ensure that commercial aquarium fish collection allows for the lawful, responsible, and sustainable commercial collection of 8 aquarium fish species from nearshore habitats of the West Hawai'i Regional Fishery Management Area (WHRFMA)". The applicant asserts "Permittees would abide by all rules and regulations set forth in HRS 189-2,3 (Commercial Marine Permit; Section 1.2.2), and HRS-188-31 (Section 1.2.1), governing aquarium permit use". One of these rules provided in the RDEIS is from HRS 188-31 1.2.2 —"Except as prohibited by law, the permits shall be issued only to persons who can satisfy the department that they possess facilities to and can maintain fish and other aquatic life alive and in reasonable health."

Comment: A number of practices of the trade from the point of collection are subject to Hawai'i Misdemeanor Cruelty to Animals statute HRS 711-1109. These documented practices of the trade include puncturing of gas bladders of fishes to prevent barotrauma during ascent from the reef. The procedure involves puncturing the gas bladder through the musculature of the fish using a sharp object such as a hypodermic needle. Later, during warehousing of the fishes prior to shipping, trimming their fins and withholding of food are common practices. The fishes are shipped in small plastic bags that are easily punctured. Food is withheld to lessen ammonia contamination from defecation during the shipping process.

All of these practices are in violation of HRS 711-1109, and we ask that they be addressed. The animal cruelty statute specifically includes violations for: (b) Deprives a pet animal of necessary sustenance or causes such deprivation (c) Mutilates, poisons, or kills without need any animal.

The effects on individual fish removed from the population matter. The manner of capture and care should be included in the analysis. These fishes are not used for subsistence, they are used for ornamentation and fleeting pleasure. The impacts of trapping, finning, starving, enclosure in confined packaging, transporting and eventual placement of remaining live "specimens" in artificial conditions must be documented and mortality data disclosed in the RDEIS analysis.

Comment: What measures are taken to ensure fish are treated humanely?
Are fishes that do not survive the harvest/storage and transport reported?
How is the report documented for public review?
What agency is charged with regulating the care of fish?

Comment:In the CIA section cultural concerns are raised by numerous cultural practitioners who view the trade as "wasteful " and therefore contrary to their traditional cultural values. The interview of respected community member John Replogle states "John also raised concern for the mortality rate of the fish and noted that there have been several instances when bags of dead aquarium fish were dumped and 'thrown out like garbage.' He described that culturally when something of value needs to be disposed of, it is done so properly and cited the example of a lei, where once it is no longer needed, it is returned to the land. John contends that although only a few cases of dumped aquarium fish have made public headlines, he believes that such cases may be more common. In describing some of his concern about the proposed action, John exclaimed that in fifty years from now, what will those people think of the culture that would allow this type of activity to happen. He stated that these marine resources are a part of a living culture and are a part of a living ecosystem that is intimately connected to the land."

5.4.3 Cumulative Impacts

Significance Criteria #8 - What is the cumulative impact of the take of aquarium fish when combined with:

- *Commercial take of aquarium fish using other legal methods*
- *Recreational take of aquarium fish*
- *Commercial and non-commercial take of aquarium fish for consumption (particularly the Achilles Tang and Kole)*

The RDEIS states “The commercial aquarium fishery has existed in Hawai’i since the late 1940s and in the past the fishery has impacted cultural resources by virtue of the fact that commercial aquarium collection occurs in a culturally significant area (the ocean), and in some instances involves culturally significant species.”

The RDEIS (page 157) states “Between 2008 and 2018, total fish biomass decreased by 45% in the WHRFMA, with a variety of drivers potentially causing these declines (Foo at al. 2020). “

Comment: The State of Hawaii has a constitutional duty to protect the natural and cultural resources for future generations. Unless the No Action alternative is chosen, the state would fail to meet its public trust obligations if it were to allow continued aquarium collecting, knowing full well that historic degradation would continue to occur.

The public trust doctrine has been adopted in Hawaiʻi as a "fundamental principle of constitutional law." In re Water Use Permit Applications, 94 Haw. 97, 132, 9 P.3d 409, 444 (2000).

The Hawaiʻi Supreme Court also adopted the precautionary principle as a corollary to the public trust, ruling that “the lack of full scientific certainty should not be a basis for postponing effective measures to prevent environmental degradation” and that “where [scientific] uncertainty exists, a trustee’s duty to protect the resource mitigates in favor of choosing presumptions that also protect the resource.” Id. at 154, 9 P.3d at 466 (quoting the Water Commission’s decision). The court determined that “at minimum, the absence of firm scientific proof should not tie the [agency’s] hands in adopting reasonable measures designed to further the public interest.” Id. at 155, 9 P.3d at 467.

Most recently in Ching v. Case, the Hawaiʻi Supreme Court reaffirmed that “[u]nder the Hawaiʻi Constitution, all public natural resources are held in trust by the State for the common benefit of Hawaiʻi’s people and the generations to come.” 145 Hawaiʻi 148, 152, 449 P.3d 1146, 1150 (2019) (emphasis added).

The State of Hawaii has a public trust obligation to mitigate and/or reverse cumulative impact on public trust resources.

3.7.2 Additional Enforcement and Compliance Measures

The RDEIS states: “As of April 2018, all recreational permits for collection of aquarium species with fine mesh nets were voided, and no collection with fine mesh nets is currently legally allowed, pending environmental review (DAR 2019a). “

Comment: Nevertheless, fine-mesh nets were and continue to be used, with limited enforcement. On and off-shore resident monitors regularly report violators of the ban, but few are caught by enforcement officers. Two that that were caught were documented to have hundreds of fish; Jason Beevers’ boat was spotted within the West Hawaiʻi Regional Fishery Management Area by DLNR enforcement officers last August 2020 with illegal collecting gear and more than 300 fish, mostly yellow tang, found when an officer inspected the boat after it landed. Stephen Howard and Yukako Toriyama were apprehended by Division of Aquatic Resources (DAR) recovered and released 235 fish of ten different species. Most of them were yellow tangs and their total retail value was estimated at $24,730. The two were accused of

committing several violations, including possessing aquarium collecting gear, an unregistered, fine-meshed lay net, and illegally collecting aquarium fish species. We understand that six of the formerly permitted collectors were cited for poaching in 2020.

Our members who monitor the collecting activity report that collectors are spotted 4-5 times a week, and if they are collecting 300-500 fish per day, they could reasonably be expected to collect/poach at least 500,000 near-shore reef fish annually.

Comment: HAR 13-60.4 identified West Hawai'i Aquarium Permit Terms and Conditions by implementing the following provisions: Aquarium collectors must submit each month's daily aquarium fishing trip reports before every 10th day of the following month. According to table 4.1, barely 47 percent of permittees provided required reports, so it begs the question: how meaningful is the data if those with permits are historically non-compliant?

Comment: The procedures outlined in Section 3.7.2 Additional Enforcement and Compliance Measures could address some of these issues. If any alternative other than the No Action alternative were selected, we would support the applicant's efforts in the RDEIS to use a triplicate certificate of origin system monitored by the DOA that traces the dealers buying the fishes and addresses the issue of poaching and possible violations of the Lacey Act.

Conclusion

In spite of commenting on every aquarium collecting document offered in the past several years, Sierra Club was not a consulted party. Many of the consulted parties pointed out that the lack of support and funding have hampered DNLR- DAR's ability to fulfill its fiduciary responsibility, namely to enhance, protect, conserve, and manage Hawai'i's unique and limited resources, which are supposed to be held in public trust for the current and future generations of the people of Hawai'i nei, and visitors alike.

We contend that collectors can pursue alternate livelihoods raising aquarium fish in captivity, working in commercial aquariums, fishing for food fish, and running boat and dive tours.

In order to protect and ensure the sustained health of the reef, traditional and customary practices, and subsistence fishing practices, Sierra Club members support the No Action Alternative.

Thank you for the opportunity to respond.

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TO: David Sakoda

FROM: Bruce Carlson Ph.D.
Richard Pyle Ph.D.
Randall Kosaki Ph.D.

DATE: April 9, 2021

SUBJECT: TESTIMONY IN SUPPORT OF RDEIS FOR THE WEST HAWAIʻI AQUARIUM FISHERY

The West Hawai'i Aquarium Fishery RDEIS has been exhaustively researched and updated and based on the best available science, we support its findings and conclusions.

Your decision on this EIS will be a judgement on the efficacy of the FRA management system. No amount of hyperbole, anecdotes, or obfuscation can erase a simple truth that the FRA system has resulted in a 20-year upward trend in the populations of the most-collected species of aquarium fishes. This is a "fact" and keeping this foremost in mind will place all other arguments in proper perspective.

No inshore reef fishery in Hawai'i has been subjected to the level of scrutiny, research, management and debate as the West Hawaiʻi Aquarium Fishery. This fishery has been required to meet higher standards than all other commerical or recreational fisheries. Thousands of hours and hundreds of thousands of dollars have been spent monitoring and reporting on the fishery and in drafting this RDEIS. Ultimately, it is the comprehensive data sets gathered by DLNR/DAR, UH and NOAA biologists over the past two decades, that provide clear evidence of the sustainability of this fishery. As a result, we continue to support this fishery as sustainable in the long-term, and reject anedotal evidence, and the mis-characterization of the available data.

We especially urge you to carefully evaluate the DAR-West Hawai'i Aquarium Project (WHAP) data, and especially to critically review the negative critique offered by Dr. Gregory Asner and his colleagues. In our opinion, their reasoning, analyses and conclusions would not withstand peer review if submitted for publication. We hasten to add that they are not able to provide any of their own publications or original field data to support their conclusions and opinions. Significantly, they fail to mention other peer-reviewed publications that reference the WHAP data and associated conclusions that the West Hawaiʻi Aquarium fishery is, in fact, sustainable by any standard metric. In particular, they should have noted the 2019 Report to the Legislature submitted by DLNR, with extensive data that support the fishery. Additionally, they ignore the conclusions published by Gove et al. (2019) in a NOAA publication, which states: *"The total abundance of nearshore fishes has shown a positive trend in all management areas – MPAs, FRAs, and open areas – across West Hawaiʻi since 2003....Total abundance has increased by 28.9%, 36.0% and 34.9% in MPAs, FRAs and open areas, respectively...."* Additionally, *"Species richness, or the total number of species present per survey, has not changed within each management area over the last 15 years..."*

We will highlight a few of the overstatements, or erroneous conclusions reached by Asner et al. These examples should warrant a critical and skeptical review of his entire testimony:

1. *Pg. 2 "For WHAP data, aquarium fish show extremely variable decreases and increases across survey years, indicating they are not necessarily stable...."*

    a. Every fisherman and every diver who has spent any time on the ocean knows that fish populations can vary dramatically over time. For example, Hawai'i reefs in the summer of 2014 had such high levels of recruitment of many reef fish species, that scientists termed it "biblical", but in other years, recuitment can be minimal. This recruitment variability is one prime factor affecting population swings, and it is not necessarily indicative of "non-stable populations", unless viewed on an inappropriate brief time scale. What is more important are the long-term population trends, which for the most critical species in the fishery, have trended upwards over the past twenty years. This is particularly true for the two most important species: Yellow Tang and Kole which comprise over 90% of the total aquarium fish catch.
    b. By analogy, In the same way that emphasizing short-term fluctuations in carbon dioxide (CO_2) levels in the atmosphere misrepresent the long-term trends of rising atmospheric CO_2 and its globally important implications, framing these short-term fluctuations in reef-fish populations as indicative of undesirable consequences of the aquarium fish collecting activity misrepresent the important story told by 20 years of data, which show that the most important fish populations are increasing.

2. *Pg. 2 "...PIFSC-ESD (data), not all....species show a trajectory of increasing abundance. Of note, the two top aquarium fish species, Yellow Tang and Kole, both show decreases...between 2016 and 2019 in open collection areas...."*

    a. Again, the 2016 to 2019 declines in some species from PIFSC-ESD (CRED) data probably represent the expected response to the massive recruitment event in 2014; a temporary boost in 2015 that was still there in 2016 but largely gone by 2019. Why was this significant biological event not mentioned as a possible or probable explanation?
    b. The WHAP data set is much more extensive spatially and temporally and offers a more robust view of population trends over two decades to evaluate population trends. The WHAP surveys are repeated several times each year (presently quarterly). Over 8,700 fish surveys have been conducted at more than two dozen sites along the coast over 20 years. By comparison, CRED data are collected only once every three years, thus obscuring seasonal and annual variability in larval recruitment and adult densities.

3. Pg. 6 *For five species, the proposed catch is higher than the annual catch data previously reported in the majority of the last 20 years.*

a. Asner et al. calculate that the potential future catch for all 7 fishers for Yellow Tang could be 200,000 and for Kole 30,000. In FY 2017, the Yellow Tang catch was somewhat higher: 265,000 but that year there were 51 licensed collectors In West Hawai'i of which 33 were very active (collecting a total of more than 10,000 fish that year). It is effectively impossible for 7 collectors to collect at close to the same rate as 33 collectors. Live fish cannot be over-collected or kept on ice. There are physical limits to how many fish one fisherman can catch, properly care for, maintain in holding tanks, and sell. In this context, we submit that the Asner calculations and conclusions are invalid.

4. Pg. 8 *Herbivores are critically important for resisting coral to algae regime shifts (Graham et al. 2015)....*

   a. Herbivores do indeed have an important ecological role on coral reefs. But a thorough reading of Graham et al. (2015) reveals a more nuanced conclusion:

      "*Interestingly, a relatively low biomass of herbivores (177 kg/ha) - below average values for the Indian Ocean - reduced the risk of a regime shift occurring....Our results suggest that although both (herbivory or nutrients) related to ecosystem trajectory, they are weaker and less certain predicators than structural complexity, depth, and the density of juvenile corals*".

   b. Data available from the WHAP surveys indicate that Hawai'i reefs have a biomass of herbivores in excess of 250 kg/ha.
   c. NOAA IEA data indicate that herbivore biomass has not decreased since 2003 in the FRAs and open areas on West Hawai'i reefs and has significantly increased in the more heavily protected MPAs (+30.8%).
   d. Tissot and Hallacher (2003) specifically studied Hawai'i reefs where intensive fish collecting had occurred and found neither any significant increase in macro-algae nor any significant coral damage (as reported in the RDEIS).
   e. The take of herbivorous species by aquarium collectors is only a fraction of the total herbivorous fish populations on these reefs, which are dominated (in terms of herbivorous activity) by many other species of acanthurids (surgeonfishes) not taken for the aquarium trade, as well as scarids (parrotfishes) pomacentrids (damselfishes), and herbivorous invertebrates. Indeed the impact of nearshore food fisheries on the herbivory of these reefs (and potential consequences for corals) most likely dwarfs that of the aquarium collectors.

5. Pg. 9 ...*targeting mostly immature fish has huge implications for sustainable useage of the resource. Protecting immature fish is key to keeping any fishery sustainable in the long term where catching juvenile fish removes them and future offspring*

   a. This statement is fundamentally incorrect. Protecting the adult brood stock is the key to keeping the fishery sustainable. Unlike most terrestrial vertebrates, fishes

such as the Yellow Tang can produce up to a million eggs per female per year. Fish fecundity increases exponentially with size, thus a fishery that explicitly avoids large reproductively mature individuals maintains its unfished reproductive output. For example, a population with millions of adult Yellow Tang will produce millions[2] of eggs, larvae and eventually new recruits. With 35% of the coast protected, and with the adult brood-stock of no interest to collectors, the population can renew itself despite the typical loss most of the offspring due to predation and other natural causes. The population trends presented in the DLNR 2019 report clearly show that this model is working in practice.

6. Pg. 9 ...*the RDEIS fails to acknowledge the primary finding of Tissot and Hallacher (2003): that seven of the ten aquarium fish species surveyed were significantly reduced by collecting.*

    a. This statement is misleading. Tissot and Hallacher conducted their research BEFORE the FRA management plan was instituted. They did in fact report a "significant difference" in populations where fishing occurs versus protected areas. However, "significant" in this context means "statistically significant" and is not a statement that the populations were in significant peril. Since then an extensive network of no-aquarium-collecting areas comprising 35% of the coast has been established and the fish populations have been closely monitored by DAR biologists and associated research divers (over 80 of them) . The long-term trends for the most heavily collected species show increasing populations, even in areas where collecting is permitted. The RDEIS is not reporting only partial information, as claimed by Asner; data collected prior to the implementation of the management plan have historical value but are largely irrelevant to the current discussion.

Our motivation to provide this testimony is to defend the use of robust, data-driven science in determining policy. Science within the U.S. has often been neglected, mis-represented, or distorted to defend political agendas. In our criticisms, we want to be clear that we do not accuse Asner et al. of intentionally promulgating distortions; we are providing a professional review of his comments and disagree with his conclusions. We want to make sure that the science and the data are interpreted appropriately and accurately. Each of us has multiple decades of experience studying reef fishes in Hawaiʻi in general, and the impacts of the aquarium fishery on populations of those reef fishes in particular. We hope that our insights gained over these decades is taken into account when you make policy and management decisions based on the best and most robust data and scientific interpretations.

In a perfect world, many of us would prefer to leave all the fishes in the ocean. This is especially true for the larger and demonstrably overfished populations consumed for food. But not everyone can enjoy the ocean and enjoy viewing marine life underwater. Aquariums do have an important and often inspirational purpose both for public facilities, and for hobbyists. Many researchers and conservationists (ourselves included) started our interest in marine biology with

a home aquarium. The arguments against this fishery are emotional, anecdotal but misleadingly powerful. If it weren't for the DLNR-WHAP data, probably none of us could support the fishery because we would not know any better. But the DLNR-WHAP data do exist, and they constitute one of the best data sets for any inshore coral reef fishery in the world. As a consequence, the aquarium fishery in Hawaiʻi is widely regarded as one of the best-managed coral reef fisheries in the world. If BLNR dismisses these robust and important data based on misleading arguments and anecdotal comments, why would any researcher ever want to devote years of hard work gathering data on any other fishery in Hawaiʻi?

The West Hawaiʻi Aquarium Fishery comprehensive management plan is recognized as a model to emulate for sustainable management of coral reef fisheries. Rejecting this RDEIS and permanently shutting down the West Hawaiʻi Aquarium Fishery would set a terrible precedent by effectively announcing that fishery management areas (FRAs) are a failure, when in fact, they have been a remarkable success story.

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TESTIMONY of William Graham on the revised DEIS, April 1, 2021

Overview

The Hawaii courts have ruled that aquarium fishing must cease until environmental review has been conducted in conformance with the Hawaii Environmental Protection Act (HEPA). The limited number and resources of the aquarium fishers in Hawaii are not sufficient to fund such a substantial undertaking as to complete all the requirements of HEPA. However, the scale of the world-wide retailers and wholesalers is large enough to justify an effort to satisfy the courts' requirement. Thus the Pet Industry Joint Advisory Council (PIJAC) has endeavored to do just that.

Three strong headwinds compromise their effort. First, the public is clearly in opposition to the taking of colorful reef fish from our waters to be sold elsewhere for confinement in aquariums. Second, it is very difficult to responsibly predict future impacts from the the extraction of the reef fish, who are largely herbivores. This is next to impossible given that climate change effects are and will be very damaging to the reefs irrespective of any aquarium fishing. And third, the very actions of the aquarium fishers themselves has been underhanded and unlawful.

The resulting situation has PIJAC initiating some ill-defined "Project" where the fishers are not identified and are not the actual applicants for licenses. Once their final EIS was rejected for numerous reasons PIJAC has now come back with a revised draft EIS in an effort to sidestep the objections.

My Testimony

The bulk of my testimony challenges the legal and procedural framework that underlies this unusual application and the current revised draft EIS. I will also make further comments on the content of the DEIS, largely regarding the fishers, the quotas and their enforcement. Others will be providing testimony on the environmental and cultural effects of aquarium fishing. I trust that the applicant will respond meaningfully to the questions I pose.

A. The procedural history of this application shows that it is unsuitable as a single, lawful HEPA invocation. Hence the current revised DEIS document is not appropriate.

The Hawaii court system has ruled that the issuing of aquarium permits by the DLNR cannot proceed without proper review in accordance with the Hawaii Environmental Procedures Act (HEPA). The trigger for HEPA is an action initiated by an applicant requiring agency approval. In this case the specific approval sought is for aquarium fishing permits. Thus the EIS documents in this matter must be in support of such an action.

The applicant (PIJAC) is seeking aquarium permits not for itself but for unnamed third parties. Is it intended that the agency approval being sought is to immediately issue permits to PIJAC for distribution to those third parties? Alternatively the agency approval being requested might be a commitment to respond favorably to applications to be submitted by these individuals in the future. Or is the intention something different? This is all unclear. What specific approval by DLNR is now requested? Please clarify.

Additionally, the third parties (fishermen) are changing in number at different stages of this lengthy process. First 14, then 10, now 7. There is no public record of the composition of those 14, 10 or 7 third parties. Furthermore, in the current revised draft EIS the applicant is asking for permits to be issued under a regulatory structure which is hypothetical and does not currently exist. The DLNR has no authority to issue such permits at this time. Thus the HEPA act is not properly invoked or consistently adhered to.

I include as an Appendix the official applicant's "action" in the various stages of Environmental Assessment, Draft EIS, Final EIS, and revised Draft EIS. These actions are reproduced using the applicant's own words. Even if the first 3 of the 4 were to be deemed acceptable as a single, somewhat modified action, surely the 4th does not qualify as such. Note that in Hawaii Administrative Rules 11-200 a "Project" is defined in the following manner: "Project means a discrete, planned undertaking that is site and time specific, has a specific goal or purpose, and has

potential impact to the environment." The project here does not adhere to those specifications. It has changed and evolved.

In the past few years the DLNR has caught, cited and prosecuted several major violations of the no-fishing rule. This applicant has seen its prior EIS rejected by the DLNR board. If the DLNR wishes to have aquarium fishing resume in the future it should adopt rules and procedures that would properly regulate the fishing. Thereafter the applicant or the fishers could resubmit a request for fishing in the WHRFMA with fine mesh nets.

B. The fishers and their annual limits

In prior EIS documents by this applicant the primary basis for evaluating impacts has been the historical take by the fishers who are to receive permits. One finds on page 139 of the final EIS (April 2020), that the impact on fish populations by the preferred alternative "...is based on the average and maximum collection of the 10 fishers in the WHRFMA, ...". A similar statement appears on page 136 of the draft EIS (November 2019).

The 14 fisher preferred alternative in the prior Draft EIS provided specific counts of historical take by those to whom permits were to be granted (Table 5-2). The 10 fisher preferred alternative in the prior Final EIS also provided specific counts of historical take by those to whom permits were to be granted (Table 5-2). But there appear to be no historical counts shown for the 7 fishers designated in the preferred alternative within this Revised DEIS. These counts should be included. Why aren't they? Why is the historical collection of fish by the permittees no longer a basis for quotas and expected population impacts? It appears that the proposed annual quotas will far exceed the historical annual collections of the 7 fishers. This change of methodology must be explained.

One can see that the revised DEIS is purposely proposing quotas that are not related to the issuance of the 7 permits. Nevertheless it asks that the overall quota be divided amongst the 7. This is clearly disingenuous. Simply put, the proposed quotas do not correspond to the permit issuance being sought. They must be adjusted downward appropriately.

In the first sentence of section 3.7.2 the applicant specifically acknowledges that the problem of poaching and otherwise illegally obtained fish has "undermined the conservation and management of the aquarium fishery". . The proposed actions in the various EIS incarnations prepared by this applicant have cited "lawful, responsible, and sustainable commmercial collection" within the Proposed Action. Have any individuals in these groups of 14, 10, and 7 fishers been cited for unlawful aquarium fishing related actions? Which, if any? I refer to the proposed permit recipients in the prior DEIS, the prior FEIS, and the current revised DEIS respectively.

In her letter of July 2018 whereby Chairperson Case informed the applicant of the need for an EIS, she spoke to the role of proposed regulations versus self-regulation by the fishers. (One notes that the applicant is not a fisher!) The pattern of recent well documented illegal activities by aquarium fishers certainly renders unconvincing any proposal for self-regulation.

C. Enforcement of the Catch Quotas

In section 3.7.2 of the DEIS the applicant is proposing the introduction of a new method of tracking and enforcing the catch quotas of the fishers, a "Certificate of Origin" paper trail. Certainly this is a worthwhile objective. Unfortunately the proposal contains lots of potential leakage opportunities which could perhaps be minimized by additional safeguards. By leakage I mean opportunities to subvert the system. A more detailed description in the EIS of the ways that fishes are shipped is necessary to better evaluate the efficacy of the proposed sampling control. Here are my observations in regard to the weak points of the proposed quota system:

a) The dealer is the key - If the dealer is not rigorous in his/her implementation of the proposal, it fails completely. I see no information as to how many dealers are potentially involved, and where they are located. The EIS must provide this information. And for the system to have any strong control the dealers should be licensed. Plus the regulations must be amended to make it illegal for any shipping

to occur outside of the licensed dealer network. Otherwise a fisher could completely avoid the paper trail that is designed to validate the shipment.

b) At the airport - We need a description of the shipping containers and the number of fish usually contained within them. From which airports and by which air carriers can the fish be shipped? This information is of primary importance to understand the scale of the enforcement undertaking.

c) Role of the Department of Agriculture - Has the applicant discussed this proposal in detail with the DOA? We certainly need an evaluation of the cost, staffing, training and logistics that would accrue to the DOA. The DOA response and analysis should have been a part of this revised DEIS.

d) Efficacy of the 1 in 10 inspection - The applicant suggests a sampling approach to inspection. It is understandable but questionable. This directly pertains to (b) above. How many shipping containers are used for a shipment, what is the container physically like, is it amenable to inspection? Outside of Hawaii, have sampling inspections like this been implemented to control illegal take by aquarium fishers? Have they been successful?

End of textual testimony

Appendix:

List of "Proposed Actions" by the applicant PIJAC, drawn from the Project Summary sections of the EIS documents

The disparities here are significant since "Action" has a specific role and definition within both HRS 343 and HAR 11-200.

1.DEA of June 2018:
Lawful, responsible, and sustainable commercial collection of various aquarium fish species from nearshore habitats pursuant to Aquarium Fishing Permits issued under HRS 188-31.

2. DEIS of November 2019

Issuance of 14 Commercial Aquarium Permits ensuring lawful, responsible, and sustainable commercial collection of various aquarium fish species from nearshore habitats of the West Hawaii Regional Fishery Management Area pursuant to Aquarium Fishing Permits issued under HRS 188-31.

3. FEIS of April 2020

Collection of aquarium fish pursuant to the issuance of 10 Commercial Aquarium Permits under HRS 188-31 and related permits ensuring lawful, responsible, and sustainable commercial collection of various aquarium fish species from nearshore habitats of the WHRFMA.

4. Revised DEIS of February 2021

Collection of aquarium fish pursuant to the issuance of 7 Commercial Aquarium Permits under HRS 188-31 and 7 Commercial Marine Licenses under HRS 189-2,3 and implementation of species-specific catch quotas, ensuring lawful, responsible, and sustainable commercial collection of 8 aquarium fish species from nearshore habitats of the West Hawaii Regional Fishery Management Area.

From:	Yasamin Alarab
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 4:44:44 PM

Aloha Mr. Sakoda,

My name is Yasamin Alarab and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Yalarab@aol.com

From: Lynn Allen
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 4:07:02 PM

Aloha Mr. Sakoda,

My name is Lynn Allen and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

North Kohala

Puna

South Kohala

My additional comment: Given the uncertainty of the upcoming effects of climate change on our oceans, reefs and reef fish we need to ensure as best as possible that the reef ecosystem maintains its integrity. The extraction of fish to support a trade (involving very few people) that has no regard for its impact on an environment (impacting many people and multiple generations). We can't afford to not get this right!

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at lynn.all@maui.net

From: Geri Allison
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Saturday, April 3, 2021 12:37:58 AM

Aloha Mr. Sakoda,

My name is Geri Allison and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at GeriAllison@yahoo.com

From: Carla Alvarado
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Saturday, April 3, 2021 1:43:34 AM

Aloha Mr. Sakoda,

My name is Carla Alvarado and I am a Part time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

Hamakua

South Kohala

My additional comment: The beautiful "golden" waters off Kona were just coming back and need to be protected. Kealakekua was teaming with these species and suddenly they were diminished. Now they are finally repopulating. The aquarium trade MUST be stopped.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at carla.alvarado@wisc.edu

From:	David Anderson
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Wednesday, April 7, 2021 8:35:05 PM

Aloha Mr. Sakoda,

My name is David Anderson and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

Hilo

South Kohala

My additional comment: I come to Hawai'i to dive and enjoy the underwater flora and fauna...I believe this activity is far more valuable to the economy and life in the State than any amount of aquarium fish collecting. I will be there again next February for a month...please leave the fish alone for everyone to enjoy in their natural habitat and state.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at dtander@gmail.com

From: Caroline Azelski
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 2, 2021 9:58:05 PM

Aloha Mr. Sakoda,

My name is Caroline Azelski and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kohala

My additional comment: Events over the last year have proven that leaving stressed species alone (especially aquatic ones) leads to populations rebounding. Self healing problems are a rare opportunity.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at caroline@azelski.net

From: Jeff Babcock
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 2:38:36 PM

Aloha Mr. Sakoda,

My name is Jeff Babcock and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Jbcrfd23@gmail.com

From: Tim Bailey
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 9, 2021 7:54:36 PM

Aloha Mr. Sakoda,

My name is Tim Bailey and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Twbailey@cox.net

From: Kerri Ballard
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 11:23:12 PM

Aloha Mr. Sakoda,

My name is Kerri Ballard and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment: Our reefs in general are under great stress. The improvement seen during Covid without the extra impact from tourism showed that, if left alone, even gross damage can begin to heal. We need to do everything we possibly can to help. Economic benefit to a very few people shouldn't outweigh our responsibility to protect our ocean .

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Kerri.ballard@hawaii.er.com

From: Joseph Balsimo
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Monday, April 5, 2021 2:45:39 PM

Aloha Mr. Sakoda,

My name is Joseph Balsimo and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the animal welfare issues and unacceptably high

mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

My additional comment: Aloha, I have been a Resident of South Kona in the last 20 years I have seen the disappearance of the yellow tang and many other near shore species at our local beaches. I realize there's been a moratorium on aquarium collecting, however I haven't seen a return of the nearest sure species in question. Aquarium fishing only benefits the person taking the fish, people of Hawaii have no benefit. Thank you
Sincerely Joe Balsamo

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at balsimo.joe@gmail.com

From: Anita Barker
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 5:34:11 PM

Aloha Mr. Sakoda,

My name is Anita Barker and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: Fish do not belong in aquariums.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at anita_paulos@yahoo.com

From:	Carlos Barrios
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Monday, April 5, 2021 11:17:29 AM

Aloha Mr. Sakoda,

My name is Carlos Barrios and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Chevron Tang

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment: The 1st time I flew to the Island of Hawaii`i, I looked down and saw

a "coast of yellow," which I later learned was called the "Gold Coast." No longer can you call it that since collectors have taken Yellow Tangs.

I have witnessed algae increasing at many of the local reefs off of Kona, at the same time I've noticed a decrease of herbivore fish that once inhabited those reefs.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at h.beachchef@gmail.com

From: Marion Bennett
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 6:53:14 AM

Aloha Mr. Sakoda,

My name is Marion Bennett and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at marion_jones1954@yahoo.com.au

From:	JoAnn Bertram
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Wednesday, April 7, 2021 5:33:48 PM

Aloha Mr. Sakoda,

My name is JoAnn Bertram and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: I am a tourist to Hawaii and I am very concerned about this "harvesting" of reef fishes. One of the joys of visiting Hawaii is snorkeling and being able to see an abundance and a variety of reef fishes. Please stop this "harvesting". It damages the ecosystem and will strongly affect the willingness of tourists to come to Hawaii.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at bertram@wtechlink.us

From:	Angie Bezhenar
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Monday, April 5, 2021 1:45:11 PM

Aloha Mr. Sakoda,

My name is Angie Bezhenar and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native

Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

Unfamiliar with these reefs, but still concerned.

My additional comment: Kua bay reef is where I dive all the time and I would be devastated to see any harm come to that reef. Fish do not need to be pets. They need to be free.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Angiebezhenar@gmail.com

From: Rebecca Bicker
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 1:48:42 PM

Aloha Mr. Sakoda,

My name is Rebecca Bicker and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

My additional comment: I scuba dive almost daily in Maui.I have spent time diving in the Big Island as well. We need to protect our reefs from the depletion of fish. This is a natural resource , not a source for aquariums.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Rebecca1957@me.co

From: Lisa Bishop
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 1:09:27 AM

Aloha Mr. Sakoda,

My name is Lisa Bishop and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment: Friends of Hanauma Bay strongly opposes this revised Draft Environmental Impact Study (DEIS) aimed at reopening West Hawaii reefs to seven aquarium collectors to take over 246,000 fish every year for the pet trade. This revised DEIS fails to address most of the fourteen reasons that DLNR unanimously rejected the original DEIS submitted almost a year ago. Reef surveys spanning decades have documented significant impacts to species taken by commercial aquarium collectors. The most impacted species including Yellow Tangs, certain butterflyfishes, and other rare native fishes, experienced population declines ranging from 60 – 99% in the areas hardest hit by the trade. In 2018, when the trade was closed, that trend finally began reversing, and abundance of Yellow Tangs and other fishes began to come back. The unacceptably high mortality rates and inhumane practices of the Aquarium Pet Trade are tragic for Hawaii's marine wildlife. It is well past time to ban this horrible business!

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at lisa.fohb@gmail.com

From: Moana Bjur
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 1:40:09 PM

Aloha Mr. Sakoda,

My name is Moana Bjur and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at moana@conservehi.org

From: Paul Blessington
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Saturday, April 3, 2021 4:36:13 AM

Aloha Mr. Sakoda,

My name is Paul Blessington and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment: As a past resident of Kona from 2009 to 2019, I witnessed the decline of Big Island's reefs. From Mau Mai to Kiholo, the reefs have gone from predominantly healthy to predominantly unhealthy. In an age where fish can be bred in captivity, and at a time when the reefs are disappearing due environmental toxification and climate stress, it is barbaric to continue the practice of aquarium collection.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at paulblessington@gmail.com

From: GREGG BLUE BLUE
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 2:28:59 PM

Aloha Mr. Sakoda,

My name is GREGG BLUE BLUE and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native

Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment: PLEASE STOP THIS NEEDLESS DECIMATION OF OUR FISH AND ALL ITS EFFECTS ON THE ECO SYSTEM

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at gblue@hawaiiantel.net

From: Warren Blum
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 3:50:49 PM

Aloha Mr. Sakoda,

My name is Warren Blum and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment: I have been a working divemaster on Maui for the past 20 years. I have seen the fish population on our reefs decline from a number of factors, one of which is the fish collection industry for the aquarium trade.
Diving and snorkeling is a huge economic driver in the Hawaiian economy. We should protect it for all locals and visitors to the islands. Mahalo.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at dive4mantas@hawaii.rr.com

From: Nate Blumenthal
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 3:55:36 PM

Aloha Mr. Sakoda,

My name is Nate Blumenthal and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

North Kohala

Puna

Hilo

Hamakua

South Kohala

Unfamiliar with these reefs, but still concerned.

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at unet3661@gmail.com

From: Ryan Boerema
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 12:27:50 AM

Aloha Mr. Sakoda,

My name is Ryan Boerema and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

Hilo

South Kohala

Unfamiliar with these reefs, but still concerned.

My additional comment: Years back, 30+, just south of Kealakekua, I came across a number of Naso literatus 'herding'--there is no better term--almost a hundred smaller, younger orangespine unicornfish. I dove the same site recently and saw less than two dozen. My dive buddy, when I recounted this, told me it had been worse in recent years. Please don't put profit before the planet. This is going to be a tough century and we'll all, not just a few guys trying to make money, need help from nature.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at ryann1k2j@sbcglobal.net

From: Ted Bohlen
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 5:54:23 PM

Aloha Mr. Sakoda,

My name is Ted Bohlen and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: Hawaii Reef and Ocean Coalition (HIROC) is a group formed to address the crisis on our coral reefs. HIROC is deeply concerned about the impact of aquarium fishing on the our coral reefs, especially from taking of herbivores that clean the reefs and improve reef resiliency that is so needed with climate change. Maintaining the current level of fish biomass is insufficiently "sustainable" when reefs are in crisis. Dismissing the moratorium on herbivores alternative alone renders this DEIS inadequate.
I personally have substantial experience with EISs. In my opinion, this pet industry's DEIS is wholly deficient in its discussion of impacts of removing almost 250,000 fish each year, the benefits of alternatives, particularly the no action and no herbivores take alternatives, and mitigation, as required under HAR 11-200.1-24. Please reject this inadequate DEIS!
Hawaii Reef and Ocean Coalition (by Ted Bohlen)

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Tbohl8@yahoo.com

From: Anne Borman
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Sunday, April 4, 2021 5:46:46 PM

Aloha Mr. Sakoda,

My name is Anne Borman and I am a Part time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native

Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment: I vigorously oppose Aquarium Fish Collecting in the Hawaiian Islands. We have been visitors for over 40 years and now residents for over 15 years and have enjoyed the beauty and abundance of the reefs while snorkeling everyday. We have notice a big decline in the many reef fish species over the years and grateful the Aquatic fish collecting practice was stopped in 2018. The revised Deis does not address the environmental impacts on the reefs AND the fish themselves. Please do not allow Aquarium fish collecting in Hawaii. Thank you for your time.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at ahborman@gmail.com

From: Anne Borman
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Sunday, April 4, 2021 5:46:46 PM

Aloha Mr. Sakoda,

My name is Anne Borman and I am a Part time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native

Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment: I vigorously oppose Aquarium Fish Collecting in the Hawaiian Islands. We have been visitors for over 40 years and now residents for over 15 years and have enjoyed the beauty and abundance of the reefs while snorkeling everyday. We have notice a big decline in the many reef fish species over the years and grateful the Aquatic fish collecting practice was stopped in 2018. The revised Deis does not address the environmental impacts on the reefs AND the fish themselves. Please do not allow Aquarium fish collecting in Hawaii. Thank you for your time.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at ahborman@gmail.com

From:	Megan Bouch
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 5:50:44 PM

Aloha Mr. Sakoda,

My name is Megan Bouch and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high

mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Megan.concord@gmail.com

From: Don Bowers
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 7:49:59 PM

Aloha Mr. Sakoda,

My name is Don Bowers and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment: The taking of reef fish by the aquarium trade is no more than trophy taking to satisfy ego or obtain profit. It does not benefit nature. As bad as trophy taking is, in Africa the fees benefit the animal refuges and the remaining animals. Aquarium collecting benefits only the profit for collectors and the ego of customers. There is no benefit to nature. There needs to be give and take balance between mankind and nature.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Osuwelder@aol.com

From:	Tony Brioso
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 2:53:52 PM

Aloha Mr. Sakoda,

My name is Tony Brioso and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

North Kohala

South Kohala

My additional comment: I have been coming to Hawaii multiple times per year since 2016 and as a PADI scuba professional spend considerable time exploring Hawaiian reefs. Since the ban there has been slow increases in the number of fish. Please do not let the aquarium trade to again decimate the fish population. Our reefs are vital to our planet and fish are an important factor in having healthy reefs.
Sincerely, Tony Brioso

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at tbrioso@kaiserair.com

From: Harriet Burkholder
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Saturday, April 3, 2021 1:09:10 PM

Aloha Mr. Sakoda,

My name is Harriet Burkholder and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at hburkh@hotmail.com

From: JERI BURNSIDE
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 3:36:35 PM

Aloha Mr. Sakoda,

My name is JERI BURNSIDE and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

South Kohala

My additional comment: I have traveled to Kona many times to dive the reefs on the western side of the main island of Hawai'i, both from beach and boat. The beautiful abundance of fish species found there is the main reason divers like myself travel to Hawai'i, and even "common" species like yellow tangs, the various wrasses, and the surgeonfishes are an essential component of the unique Hawaiian SCUBA experience that draws divers from around the world. Allowing the resumption of taking these species for the aquarium pet trade would be a terrible mistake.

I am not only a SCUBA diver, but I also have a bachelor's degree in Biology; I have worked for several years as a diver volunteer for the Aquarium of the Pacific in Long Beach, CA, and for a time I also owned a retail pet store that sold tropical fish. Once I saw the terrible mortality and morbidity for the wild-caught marine tropical fish species due to the stresses of capture and shipping, I refused to stock those species in my shop. I only sold captive-bred freshwater species for that reason. A wild fish captured for the marine fish pet trade is very likely to die even before it makes it to the tank in a retail pet store; and even if it does survive long enough to be sold, its unique genetic makeup will never be available in the wild to contribute to the essential genetic diversity needed to maintain a robust, healthy wild population. Just because a species is abundant now, does not mean it will remain so in the future - especially with the looming issue of ocean warming and acidification and the potential loss of coral reef habitat.

There is NO compelling reason to condemn hundreds of thousands of wild fish to a certain genetic dead end and death in captivity. These fish are not feeding hungry people; they are simply ornaments in a collector's tank. Opening up the Hawaiian reefs to the hunting of "common" fish species for the tropical fish trade will undoubtedly feed the black market for forbidden species as well; who will be policing the collection bags of every hunter on the reef? How will you prevent the rare and threatened species from being taken as well? The answer is, you can't.

It's quite a treat for divers in Hawaii to catch a glimpse of a bandit angelfish or a Tinker's butterfly; but you can bet that once "legal" collecting of other species for the pet trade is permitted again, these rare species will become targets for the illicit rare fish trade. The prices that people are willing to pay for rare specimens will trump whatever laws are in place to protect them, and by opening up Hawaiian waters to hunting for the pet trade you will make the taking of these species even easier. https://reefbuilders.com/2021/02/10/10-rare-hawaiian-

aquarium-fish/

DO NOT re-open Hawaiian reefs to hunting for the pet trade. Protect the unique and exquisite populations of Hawaiian reef fish for future generations of divers and snorkelers to enjoy, and protect the genetic diversity and health of the species that make Hawaiian reefs a magnet for tourists from around the globe. Thank you.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at jeribrav@gmail.com

From:	Donna Burrows
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 10:54:51 PM

Aloha Mr. Sakoda,

My name is Donna Burrows and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at herder@flash.net

From: Michael Carlson
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 3:16:52 AM

Aloha Mr. Sakoda,

My name is Michael Carlson and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at mroneguy@gmail.com

From: Brent Carman
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 2, 2021 8:48:44 PM

Aloha Mr. Sakoda,

My name is Brent Carman and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at brent.a.carman@gmail.com

From: Lynn Chapman
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 2, 2021 6:43:10 PM

Aloha Mr. Sakoda,

My name is Lynn Chapman and I am a Part time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kohala

My additional comment: I snorkel a few days a week in Makawai Bay off the south Kohala Coast and over the last 10 years I have noted a definite decrease in colorful reef fish. These precious fish are a treasure and should not be exploited for commercial profit. I believe there should be a full, permanent ban on aquarium fish harvesting.
Lynn Chapman

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at sun2c303@gmail.com

From: Ryan Christopher
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 1:04:43 PM

Aloha Mr. Sakoda,

My name is Ryan Christopher and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kohala

My additional comment: I have been enjoying the reefs of the Big Island for over 20 years. I have personally seen the decline of the reefs first hand. Why would we exacerbate the problem by allowing 250,000 fish a year to be taken off our reefs. This will be profitable for a few people yet the entire island will suffer. What happens when the reefs are empty and tourists don’t want to visit any longer. This is a valuable asset we must protect.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Rcheisto808@gmail.com

From: Adam Clark
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 8:39:45 AM

Aloha Mr. Sakoda,

My name is Adam Clark and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

My additional comment: Adam Clark

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at adamclark@att.net

From: Jill Nadine Clements
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 8:08:48 PM

Aloha Mr. Sakoda,

My name is Jill Nadine Clements and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Puna

Hilo

My additional comment: I have been snorkeling and diving the Hawaiian islands since late ‘80’s
In just this last year I have seen a huge!!! Drop in fish-Kehei, Mauna Lani coast!!
Please think of the future for our children/Kekiki

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at nadinascremes@icloud.com

From: Vivian Cohen
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 10:51:38 AM

Aloha Mr. Sakoda,

My name is Vivian Cohen and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

South Kohala

My additional comment: Do not allow the aquarium trade to remove our fishes from their natural habitat. Snorkelers and divers come to see these wonders and have noticed the depletion. Aquaculture can satisfy the hobbyist. Leave our fishes to thrive in Hawaii.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Vhlcohen@msn.com

From: Radine Coopersmith
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 5:45:41 PM

Aloha Mr. Sakoda,

My name is Radine Coopersmith and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment: Return the golden coast.... we get a lot of money from Tourism that loves snorkelling and scuba diving... Healthy reef support the sport fishing industry as well. Spare our reef fish that do not help anything other than individuals interest Watching them through glass.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at konareefe13@gmail.com

From: Kacey Coyle
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Saturday, April 3, 2021 2:04:27 PM

Aloha Mr. Sakoda,

My name is Kacey Coyle and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at kach0035@umn.edu

From: Sarah Crawford
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 9:33:48 PM

Aloha Mr. Sakoda,

My name is Sarah Crawford and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

Puna

South Kohala

My additional comment: I began snorkeling and diving in West Hawaii as a visitor in 1990 and returned many times before moving to North Kona full-time in 1997. At that time, I had been certified as a rescue diver and later I became a divemaster. When my three children were old enough, each of them became divers, as well. Two are certified rescue divers and one is an advanced diver.

During my visits from 1990 to 1997, I noticed how the fish population dwindled with each visit. After becoming a resident and while earning my divemaster rating and beyond, the fish population became more and more sparse. As a result, other animals were affected -- many of the creatures underwater have symbiotic relationships with others. For example, cleaner wrasses clean the teeth and scales of other underwater animals. Yellow tang clean the shells of green turtles. I'm sure you've heard all this before, but it's a reminder that life underwater is delicately balanced.

Our oceans are under attack from many sources, from oceanic temperature increases to disturbances in the global conveyor belt, from widespread and devastating plastic and chemical pollution to industrial transnational overfishing, among others. I hope you realize that the ocean, which has served to save humans from so much of their carbon atmospheric pollution, and its native inhabitants need all the help we can give to make them healthy again. The good news is that the ocean can replenish its own riches if we stop interfering with destructive actions.

Please do all you can to minimize, or, better yet, eradicate the aquarium trade from Hawaii. We need the fish wild and in the ocean, not in tanks in doctors' offices and Chinese restaurants.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at scrawford2@aol.com

From:	lois crozer crozer
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 4:21:26 PM

Aloha Mr. Sakoda,

My name is lois crozer crozer and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: It's so sad to see the depletion of the fish because of climate change and pollution and then the added stress of aquarium collecting.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at lbc@hawaiiantel.net

From: Judith Cucco
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 10:30:39 PM

Aloha Mr. Sakoda,

My name is Judith Cucco and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: I have done more than 1,000 species and abundance survey counts for REEF on Oahu since 2010 and I have seen a trend of fewer fish and fewer species over time. The aquarium trade steals our natural resources and sells them for profit. We need to protect our fish from exploitation.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at myjet2@gmail.com

From:	Joe Culbertson
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Sunday, April 4, 2021 12:35:12 AM

Aloha Mr. Sakoda,

My name is Joe Culbertson and I am a Part time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

South Kohala

My additional comment: This industry is defined by waste and the drive to scarcity for increased value and profitability.
In pursuit of target species from the reef, the collector's 'pattern and practice' necessarily damages living coral and disrupts other living organisms as they plant and then move their feet and gear around the reef.
At every other step up the captivity chain, from puncturing swim bladders, to confinement in holding tanks, to shipping via air freight, losses are built into a market pricing system.
And according to a recent documentary film, 99% of all wild Hawaiian reef fish die within 1 year of taking and shipping overseas.
This is no sustainable fishery or for that matter, any kind of business plan…(except that the natural resources are free and unlimited after a $50 permit from the state!)

The 'tragedy of the commons' is on clear display by this industry.
Since no individual permitee knows to what extent other permittees are taking and perhaps approaching theoretical regulatory limits on a yearly basis, the 'tragedy of the commons' promotes unrestrained taking at every occasion by individuals when opportunities present themselves.
This motivation is deeply offensive and completely at odds with a conservation ethic of restraint built into centuries old Hawaiian cultural traditions.

Joe Culbertson

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at progreenery@gmail.com

From: Piper Davies
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 11:52:38 AM

Aloha Mr. Sakoda,

My name is Piper Davies and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Hamakua

My additional comment: Piper Davies. Just in the time of Covid the reefs were thriving with many more fish than when there are so many tourists.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at piperspirit@gmail.com

From:	Michael Denney
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Monday, April 5, 2021 1:26:12 PM

Aloha Mr. Sakoda,

My name is Michael Denney and I am a Part time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

My additional comment: Aquariums are nothing more than residential fish zoos that most owners lose interest in. Better to see colorful fish in their natural environment at Kahalu'u Bay.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Mtdenney@maine.rr.com

From:	Steven Dennis
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Saturday, April 3, 2021 3:36:51 PM

Aloha Mr. Sakoda,

My name is Steven Dennis and I am a Part time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Potter's Angelfish

Orangespine Unicornfish

Chevron Tang

Bird Wrasse

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

North Kohala

South Kohala

My additional comment: We are homeowners in South Kohala on the beautiful Big Island. We have been diving and snorkeling the reefs here since 1982. We also have a home aquarium on the mainland. We ONLY buy tank raised fish for our home aquarium and there is no reason why ever home aquarium owner can't do the same. On behalf of our 6 grandchildren, please protect our reef fish and reef eco-systems for all future generations of Hawaiians and visitors.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at oceansteward@hotmail.com

From: Fred Dente
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 5:28:47 PM

Aloha Mr. Sakoda,

My name is Fred Dente and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: I am a snorkeler and I see the barren and empty reefs, compared to just a few years ago. Do NOT allow the taking of any more reef fishes for aquarium collecting or for any other reason.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at koikoi1@hawaii.rr.com

From:	Suzanne Dmytrenko
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 5:36:21 PM

Aloha Mr. Sakoda,

My name is Suzanne Dmytrenko and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at sdmytrenko1@gmail.com

From: Russell Drakeley
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 9:13:29 AM

Aloha Mr. Sakoda,

My name is Russell Drakeley and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Hilo

South Kohala

My additional comment: Have been a regular visitor to Kona coast of Hawaii for three decades. Have explored these reefs as a diver many times and I'm appalled that DLNR would even consider overturning the ban. Yellow tang retail at over $450 each. There's a reason for this - they are nothing more than "trophies" to be collected by the morons that support the aquarium trade. Leave these fish where they are for benefit of the environment, the people of Hawaii and visitors to these islands - and not least for the fish themselves.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at russelld@cgr.co.uk

From: James Duff
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 2, 2021 7:54:46 PM

Aloha Mr. Sakoda,

My name is James Duff and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

Hilo

South Kohala

My additional comment: I am extremely concerned about the general situation of stripping the reefs of the only caretakers of the reefs health which are these fish people have been exhaustively removing for their short term personal gains. We are losing the reef caretakers for a few dollars to people who have made it their career. This is unacceptable and it has to stop. The fact is that nobody is doing anything to help these corals except for the reef fishes. The fish are the best caretakers of the coral reefs. I'm completely disgusted with the aquarium industry using these fish as their personal banking accounts. Free money for the taking with the assistance of the DLNR. The fact is that nobody needs the fishes more than the corals. Please Stop the theft of the keystone species of the coral reefs ecosystems.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Jaduff3@hotmail.com

From: Jeanne Duning
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 3:58:02 PM

Aloha Mr. Sakoda,

My name is Jeanne Duning and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: South Maui- I have noticed a marked general decrease in reef fish, especially the yellow tang over the 13 years I have been snorkeling and diving this area.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Mauijeep@gmail.com

From: medford dyer
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 5:07:54 PM

Aloha Mr. Sakoda,

My name is medford dyer and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kohala

South Kohala

My additional comment: There is no logical or rational reason that collecting of fish for aquariums should be allowed. Fish are a part of the 'aina and should be afforded at least the minimal protection of not being pulled out to go in aquariums. That this is even being debated is crazy in my opinion. Leave the fish where they legally, morally, and rightfully belong.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at med.dyer@gmail.com

From:	McKee Eileen
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Thursday, April 8, 2021 2:12:02 PM

Aloha Mr. Sakoda,

My name is McKee Eileen and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Meileen@yahoo.com

From:	Granger Eltringham
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 3:46:21 PM

Aloha Mr. Sakoda,

My name is Granger Eltringham and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native

Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at needlefishboy@gmail.com

From:	Kenzie Erickson
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 2:33:26 PM

Aloha Mr. Sakoda,

My name is Kenzie Erickson and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

Unfamiliar with these reefs, but still concerned.

My additional comment: Fish belong in the ocean. They should not be exploited, used and abused by humans.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Kenzington19@yahoo.com

From: Donald Erway Erway
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 2, 2021 6:44:21 PM

Aloha Mr. Sakoda,

My name is Donald Erway Erway and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at der1way@earthlink.net

From: Marjorie Erway
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Saturday, April 3, 2021 5:16:13 AM

Aloha Mr. Sakoda,

My name is Marjorie Erway and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar

with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment: I personally became aware at how many more Yellow Tang there were after the ban went into affect. I suppose they were more noticable because they are so colorful that they can be seen in waves as they're breaking in the deeper waters.
It's understandable that putting any businesses out of business, esp. right now during the very low economic problems the nation is having, but this fish collecting business absolutely needs to be stopped. Ocean water fish aquariums should not be filled with fish from Hawaii.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at merway@hawaii.rr.com

From: Michelle Estling
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 4:47:24 PM

Aloha Mr. Sakoda,

My name is Michelle Estling and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: In years past Molokini was abundant with every species of fish. These days certain species are seldom seen. Molokini used to have an abundance of Opihi and now you are lucky to see one. We are a Scuba diving and snorkeling shop and our livelihood and the ocean's ecosystem rely on a balance of all species of fish to keep the ocean healthy.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at merealty@maui.net

From:	Scott Fallon
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 2:29:09 PM

Aloha Mr. Sakoda,

My name is Scott Fallon and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: I have been a saltwater aquarium enthusiast in the past so I know firsthand that collection in the wild is unnecessary. Wild-caught fish have a very poor survival rate after capture--they end up being more expensive for hobbyists than aquacultured fish because so many purchased die prematurely (often within a week or two of purchase because of the trauma from their capture...which is not including the high death rate before even making it to hobbyists). With aquaculture of even iconic Hawaiian fish such as the Yellow Tang now successful there is simply no reason for wild-caught practices to continue. An aquacultured fish is more expensive than wild-caught, but not in the long-run given that it has a much, much higher survival rate, meaning the hobbyist is not constantly replacing dying fish (with more wild-caught fish that will then die in a never-ending cycle). If you also factor in the externalities (damage to reefs, etc.) the cost of wild-caught can no longer be justified when

aquaculture is now so hugely successful and environmentally friendly.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at scottfallon425@gmail.com

From: M Kim Ferris
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 8:25:38 PM

Aloha Mr. Sakoda,

My name is M Kim Ferris and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

South Kohala

My additional comment: I grew up on the island of O'ahu and as a young child could remember the many different species of fish that would swim in our coral reefs. I enjoyed each adventure snorkeling to marvel at this abundant marine life. As an adult now I live on the island of Maui. It makes me so very sad indeed to see that there are barely fish, if any at all living among the coral. Recently I Went snorkeling at a spot called, "Coral Gardens" in south shore Maui. It was once a beautiful, gorgeous reef; so colorful and full of life. Now it is literally a 'dead zone' - no fish and brown, dead coral. I oppose taking any marine life for commercial use from the ocean surrounding the Hawaiian islands.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at bluesky122355@yahoo.com

From:	Kathy Flynn
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 9:22:33 PM

Aloha Mr. Sakoda,

My name is Kathy Flynn and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at kflynnworks@gmail.com

From: Georgie Fong
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Saturday, April 3, 2021 3:55:26 AM

Aloha Mr. Sakoda,

My name is Georgie Fong and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kohala

Hamakua

My additional comment: Snorkeling and swimming with coral fishes is one of the most rejevenating activity. In my 20 years experience, I feel that the abundance of coral fishes has diminished by 50%.
Please protect our coral fishes, they are the steward of the health of the coral "ecosystem". Our coral fishes DESERVE to live their "God Given " Natural Free life in the ocean and NOT in a Glass container as a "JAIL FISH" for no CRIME committed other than to financially benefit a group of UNSKILL greedy people who wants to make money. Those people should acquire a skill and get a DECENT JOB.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at peppisascho@yahoo.com

From:	Judy Forehand
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Thursday, April 8, 2021 10:02:40 AM

Aloha Mr. Sakoda,

My name is Judy Forehand and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

Puna

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at 4handfarm@gmail.com

From: Neil Frazer
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 6:23:23 PM

Aloha Mr. Sakoda,

My name is Neil Frazer and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment: I have personally witnessed the decline in reef fishes over the last 40 years of my full-time residency at Kailua O'ahu. The decline of reef fishes in that time has been both striking and heart-breaking. We need these fish. Please put an end to aquarium fishing.

With regard to fishing generally, I would like you to know that since 1954 at least, fisheries economists have been vigorously pointing out that fishermen fish until their costs exceed their revenue. By subsidizing fishing in any way, we incentivize fishermen to fish longer and harder. In other words, if we want there to be any fish left in the sea, we should be taxing fishermen not subsidizing them. Moreover, there should be no fishing at all on the high seas.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at neilfrazer@icloud.com

From: Shirley Fritz
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 8:34:02 PM

Aloha Mr. Sakoda,

My name is Shirley Fritz and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

My additional comment: We swim at Kailua-Kona Bay where the number of fish has increasingly gone down.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at wsfritzz22@gmail.com

From:	Kevin Galloway
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Monday, April 5, 2021 2:36:10 PM

Aloha Mr. Sakoda,

My name is Kevin Galloway and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

Unfamiliar with these reefs, but still concerned.

My additional comment: As members of society we should take responsibility and ownership for our ecosystems especially in Hawaii where we cherish protecting our islands natural resources. The answer is so simple, we need to be putting our resources before someone making a buck. It is our duty and should be obvious, both morally and scientifically.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Kevin.Galloway.erau@gmail.com

From: benjamin garfinkle
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 2, 2021 9:47:16 PM

Aloha Mr. Sakoda,

My name is benjamin garfinkle and I am a Part time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment: I have dove/fished/snorkled in west hawaii constantly since 2005 and have seen the rapid decline in the reef quality /fish devisrsity/how much smaller the fish are and how few fish are here since I started diving here in 2005. I am on the board of the nature conservancy Hawaii and we study the science and fish counts and know how bad the situation is there is absolutely no need to open the aquarium trade to take fish that most die shortly after be taken this MUST stop premantely . We also have the science and data that shows that the TRY WAIT AREaA is improving very quickly since it was closed 3.5 years ago certain fish have recovered up to 40% since the closure we dove the try wait area this week and can first hand see the improvement in the ref/fish quantity and diversity

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at benjygarfinkle@mac.com

From: Emily Garland
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 12:44:16 AM

Aloha Mr. Sakoda,

My name is Emily Garland and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Hilo

South Kohala

My additional comment: I am an avid snorkeler. Snorkeling for me is a peaceful meditation that allows me to appreciate Hawai'i's underwater beauty. I have lived in Hawaii since 2015. Since the aquarium trade ended in 2018, I have noticed an increase in the number and diversity of marine life. Please help continue to protect this life and all the benefits it brings to Hawai' nei. Mahalo.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Emilygarland@gmail.com

From: JoAnn Garrigan
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 2:14:18 PM

Aloha Mr. Sakoda,

My name is JoAnn Garrigan and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Puna

Hilo

My additional comment: I am totally against this business on our island. I have recently visited 69 Beach, A bay, Hapuna and I have visited Hilo Beach recently. Fish types and amounts still look scarce. I have heard the stories about how it used to be This Island needs its beautiful reef fish left in, on, about their homes, their reefs. This is not a business that the island of Hawaii should be proud of. Wild fish belong in the sea. The stress of mailing them around the world to the mainland, wherever they are going, is reprehensible. Tourists and residents alike need to be able to see the beauty of the local reef fish while swimming in the waters. It's embarrassing when there is less to see when I take visitors to the beach to see our reefs. Leave the reefs and their cohort fishes to heal and to thrive and make Hawaii island a true paradise for all. JoAnn Garrigan 8089347153

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at joanngarrigan@gmail.com

From: Kevin Gavagan
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 12:25:33 PM

Aloha Mr. Sakoda,

My name is Kevin Gavagan and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

Hilo

Hamakua

My additional comment: This is nothing but exploitation of our natural resources. This activity adds nothing to our Economy and our marine environment pays the heavy price.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at kgavagan1@hawaii.rr.com

From: Judith Gentzel
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 5:50:44 PM

Aloha Mr. Sakoda,

My name is Judith Gentzel and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

South Kohala

My additional comment: Keei Beach in south Kona is a place where many folks enjoy snorkeling, fishing and surfing. The fish need to stay in our ocean. They are such an important part of the water habitat. If this is challenged with reef fish capture by the thousands, you tell me what the ecological benefits are. I do not know of any.
Sincerely, Judith Gentzel

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at judyannag@gmail.com

From: Venus Glavor
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 3:23:14 PM

Aloha Mr. Sakoda,

My name is Venus Glavor and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: I have lived in kihei maui for over 40 years and have seen the decline in all of these reef fish along all of maui's coast along with our reef. Please don't allow the mass taking of our reef fish.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Kumilei@aol.com

From: Cathy Goeggel
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 3:49:03 PM

Aloha Mr. Sakoda,

My name is Cathy Goeggel and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: When I dive on O'ahu, where I live, comparing the numbers and variations of fishes that I see, compared to 50 years ago, when I first came to Hawai'i- the loss of diversity and color is appalling. The DEIS does not offer any hope for the future health of the ocean. Please protect what your department is mandated to- without the ocean, Hawai'i will perish. Mahalo!

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at cathyg@animalrightshawaii.org

From: Janet Goodmanson
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 2, 2021 10:43:18 PM

Aloha Mr. Sakoda,

My name is Janet Goodmanson and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment: Please protect our reefs and underwater wildlife to the fullest extent.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at janetgoodmanson@gmail.com

From: Dan Gordon
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 12:12:09 PM

Aloha Mr. Sakoda,

My name is Dan Gordon and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment: What other wild animals do we trap and put in cages in our homes - because that is what the aquariums are they are cages. We feed foods to them that do not nourish them. Most of them die in transport or shortly after being bought. These fish are part of a very complicated environment that we are polluting enough as it is. Let them live wild!

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at dangordon360@gmail.com

From: Jamie Gottlieb
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 12:05:39 PM

Aloha Mr. Sakoda,

My name is Jamie Gottlieb and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Hamakua

Unfamiliar with these reefs, but still concerned.

My additional comment: Please continue to ban taking these fish. There is no reason to take them (other than $). Not banning would harm the fish, our reefs, and possibly make some of them be extinct.
We need Nature as it is.
Thank you.
Jamie

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Jamiegottlieb3497@gmail.com

From: Cat Gould
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 2:24:00 PM

Aloha Mr. Sakoda,

My name is Cat Gould and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: As an Australian who has spent the last 50 years on and off the Great Barrier reef I know full well the impact that collecting has made. Please protect the Hawaiian reefs, they need our protection now more than ever as they struggle with the impacts of climate change and pollution.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at cat1sun@yahoo.com

From: John Graves
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 9, 2021 10:06:25 PM

Aloha Mr. Sakoda,

My name is John Graves and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

South Kohala

My additional comment: I only came to Hawaii last year as a graduate student at UH Hilo, but I have been absolutely captivated by the beauty of this islands reef ecosystems. I am currently working on a project investigating the impacts of herbivores on reef resilience on the Kona coast. There is strong evidence from literature on coral reefs throughout the world, showing that herbivore abundance and diversity are not only fundamentally important indicators of reef health, but can also increase resilience in the face of anthropogenic pressures and coral bleaching. Our reefs are under pressure from pollution, agricultural runoff, plastic accumulation and especially increased sea surface temperatures. The negative impacts of the aquarium trade on targeted species far outweigh the economic benefits. The moratorium on the aquarium trade is one of the few bright spots for coral conservation here in Hawaii, and I urge the DLNR to keep this ban in place so that our reef ecosystems here may continue to thrive for generations to come.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at graves22@hawaii.edu

From: Michael Greenspan
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 8:26:52 PM

Aloha Mr. Sakoda,

My name is Michael Greenspan and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment: I have been coming to Hawaii since 1981. I would say the fish population has diminished by at least 80% since that time on the reefs that I snorkel. Back then clouds of all types of fish were present. Now it is so sad what has happened. Hardly any fish left. If the tropical fish collecting is allowed to continue, there will be no fish left in the ocean. How could anyone let this happen, knowing how the hawaiian people depend on fish for food! There has been a slight uptick in fish at Mahukona beach park in North Kohala where I snorkel mostly, but hardly noticeable. It will probably take decades to bring the number of fish back to where it was in l981. And even then the hawaiian people were telling me how much the fish have gone away. How can we let a few people rape our beautiful fishes for there profit and leave the rest of us citizens with nothing to see in the ocean anymore and no fish to reproduce new fishes. Please stop this destructing business from ruining Hawaii's tourist industry, because if there are no fish who will come here to dive and snorkel. Also I used to snorkel around the Mexican rivera back in the day and this has already happened there, no fish left at all, and all the reefs are dead. Please protect Hawaii from this horrible threat. Thank you for your consideration.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at vcarmg@gmail.com

From:	Edward Grella
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Wednesday, April 7, 2021 9:37:17 PM

Aloha Mr. Sakoda,

My name is Edward Grella and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: Please keep the reef beautiful and don't fill pockets of greedy business owners

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at elg275@yahoo.com

From: Laura Grote
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 1:55:37 PM

Aloha Mr. Sakoda,

My name is Laura Grote and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment: When speaking with long time residents, I heard stories of watching the populations of fish decrease by the year. I myself document the bleaching and death of coral reefs. THE PLANET DEPENDS ON ITS DELICATE ECOSYSTEM. We al need to work together, as a system.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at lauraagrote@gmail.com

From: Gregg Gruwell
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Sunday, April 4, 2021 11:13:12 PM

Aloha Mr. Sakoda,

My name is Gregg Gruwell and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hamakua

South Kohala

My additional comment: I have been snorkeling Kona since 1988 I moved to Kona in 1999. Being a US Naval Officer for 14 years, I think I am a good judge of what I see. And that is 75%+ of the Aquarium collected fish are gone. I just had friends visit from Seattle. From Captain Cook, to North Kohala, they snorkeled and were saddened and shocked by the lack of fish.

This will affect our post Covid economy. Kona was once the Gold Coast but that gold has been extracted by the aquarium trade.

Please stop this practice once and for all!

Mahalo -
Gregg Gruwell, Kamuela

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Starriderhi@hotmail.com

From: Matthew Gurewitsch
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 5:18:52 PM

Aloha Mr. Sakoda,

My name is Matthew Gurewitsch and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

South Kohala

My additional comment: I have lived in Hawaii full time for ten years. During this time, I have seen fish populations on Maui (where I snorkel at least 300 days a year) and the Big Island (which I visit occasionally) dwindle--in all too many cases to the point of complete disappearance. On no account should we stand idly by while our aina is plundered. Nor should we condone the ongoing attempts of short-sighted commercial interests and their self-serving, transparently specious "Environmental Impact Statements" to whitewash their extractive, unsustainable, selfish practices.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at matthew@alohaheights.com

From:	Gary Gustafson
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 6:57:19 PM

Aloha Mr. Sakoda,

My name is Gary Gustafson and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar

with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment: The revised draft DEIS does not include consideration of using private aquaculture facilities to propagate tropical fish for aquariums instead of allowing aquarium collectors to adversely impact wild fish stocks. In addition, the impacts of aquarium collecting on endangered monk seals and the sport fishing community need to be more thoroughly described.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at gusnlinda@gmail.com

From: Linda Gustafson
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 6:43:42 PM

Aloha Mr. Sakoda,

My name is Linda Gustafson and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar

with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

My additional comment: The amount of tourism and dollars that come from people viewing reef fish and the joy they bring far outweighs the few people who benefit from aquarium collecting. Don't spoil reef fish viewing for many so a few can make money and destroy this wonderful resource of the sea!

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Lkaygus@gmail.com

From: Geoffrey Hajim
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 1:38:13 AM

Aloha Mr. Sakoda,

My name is Geoffrey Hajim and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

Puna

Hilo

Hamakua

South Kohala

My additional comment: With the reef system under stress from climate change, now is the time to shut down all industries that have negative impacts on the reef!

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at hajim@hawaiiantel.net

From: Taylor Hall
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 9, 2021 12:47:58 AM

Aloha Mr. Sakoda,

My name is Taylor Hall and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment: I've witnessed fish diversity all over the reefs of Oahu, and outer islands, disappearing and I'm gravely concerned. We need to protect our fish and reefs before it's too late!! Our government must take action now to stop the damage that is being done by aquarium trade.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at tylrspice@aol.com

From:	Suzanne Hammer
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Thursday, April 8, 2021 12:27:46 AM

Aloha Mr. Sakoda,

My name is Suzanne Hammer and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

North Kohala

Hamakua

My additional comment: I have been swimming snorkeling daily in Hawaii for forty five years 25 of those every am in Hanauma Bay where aquarium hunters even come at night and take fish
I have swam Honolulu, Kailua , Waimanalo and Hanauma Bay in succession and outer island occasionally
I have watched the take of fish and have experienced the robbing of our reefs
Chevron butterfly fish, reticulated butterfly fish, and pyramid butterfly fish all taken

The aquarium hunters seem interested in money and have the political connections to ravage Hawaiian waters to depletion without allowing the reefs to rebound
It is tragic for those of us watching the devastation this practice causes

Suzanne Hammer MD

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Suzannehammer@mac.com

From: Suzanne Hammer
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 12:28:05 AM

Aloha Mr. Sakoda,

My name is Suzanne Hammer and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

North Kohala

Hamakua

My additional comment: I have been swimming snorkeling daily in Hawaii for forty five years 25 of those every am in Hanauma Bay where aquarium hunters even come at night and take fish
I have swam Honolulu, Kailua , Waimanalo and Hanauma Bay in succession and outer island occasionally
I have watched the take of fish and have experienced the robbing of our reefs
Chevron butterfly fish, reticulated butterfly fish, and pyramid butterfly fish all taken

The aquarium hunters seem interested in money and have the political connections to ravage Hawaiian waters to depletion without allowing the reefs to rebound
It is tragic for those of us watching the devastation this practice causes

Suzanne Hammer MD

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Suzannehammer@mac.com

From: Phyllis Hanson
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 12:59:50 PM

Aloha Mr. Sakoda,

My name is Phyllis Hanson and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

My additional comment: This has been an ongoing battle since I moved here, in 1988. It's ridiculous to think 1000s of fish can be removed from our near waters without an impact. It's also ridiculous that a few people should benefit (from fish collecting) at the expense of the many people who live or visit this area.
Please, do NOT open this area up to more commercialization.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at HawaiiSkier@hotmail.com

From: Dan Harrang
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 5:22:50 PM

Aloha Mr. Sakoda,

My name is Dan Harrang and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Orangespine Unicornfish

Bird Wrasse

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: Neither the arguments pro or con mention that up to 2/3 of the fish (or more) may die in transit; yet it's still profitable for the shippers to take as much as they can. A few individuals take what belongs to all of us. And, removing just a few species can cause a reef community to collapse. This is proven!

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at danharrang@yahoo.com

From: Penelope Hazzard
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 4:40:11 PM

Aloha Mr. Sakoda,

My name is Penelope Hazzard and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

Puna

My additional comment: Again, this is of little economic benefit to Hawaii, and benefits very few residents. Meanwhile the damage may be irreparable.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at pennyhazz@yahoo.com

From: Jeannette j Heidrich
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Sunday, April 4, 2021 7:28:41 PM

Aloha Mr. Sakoda,

My name is Jeannette j Heidrich and I am a Part time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

North Kohala

South Kohala

My additional comment: We live on the Kona Coast. We have seen fewer fish on these reefs over the last several years. Only recently, has the population shown a slight increase. These fish are needed for the health of the reef. these fish are needed for the economy of Hawaii, so that tourists will come visit the state to see the beautiful fish IN THE WATER

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at jheidrich@mac.com

From:	Karen Heifet
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Wednesday, April 7, 2021 3:08:42 PM

Aloha Mr. Sakoda,

My name is Karen Heifet and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: I have seen a decline in fish at Molokin and south Maui snorkeling areas over the 21 years I have lived here. Please protect our reefs and fish from commercial selling of tropical fish.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at chetandkaren@gmail.com

From: Vicki Hendrix
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 9:14:10 AM

Aloha Mr. Sakoda,

My name is Vicki Hendrix and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment: I have seen decline over the years and am very concerned about the possible impact of future removal.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Vicki.hendrix@gmail.com

From: david hill
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 2:55:21 PM

Aloha Mr. Sakoda,

My name is david hill and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at dph0277@gmail.cm

From:	Ryan Hill
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Friday, April 9, 2021 9:00:23 PM

Aloha Mr. Sakoda,

My name is Ryan Hill and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Potter's Angelfish

Orangespine Unicornfish

Chevron Tang

Bird Wrasse

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kohala

My additional comment: Puako reefs have less and less diversity of fish.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Ryan.a.hill04@gmail.com

From: Scott Hill
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 9, 2021 9:27:08 PM

Aloha Mr. Sakoda,

My name is Scott Hill and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kohala

My additional comment: Puako reef needs to maintain its reef abundance and diversity. 246,000 reef fish per year for aquariums seems like too much. I also think reef fish should not be caught for food either.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at scott.david.hill@gmail.com

From:	Fern Holland
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 3:28:21 PM

Aloha Mr. Sakoda,

My name is Fern Holland and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: As a scientist with a marine biology major and a thorough understanding of the importance of healthy fisheries and marine ecosystems I am gravely concerned about the survival of Hawaii's coral reefs and the species that inhabit them.

As a Kaua'i resident who has supported the subsistence fishing project on our far north shore and in recent years, due to decreased impact, have seen (and heard a great deal about) the increased abundance and assemblage of fish already returning in a short period to this area. This has given me renewed hope that correct management can strengthen fisheries and species chance of survival in even a short period of time.

I am very concerned about the failure of this DEIS to properly assess the true impacts associated with the aquarium trade in our waters. The revised DEIS fails to acknowledge the depletion of natural abundance the trade has caused, and would continue to cause, as well as all the impacts that result from that depletion.

The DEIS fails to include the scientifically proven impacts of collection for the aquarium trade as though their stance is the totally inaccurate position that depleted abundance is now the new natural state of our reefs.

Reef surveys spanning decades have documented significant impacts to species taken by commercial aquarium collectors. The most impacted species including Yellow Tangs, certain butterflyfishes, and other rare native fishes, experienced population declines ranging from 60 – 99% in the areas hardest hit by the trade. In 2018, when the trade was closed, that trend finally began reversing, and abundance of Yellow Tangs and other fishes began to come back.

Without an increase in fish abundance, the entire fisheries have decreased resilience and the impacts of climate change are likely to be far worse. In a time where our marine ecosystems and fisheries are under such extreme pressure it is completely irresponsible to approve an assessment that falls so short of providing an accurate reflection of the true impact of this industry on our fisheries.

Thank you for your consideration,

Fern

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at fernnygirl@yahoo.com

From:	Ryan Holmboe
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Saturday, April 3, 2021 8:16:32 PM

Aloha Mr. Sakoda,

My name is Ryan Holmboe and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar

with in the following Hawaii Island district(s):

North Kona

South Kona

South Kohala

My additional comment: I can't support the fish collecting industry, that takes important creatures from the natural reefs for purely selfish reasons, and monetary gain. As a local scuba diver that has been diving on the local reefs of the west coast for 10 years I've seen the special/rare species disappear and not return. I can't see any compelling argument for any continued fish collecting for the aquarium trade.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at ryan@jacksdivinglocker.com

From: Mark Howard
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 9:07:05 PM

Aloha Mr. Sakoda,

My name is Mark Howard and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Chevron Tang

Bird Wrasse

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment: I am a long time diver and SCUBA instructor and have been diving Hawaii for over twenty years. I own a house in Wailuku. My son is a marine scientist - graduated UH Hilo'09. We have seen firsthand the effects of commercial exploitation of reef fish, such as yellow tangs, and how that adversely affects reef health. There is no reason to have commercial reef fish collection anywhere in Hawaii. 90% of captive fish never see a mainland owner - and even there, can expect a very short lifespan. We have maintained saltwater tanks, and I can tell you it difficult to maintain a healthy environment for a small group of fish; much less hundreds. Please do not allow senseless exploitation of my granddaughter's future.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Howard4113@msn.com

From:	Alice Hughes
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Saturday, April 3, 2021 12:01:46 PM

Aloha Mr. Sakoda,

My name is Alice Hughes and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Alicehughes009@yahoo.com

From: Brent Humble
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Monday, April 5, 2021 1:12:24 PM

Aloha Mr. Sakoda,

My name is Brent Humble and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment: 40 years ago when I would snorkel the reef would be teaming with fish and I've seen a drastic decline over the years. I've seen more species showing back up and the aquarium collection trade is no longer appropriate here in Hawaii

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at kapihanafilms@hotmail.com

From: David Hunt
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 10:18:01 AM

Aloha Mr. Sakoda,

My name is David Hunt and I am a Part time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment: Stealing and enslaving our native reef fish for the ignorant "enjoyment" of non-islanders is unethical and barbaric. Our reefs and our reef fish have inherent RIGHTS to live and thrive without suffering the consequences of human greed and ignorance.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at davidjameshunt@hotmail.com

From: Jacqueline Hunter
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 5:19:12 PM

Aloha Mr. Sakoda,

My name is Jacqueline Hunter and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: If you touch these fish I am going to commit a HECKIN murder because seriously?? Leave the fish alone. No fish mean less food for predators. No fish means more algae and other things they eat. If you fuck up this food chain you're further fucking up the ocean and I *will* be outraged because how *dare* you ruin these regions for the generations to come, for the people who like to swim and see the fish now, just so someone can capture twenty fish (most of which will die in the process) and someone else can have a pwetty wittle fishie in their tank that'll probably die in a few weeks. They belong in Hawaii. Keep them there.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Theawesomegilbird27@gmail.com

From: Betsy Jewett
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 2:14:12 PM

Aloha Mr. Sakoda,

My name is Betsy Jewett and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Chevron Tang

Bird Wrasse

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

My additional comment: It has been a great joy to see more numbers and larger specimens of many reef fish we love and watch during our snorkeling swims. We now want to snorkel on the reefs more than ever!

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at betsyjewett@gmail.com

From: Mary Johnson
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 10:01:44 AM

Aloha Mr. Sakoda,

My name is Mary Johnson and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

Puna

Hilo

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at mlj626@att.net

From: Gary Johnson
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 7:07:42 PM

Aloha Mr. Sakoda,

My name is Gary Johnson and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the animal welfare issues and unacceptably high

mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment: I have lived on Maui for 8 years and snorkel neatly everyday. It is shocking how few fish are left .Permitting
profit by further loss of fish is spalling and will also impact tourism. Tourists ask me where are the fish? I have to say I am sorry.
Please don't sell our fish to aquariuns

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at southmauiinventor@gmail.com

From: Jennifer Johnson
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 3:13:42 AM

Aloha Mr. Sakoda,

My name is Jennifer Johnson and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Jlrider@hawaii.edu

From: mark johnston
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 2:43:15 PM

Aloha Mr. Sakoda,

My name is mark johnston and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at mark_johnston01@yahoo.com

From: Makana Kadooka
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 2:36:31 AM

Aloha Mr. Sakoda,

My name is Makana Kadooka and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at kkadookie55@gmail.com

From: Etta Karth
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Monday, April 5, 2021 6:21:12 PM

Aloha Mr. Sakoda,

My name is Etta Karth and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment: As a resident and employee on the Island of Hawaii I've followed the fish collecting situation since about 2006.

The laws that are already in place for these fish and many many other biota have not and are not being enforced very well. I know people who break the rules all the time. Even if someone like me reports violations, its rare that the authorities act on it, especially if locals are violating these rules :/

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at mamanirvana4@gmail.com

From: Donna Kauhane
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 2:54:59 AM

Aloha Mr. Sakoda,

My name is Donna Kauhane and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high

mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: As a fifty plus year resident of Maui, I have seen how the reef and fishes have changed over the years. Please be a force for the good of Hawaii's natural beauty and living treasures. Please do not allow the aquarium trade to continue to deplete our wonderful fishes. Please reinstate the ban on taking these beautiful creatures from their home here in Hawaii.
Mahalo.
Donna Kauhane

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at donnakauhane@hawaii.rr.com

From: Karina Keith
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Monday, April 5, 2021 2:29:06 PM

Aloha Mr. Sakoda,

My name is Karina Keith and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

South Kohala

My additional comment: Taking this many fishes from their natural habitat will disrupt the beautiful and natural state of our reefs which we continue to work so hard to protect because we know how important they are for not only the marine life but for the human life on the island as well.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Karina_k10@yahoo.com

From: Anita Kelleher
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 1:32:06 PM

Aloha Mr. Sakoda,

My name is Anita Kelleher and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment: Anita Kelleher

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Anitakelleher@me.com

From:	Cynthia Kennedy
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Wednesday, April 7, 2021 2:00:15 AM

Aloha Mr. Sakoda,

My name is Cynthia Kennedy and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at cgpunihaole@gmail.com

From:	Kathryne Kent
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 5:10:29 PM

Aloha Mr. Sakoda,

My name is Kathryne Kent and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

My additional comment: Please stop this barbaric practice of taking and selling our beautiful reef fish. It's outrageous to have a business like this still being considered in these days of climate change and coral die off. Enough!!

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Kksolar@lava.net

From: Risa Kuroda
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 9, 2021 5:01:00 PM

Aloha Mr. Sakoda,

My name is Risa Kuroda and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: Adjusted to 2019 dollars, Hawaii's coral reefs were estimated at a conservative $14.8 billion, bringing $534 million per year directly to the state and the tourism industry just by the fact of the reefs being there and alive. https://scholarspace.manoa.hawaii.edu/bitstream/10125/2723/1/vol58n2-231-242.pdf. Majority of all coral reefs globally are also expected to die off in the next century, and the aquarium industry simply need not exacerbate ecological collapse and hinder Hawaii's long-term economic recovery in the aftermath of COVID-19. These environmental and economic externalities are not adequately outlined in the DEIS. If this industry is to be supported by the state, they must positively contribute to the state or else it is just embarrassing sanctioning of highway robbery.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at kurodar@bc.edu

From:	Alexis Iacuzzo
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Monday, April 5, 2021 11:58:42 PM

Aloha Mr. Sakoda,

My name is Alexis Iacuzzo and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment: I work on boats doing ocean tours along the Kona coastline. I frequently dive and snorkel many reefs in a 20 mile stretch along the coast. In the 6 years that I've lived here, I have noticed a decline in fish. I always love pointing out the "Gold Coast" of yellow tang and will tell my guests how amazing it is to see the large schools of bright yellow. Then when I am in the water to show, my heart sinks to see such small clusters. Some schools are less than 10 fish.
I've had guests comment frequently how they are amazed at how much less fish are here than 5, 10 , 15, 30 years ago. There is absolutely no sustainability for our reefs. Here is also minimal to no enforcement of boats , public and private. From engaging n illegal activities. When someone does get caught, it ends up being such a minimal fine that there is no reason to even worry about being caught.
We are destroying Hawaii. We need to take responsibility and start acting differently to preserve the beauty of Hawaii.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Aliiacuzzo@yahoo.com

From: Wendy Lafer
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 9:31:02 PM

Aloha Mr. Sakoda,

My name is Wendy Lafer and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment: Scientific data clearly supports severely limiting or eliminating tropical fish collecting during current climate change. The misbehavior of those in the aquarium business have added to the egregiousness of the situation. As a user of the reefs, I can attest to the almost complete devastation of living coral during this year and previous years. The ocean as a food source is considerable while the necessity for catching fish for aquariums is an unnecessary devastation that should not be allowed during these current conditions.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at refalydnew@yahoo.com

From: Sally Lambert
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 2:37:18 AM

Aloha Mr. Sakoda,

My name is Sally Lambert and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment: I have spent 45 years in the ocean around Kona and Kohala. I have enjoyed snorkeling among the coral reef and shorelines of this area where I have observed the beauty and behaviors of these and other marine animals.
It is difficult to understand why the DLNR is once again considering an unacceptable DEIS from fish collectors whose economic needs will never be more important than the ecological need to keep these fish where they have been born and should continue to live out their lives. There is no reason that anyone should feel they have a right to remove these fish from their reef. They obviously need our protection and the pet trade will have to survive without these White List species.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at sjlambert@hawaiiantel.net

From: Antoinette Lang
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 9:27:45 AM

Aloha Mr. Sakoda,

My name is Antoinette Lang and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

North Kohala

Puna

Hilo

South Kohala

My additional comment: I am concerned with all the reefs in Hawaii. I lived on big island for 15 years and my friend witnessed from her home people coming withlarge tanks on a truck and stealing fish in the middle of the night from Kapoho reefs Wai'Opea. This reef was a preserve which is now covered in lava. Please stop these people from taking what few fish are left.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at antoinettelang@yahoo.com

From: Nicole Larson
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 11:38:32 PM

Aloha Mr. Sakoda,

My name is Nicole Larson and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at nicole4oceans@gmail.com

From:	Geoffrey Lauer
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Thursday, April 8, 2021 6:13:06 PM

Aloha Mr. Sakoda,

My name is Geoffrey Lauer and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar

with in the following Hawaii Island district(s):

Hilo

My additional comment: Hawaii's Dept. of Land and Natural Resources (DLNR)issued a revised draft EIS with comments welcome through April 9, 2021.

This EIS is deeply flawed and does NOT SUPPORT the need, cost, impact, sustainability, cultural considerations, or rebound of fishes since the closure of 2018.

Specifically the EIS:
1) still denies the scientifically proven, significant NEGATIVE impacts of aquarium collection in West Hawaii
2) FALSELY and with the weakest evidence (if any) Claims that taking over 246,000 fish each year won't cause population declines
3) FALSELY Claims there would be no adverse natural, socio-economic, or cultural impacts that need addressing
and
4) Disregards that the largest surge in Yellow Tang abundance ever documented resulted from the closure of West Hawaii to aquarium collection in 2018

Leave the reefs to recover and be a natural and wonderful resource to us all.

Geoffrey Lauer

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at gmlauer@gmail.com

From: Brian Lawes
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 1:00:38 PM

Aloha Mr. Sakoda,

My name is Brian Lawes and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Brlawes@gmail.com

From: Laura Legge
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 7:23:50 AM

Aloha Mr. Sakoda,

My name is Laura Legge and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar

with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: Please, the time left to do the right thing is NOW. We need all our reefs protected to save our beautiful coastal waters, and the health of our oceans, for the generations to come.
I'm an avid diver who spends a lot of money on Hawaiian small businesses supporting my beloved time in the ocean. How will these family owned businesses be impacted if our reefs are depleted?
Do the right thing NOW and let's stop this irresponsible trade. Do NOT let future generations look back at ours in despair wondering why we didn't malama aina/kai when we had the opportunity to do so.
Mahalo

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Laura.k.Legge@roadrunner.com

From: Shelby Leicher
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 2:10:13 PM

Aloha Mr. Sakoda,

My name is Shelby Leicher and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

My additional comment: As a Scuba Diving professional, my livelihood depends upon the multi-million dollar diving business that only flourishes if our reefs flourish. Hawaii stands to make much more money by keeping its fish in their ocean where they belong so tourists can come see them in their wild beauty - not in an aquarium.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at shelbyj67@gmail.com

From: Sammarye Lewis
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 2, 2021 8:04:52 PM

Aloha Mr. Sakoda,

My name is Sammarye Lewis and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Hilo

South Kohala

My additional comment: Extinction is forever! When the coral reefs are gone because of greed and profit, the ocean and it's creatures will die... When the Ocean dies, we die...

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at sammarye@gmail.com

From:	Sammarye Lewis
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 6:56:05 PM

Aloha Mr. Sakoda,

My name is Sammarye Lewis and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

Unfamiliar with these reefs, but still concerned.

My additional comment: Remember: Extinction is Forever.... When the Oceans die, we die

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at sammarye@gmail.com

From: Kurt Lieber Lieber
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 11:40:29 AM

Aloha Mr. Sakoda,

My name is Kurt Lieber Lieber and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high

mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment: I have been scuba diving in the waters around Kona since 1984. I'm a photographer and have been distraught by the change in reef fish abundance. In the 80's I'd see Yellow Tangs in schools of hundreds. Large parrot fish, where now I haven't seen a 3 footer in a decade, at least. Another fish that has disappeared is the Flame Angel, used to see several on each dive and now it is big news if I see just one! The lack of the herbivores is leaving the corals with no defense against invasive sea weeds, and in some spots you can see large mats of the stuff smothering the coral heads. Because of the decline in abundance I stopped visiting Hawaii in the 90's. My friends and I went to places that had better protections for the reef fish, places like Fiji, the Philippines, the Maldives and Australia. I don't feel that your evaluation of the costs that the aquarium trade have on dive tourism takes in to account all of us that have taken our dollars elsewhere. I started going back to Hawaii in 2016 because I decided that I want to help the place that has fascinated me since my first dive there in 1984. Please do NOT allow any take of the reef fishes anymore. I visit Kona 3-4 times a year now, and can see glimpses of what it used to look like. I hope my kids and grand-kids get the opportunity to witness the beauty of the Hawaiian underwater world.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at kurt@oceandefenders.org

From: PaulaKay Lindauer
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 2, 2021 6:53:11 PM

Aloha Mr. Sakoda,

My name is PaulaKay Lindauer and I am a Part time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

Hilo

Hamakua

South Kohala

My additional comment: I have property in Hawaiian Acres. I love the Hamakua coast and all the big island. I believe that none of these fish should be taken for any type of pet trade. I heard they are now breeding fish just for aquariums so the wild are left alone. I have a friend from Hawaii who lived in the mainland for years. He used to buy rare fish and have them sent in the mail and when he was done with his aquarium, he just flushed them down the toilet. Cruel. Just plain cruel. We need to save these fish.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at pklindauer@sbcglobal.net

From: Jodi Loetscher
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 8:52:10 AM

Aloha Mr. Sakoda,

My name is Jodi Loetscher and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: I am just concerned that human beings care more about their superficial desires than they do about preserving the planet and it's wildlife.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at jodinmike1@comcast.net

From: Meizhu Lui
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Monday, April 5, 2021 1:40:04 AM

Aloha Mr. Sakoda,

My name is Meizhu Lui and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kohala

Hamakua

My additional comment: As we try to make an economic recovery, tourism will still be important. A main attraction is our beautiful and diverse species of fish. Let fish lovers come and see the fish in their native habitats; a much better than owning a few and watching them swim circles in a tiny tank. And rather than allowing just a handful of collectors to make money by exporting this important resource, let the many who work in the tourism industry keep their jobs in part because people want to come and enjoy our waters and the life that is naturally teeming within it.

For locals and tourists alike, it was wonderful to see the yellow tangs return to Mahukona. Many of us also swim at Laupahoehoe Point where fish are not as abundant as they could be. We are critical of other countries for their trade in endangered or wild animals; we need to be mindful of the harm we do to nature ourselves when we allow the balance of nature to be upset. Please do not allow the return of the aquarium trade!

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at meizhului@gmail.com

From: Lyn N
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 5:37:15 PM

Aloha Mr. Sakoda,

My name is Lyn N and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at lynn_kapolei@hotmail.com

From: Diana Madaras
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 2:21:22 PM

Aloha Mr. Sakoda,

My name is Diana Madaras and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

Unfamiliar with these reefs, but still concerned.

My additional comment: Where are the Yellow Tang?

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at madaras@maui.net

From: Elizabeth Mantone
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 10:07:16 AM

Aloha Mr. Sakoda,

My name is Elizabeth Mantone and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at mantonee52@gmail.com

From: Cheryl Manuel
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 11:52:24 PM

Aloha Mr. Sakoda,

My name is Cheryl Manuel and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at cherylseals25@gmail.com

From: Matthew Martin
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 9:18:24 PM

Aloha Mr. Sakoda,

My name is Matthew Martin and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at m.g.martin222@gmail.com

From:	Marty Martins
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 2:52:59 PM

Aloha Mr. Sakoda,

My name is Marty Martins and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Chevron Tang

Brown/Lavender Tang

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

South Kohala

My additional comment: I have snorkled the ‘Ulua-Mokapu reef on Maui since 1999 and have watched the number of reef fish, especially Yellow Tang and Moorish Idols, diminish to where there are no Yellow Tang left. I know trappers are to blame.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at mauihakuaina@gmail.com

From:	Nancy Maupin
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Wednesday, April 7, 2021 9:27:38 PM

Aloha Mr. Sakoda,

My name is Nancy Maupin and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

South Kohala

My additional comment: I have been snorkeling at Makaiwa and Waianae Bays for years and have seen a steady decline in the reef fish populations. This not only affects the tourism but the health of the reef as well.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at nancy.maupin@yahoo.com

From: alma mcgoldrick
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 9:29:04 PM

Aloha Mr. Sakoda,

My name is alma mcgoldrick and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native

Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

My additional comment: I have snorkeled many of the Hawaiian Island reefs for 50 years and have been concerned for many years past to see the lack of reef fish in many places, not just Hawaii island. why should aquarium fish hunters be allowed to steal the fish that are needed for balance and care of the reefs, cleaning them from algae etc?? With seas warming and coral bleaching even more need to keep the fish on the remaining reefs
Often the fish taken die before they even reached the mainland. and they are treated to horrible conditions on the way.
Its is no good giving half measures, the takers will not police themselves with how many they take.
I think there MUST be complete ban on all taking of fish from the reef for aquariums. let the people who do this take their boats instead for tourists and locals to snorkel and watch the fish

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at almabmcgoldrick@gmail.com

From: Michael McGuire
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 2:48:53 PM

Aloha Mr. Sakoda,

My name is Michael McGuire and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

North Kohala

South Kohala

My additional comment: Save our reefs by saving our reef fish! we need them in Hawaii on our reefs more than in a aquarium.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at mikemcguire87@msn.com

From:	Peter Meechan
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Wednesday, April 7, 2021 8:24:49 AM

Aloha Mr. Sakoda,

My name is Peter Meechan and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native

Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment: We have seen fish stocks and the reef diminished on our local reef Ke'ei and all along the West Coast.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at emailpetermeechan@yahoo.co.uk

From: Matt Meier
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 3:09:32 PM

Aloha Mr. Sakoda,

My name is Matt Meier and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at meiermatthew@hotmail.com

From: Justice Meza
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 9, 2021 6:02:23 PM

Aloha Mr. Sakoda,

My name is Justice Meza and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

South Kohala

My additional comment: This is a ridiculous and reckless proposition. You would trade the eternal Beauty and betterment of our planet in exchange for a few years of a fish tank. This goes against the very spirit of our ancestors.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Jst.meza@gmail.com

From: Kyle Millar
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 2:44:25 PM

Aloha Mr. Sakoda,

My name is Kyle Millar and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

Puna

Hamakua

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Kmillargolf@gmail.com

From:	Nina Monasevitch
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 9:33:21 PM

Aloha Mr. Sakoda,

My name is Nina Monasevitch and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: Our oceans are dying before our eyes. The main reason is over extraction. Taking fish for aquariums is 100% wrong. It is unsustainable, cruel, unhealthy, unethical, and goes against Hawaiian cultural values. The ocean is literally our life support system, if the oceans die, we die. Time to realize that protecting our ocean ecosystem is vitally important, much more important than the greed that drives the aquarium trade business.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at oceanmana@hawaiiantel.net

From: David Monasevitch
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 2:41:48 PM

Aloha Mr. Sakoda,

My name is David Monasevitch and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native

Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: The aquarium trade is over! It is not sustainable, by any definition. Grow up. Get a real job. Start contributing to your stewardship agreement as a man being. It's beyond the tipping point. Make haste.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at davidmonasevitch@hawaiiantel.net

From: Rebecca Moore
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 2:48:20 PM

Aloha Mr. Sakoda,

My name is Rebecca Moore and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at igorcat88@yahoo.com

From: Constance Moore
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 12:54:39 PM

Aloha Mr. Sakoda,

My name is Constance Moore and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment: I've been to the North & South Kona Reefs. They're stunning, but if we don't protect them, they will not survive for future generations. This needs to be taken seriously. It makes me sick to think that "collectors" would be given the green light to put these beautiful fish in aquariums to live out their lives. Please stop this selfish and deadly behavior!

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Tyler4mom@gmail.com

From: Mike Moran
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 4:51:25 PM

Aloha Mr. Sakoda,

My name is Mike Moran and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the animal welfare issues and unacceptably high

mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Hamakua

My additional comment: No matter how long & hard the community tries to protect this resource, outside financial forces keep removing it with State government support' Stop it now

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at mmmmahalo2000@aol.com

From: Karlene Morrow
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Saturday, April 3, 2021 10:51:14 AM

Aloha Mr. Sakoda,

My name is Karlene Morrow and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment: As someone who lives in a Hawai'i because of year round access to the beaches and ocean I don't want the natural resources depleted for the profit and enjoyment of only a few.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-

economic, and cultural impacts of what it proposed.

I can be reached at Karlene.kona@gmail.com

From: Nancy Mueller
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 2, 2021 6:56:29 PM

Aloha Mr. Sakoda,

My name is Nancy Mueller and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

My additional comment: In order to make our ecosystem whole, we must protect all our species. We don't filly understand all the many interdependencies. Maine Protected Areas are the best way to manage this. There should be a large buffer around all MPAs

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Nmueller10@me.com

From:	Heather Mueller
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 6:10:33 PM

Aloha Mr. Sakoda,

My name is Heather Mueller and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

Unfamiliar with these reefs, but still concerned.

My additional comment: North Kona
When they were allowed to take the fish ...seemed like less fish ...when it stopped seemed like more
Please leave the fish

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Joemueller5@gmail.com

From: Jason Murray Murray
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 6:01:01 PM

Aloha Mr. Sakoda,

My name is Jason Murray Murray and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment: Please stop allowing collection of our native wildlife. Reef fish very important to keeping our coral healthy and we are already loosing too much to climate issues. Respect it and protect it. Now is the time to stop this trade for good. THE BENEFITS DO NOT OUTWEIGH THE LOSSES. Our reefs need your help now more than ever.
Mahalo
Jason Murray

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at jason@jasonswatergardens.com

From:	Thomas Nakagawa
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 5:45:22 PM

Aloha Mr. Sakoda,

My name is Thomas Nakagawa and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: The tourists would ask me " What happened to all the beautiful fishes "at Ulua Beach, Wailea, Maui. The aquarium trade stole them.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at tomnakagawa@yahoo.com

From:	Cynthia Nakamura
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Thursday, April 8, 2021 1:23:44 PM

Aloha Mr. Sakoda,

My name is Cynthia Nakamura and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

My additional comment: Hawaii's reefs and fish must continue to be protected to ensure a healthy ocean ecosystem and to avoid the depletion of fish species. The ban on the collection of reef fish for the past three years has brought increases in fish populations, demonstrating that the ban has had a positive impact on the reef ecosystem. Allowing Hawaii's reef fish to be caught for commercial purposes will once again lead to a rapid decline in the fish populations, and additionally can lead to damaging the coral as boats are driven over shallow reefs.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at csn@hawaii.rr.com

From:	Patricia Nakao
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Wednesday, April 7, 2021 4:55:05 PM

Aloha Mr. Sakoda,

My name is Patricia Nakao and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: I have been snorkeling all around Maui for 50 years and it is apparent how the reef diversity and abundance have declined where they are not protected. Commercial collection of the fish only diminish our reefs more. Why should Hawaii's precious resources like the indigenous or endemic fish be collected for the profit of a few collectors and hobbyists? Should we allow collectors into our native forests to collect i'iwi so some collector can make a profit and some hobbyist can keep the native bird in a cage? Same thing. Just as the elements of our native forests should be preserved, so should our ocean resources. Furthermore, there is no way to actually monitor fish collectors to insure they abide by limits. Pau, already. Just ban the practice, once and for all, please. Mahalo for considering my comments.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at kulasings@gmail.com

From: Shannon Nakaya, DVM
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Saturday, April 3, 2021 12:50:32 AM

Aloha Mr. Sakoda,

My name is Shannon Nakaya, DVM and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: These are native wild animals, and much any other native wildlife, should be protected from being captured, transported, and kept in artificial environments. The pet trade has a long history of harvesting creatures from their native habitats and selling them for paltry sums as "disposable" pets. As a veterinarian, I can testify that most of the health problems with these animals are the result of inappropriate husbandry. In short, they get sick and die prematurely because they are challenged to survive with the wrong temperature, salination, diets, lighting, aeration, etc. Moreover they are often subject to stresses they would normally avoid such as crowding or sharing space with competitive species or predators. If animals such as these are unable or unwilling to successfully reproduce in captivity (which is not happening), then that captive environment is lacking for the species. Humans who want to observe them up close should put on a mask and snorkel or watch a video.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at shannon@origamidoghawaii.com

From:	Keith Neal
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Monday, April 5, 2021 11:46:14 PM

Aloha Mr. Sakoda,

My name is Keith Neal and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

North Kohala

South Kohala

My additional comment: The very survival of Hawaii's coral reefs is at stake, because without an increase in fish abundance, the impacts of climate change will be far worse. Reef surveys spanning decades have documented significant impacts to species taken by commercial aquarium collectors. The most impacted species including Yellow Tangs, certain butterfly fishes, and other rare native fishes, experienced population declines ranging from 60 – 99% in the areas hardest hit by the trade.

DAR must consistently and coherently manage 'resources' ...and actually regulate. Hawaii DLNR management regulations must include species and accurate quantity reporting of takings.

Perhaps adapting a working model from an other fishery jurisdiction, based on science, based on carrying capacity of specific ecological areas? I suggest looking to the Washington state fisheries.

Example: Simply look at how Salmon is manged. Consider level of reporting if applied to Hawaii aquarium collectors as Salmon in the WA fishery? http://www.eregulations.com/wp-content/uploads/2020/06/Catch-Record.pdf

Furthermore, A given geographic area has different impacts, carrying capacity, and regenerative capability.
http://www.eregulations.com/washington/fishing/marine-area-rules-definitions/

Each area has it's specific rules: Example See marine area 10;
http://www.eregulations.com/washington/fishing/marine-area-10/

Thank you for your consideration.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at windrider4002@yahoo.com

From:	Kaylee Nicholls
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Thursday, April 8, 2021 2:28:58 AM

Aloha Mr. Sakoda,

My name is Kaylee Nicholls and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: The ocean provides us with more oxygen than rainforests. We shouldn't be messing with it for a hobby. Hawaii is doing so well because if it's protections of the ocean. Let's no unravel that.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at kayleenic5@outlook.com

From:	Dorothy Norris
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Thursday, April 8, 2021 3:10:44 PM

Aloha Mr. Sakoda,

My name is Dorothy Norris and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

Puna

My additional comment: An adequate herbivore population enhances coral growth by reducing the growth of algae on our reefs. If you remove a significant portion of that population, the coral will die and we will have nothing left of our reefs to protect against the eventual sea level rise and storm caused by global warming. In the recent years, we have witnessed the need to protect our shoreline and our island paradise. We have worked hard to address some of the other factors that degrade our reefs (sunscreen, pollution) and we don't need to add to our problems by allowing another nail in our reef's coffin. Please do not accept the DEIS as it stands - It needs to accurately describe the impacts of the reef community.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at dotnorris1@gmail.com

From: Lawrence Nunez
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 4:11:39 PM

Aloha Mr. Sakoda,

My name is Lawrence Nunez and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native

Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment: Diving and snorkeling the last five years in Hawaii I have noticed the deterioration of the reefs and wildlife. We need to protect these species at all costs.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Larrynunez@hotmail.com

From: Susan Olson
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 9:26:51 PM

Aloha Mr. Sakoda,

My name is Susan Olson and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high

mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment: Our West Hawaii reefs desperately need more protection as climate change has caused coral bleaching and disruption of habitat. Our reef fish are critical to bringing health back to the reefs. We should continue to have NO FISHING zones and to limit fish taken. Aquarium fishing should be banned in the State of Hawaii.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at susankukana124@gmail.com

From: Kelly ORourke
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 2, 2021 5:49:36 PM

Aloha Mr. Sakoda,

My name is Kelly ORourke and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Puna

Hilo

Hamakua

My additional comment: The Lower Puna area has had it's share of challenges associated with the volcanic eruptions; please do not add further to the stress this beautiful island is navigating. All species are necessary to contribute to the symbiotic recovery.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at synergyhappens@gmail.com

From: Laura Parks
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 3:56:24 PM

Aloha Mr. Sakoda,

My name is Laura Parks and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Hilo

My additional comment: www.respectbumpersticker.com

https://www.facebook.com/oceanrespectcampaign

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at oceanrespectcampaign@gmail.com

From: Darby Partner
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 8:29:58 PM

Aloha Mr. Sakoda,

My name is Darby Partner and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Puna

Hilo

My additional comment: I Swim near south kona and kona town reefs daily. The reefs are a life line of the Hawaiian island and fish are greatly needed to keep them healthy. Please keep fish on the reef!

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Midwife108@gmail.com

From: Zach Patitucci
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 2:59:17 PM

Aloha Mr. Sakoda,

My name is Zach Patitucci and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

Unfamiliar with these reefs, but still concerned.

My additional comment: We need to protect Hawaiian reef more than from a variety of stressors and extraction for aquariums seems like an easy way compared to global climate change

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at zpatitucci@gmail.com

From: Robert Pecoraro
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 9:01:27 PM

Aloha Mr. Sakoda,

My name is Robert Pecoraro and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

My additional comment: Hawaii's reefs are in trouble due to the affect of climate change. 2014-15 brought a significant coral bleaching event, which killed a lot of coral. Some of the coral started to recover, but a small amount compared to what was lost. 2019 was another very warm year that also stressed many corals. The dead corals encourage algae growth, which could take over the reefs if not controlled by the herbivores, many of which are the target species of aquarium collectors. We don't know what the future will bring, but things are not looking so good for the health of our reefs here in the islands. The added impact of collecting hundreds of thousands of fish each year cannot have anything but a negative affect on an already stressed environment. As an avid diver, I used to visit Hawaii to dive the beautiful reefs. They inspired my wife and I to move here after we retired. They also draw thousand of people from around the world and they support the many dive and snorkel operations. These fish belong here on the reef, not in someone's private aquarium. They help provide for a healthy ecosystem, which support the aforementioned businesses, as well as many ancillary businesses, which benefit from dive tourism. Since the moratorium on collecting fish began, a few years ago, my wife and I, as well as our network of divers, have noticed the abundance of the aquarium trade target species, such as Yellow Tangs and Brown Tangs. We are also seeing an abundance of easily collectable fish, such as frogfish, which were rarely seen, prior to the moratorium. Please consider making Hawaii a no take zone permanently. Let's keep Hawaii's tropical fish in Hawaii, where they belong, for all to enjoy.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at nyfrogman@gmail.com

From: Sue Perley Perley
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 3:05:16 PM

Aloha Mr. Sakoda,

My name is Sue Perley Perley and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: I am greatly concerned about aquarium collecting for all of Hawaii. The depletion of reef fish on Maui where I snorkel regularly is devastating. The rules are not being enforced. Aquarium collecting should not be allowed anyplace in Hawaii. The cost on every level far outweighs the benefits.
Mahalo!

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at sperley1111@mac.com

From: Laura Posson
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 9:43:50 PM

Aloha Mr. Sakoda,

My name is Laura Posson and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

South Kohala

My additional comment: In addition to the unmitigated depletion of fish stocks, in my experience, aquarium collectors have no respect for the coral and will destroy large coral heads to get the rare creatures inside. I have seen numerous coral heads destroyed that previously had resident harlequin shrimp, for example.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Lposson83@gmail.com

From: Louise Priest
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 3:36:34 PM

Aloha Mr. Sakoda,

My name is Louise Priest and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at bazwez@aol.com

From: Dawn Reed
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 4:09:23 PM

Aloha Mr. Sakoda,

My name is Dawn Reed and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at dawnreed25@gmail.com

From: Tim Reed
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 1:41:00 PM

Aloha Mr. Sakoda,

My name is Tim Reed and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native

Hawaiian cultural practices and beliefs,

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Timr@kauradio.com

From: Thomas Reppuhn
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 5:54:11 PM

Aloha Mr. Sakoda,

My name is Thomas Reppuhn and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

Unfamiliar with these reefs, but still concerned.

My additional comment: Please stop giving away our natural resources, stop all commercial collection and keep these poachers off our reefs!

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Reppuhn2@yahoo.com

From: Lynn Rinker
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 2:41:54 AM

Aloha Mr. Sakoda,

My name is Lynn Rinker and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment: Please protect our reefs, the coral and the wildlife. Don't deplete Hawaii waters for personal aquariums.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at lynrin@comcast.net

From: Anke Roberts
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 3:06:06 PM

Aloha Mr. Sakoda,

My name is Anke Roberts and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Unfamiliar with these reefs, but still concerned.

My additional comment: I like snorkeling around Oahu, and outside the marine protected areas we see very few herbivores to keep the reefs free of algae. As a result, the coral coverage has been declining, and once healthy coral is smothered by fast growing (and ugly!) brown algae. If not for the people of Hawaii, then protect the reefs and important reef fish for your tourism dollars. Once the world knows that we don't have any tropical reef fish left, the world will stop coming to Hawaii and tourism spending will be in drastic decline. But do it for the children of Hawaii, so they can see in the ocean the wonders their parents and grandparents used to see.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at anke_roberts@hotmail.com

From:	Eileen Robn
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 1:51:41 PM

Aloha Mr. Sakoda,

My name is Eileen Robn and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: I live, snorkel and dive on Maui. I have seen the changes in fish populations over the last decade. The decline in fish populations has been quite obvious. Collectors are interested in only profits and not our sensitive reefs. Collecting is just another added stress to an already fragile ecosystem.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at iceileen@gmail.com

From:	Athena Roesler
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 3:32:55 PM

Aloha Mr. Sakoda,

My name is Athena Roesler and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native

Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

North Kohala

South Kohala

My additional comment: Two years ago when snorkeling the reefs especially off Puako and at Mauna Kea I could not believe how few fish I saw compared to previous visits. It was truly saddened and amazed at how low the populations were and how little the diversity there was in types of fish.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at pbstorm@aol.com

From: Kelly Rohlfs
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 2, 2021 8:18:47 PM

Aloha Mr. Sakoda,

My name is Kelly Rohlfs and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Karohlfs@gmail.com

From:	Sam Rohlfs
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Friday, April 2, 2021 7:34:52 PM

Aloha Mr. Sakoda,

My name is Sam Rohlfs and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

South Kohala

My additional comment: Raping the reefs for people's aquariums is absolute lunacy. How can such a practice even gain consideration? Do thr right and obvious thing - stop taking reef fish

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Samrohlfs@gmail.com

From: Mikhail Rudenko
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 11:55:42 PM

Aloha Mr. Sakoda,

My name is Mikhail Rudenko and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment: I am a scuba instructor, professional underwater photographer and a owner of a dive business in North Kohala. I have a degree in biology, I've spent 10k+ hours underwater in Hawaii educating divers, guiding tours and photographing marine animals. So yeah, I do have an idea of what I'm talking about.
Leave fishes where they belong - in the Ocean!!
The very reason why millions of tourists come to Hawaii is the beauty of the Underwater world. Capturing the most colorful creatures of the reef destroys everything - from the health of ecosystems to the very fabric of tourism-based economy of the island of Hawaii. Not to mention that only about 20% of captured fishes actually make it to aquariums. The practice itself is gruesome and benefits only a handful of individuals. No credible scientific report shows that there is no impact to the reef eco-system from aquarium collecting. One does not need to be a scientist to understand that any action has a reaction. In this case it is algal bloom caused by decreasing the number of herbivorous fishes (every species on the above list). Algal bloom is one of the worst enemies of coral as they both compete for oxygen and nutrients. And therefore when the numbers of herbivorous fishes are decreased the whole reef takes a blow. Sometimes a fatal one. Don't let that happen in one of the very last remaining most pristine coral ecosystem in the state of Hawaii.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at mauispeardiver@gmail.com

From: Shannon Rudolph
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 9, 2021 1:09:52 PM

Aloha Mr. Sakoda,

My name is Shannon Rudolph and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

South Kohala

My additional comment: The diving industry is very important to tourism. Private businesses should not be able to steal 'public property and assets'.
In this day & age - the aquarium industry is harming all residents of Hawai'i. It must stop.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at shannonkona@gmail.com

From: Lupita Ruiz-Jones
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 11:33:03 PM

Aloha Mr. Sakoda,

My name is Lupita Ruiz-Jones and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: Future generations deserved to see high biodiversity and abundance of reef fishes in Hawaii.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at lupita.ruiz.jones@gmail.com

From: Garry B. Russell Russell
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 9:43:32 PM

Aloha Mr. Sakoda,

My name is Garry B. Russell Russell and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high

mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

My additional comment: As an avid scuba diver it has been obvious the changes in the reef from aquarium collectors. There has been plenty of destruction of the coral as well as a depletion of all types of fish population. I have also witnessed aggression from aquarium collectors when confronted with objections from those opposed to this practice.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at garrytuba@aol.com

From:	Kurt Samuelson
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Thursday, April 8, 2021 12:50:09 PM

Aloha Mr. Sakoda,

My name is Kurt Samuelson and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS minimized the impacts of aquarium collecting on these species.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at scubuzza1784@outlook.com

From:	Mark Schacht
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 1:47:59 PM

Aloha Mr. Sakoda,

My name is Mark Schacht and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

South Kohala

My additional comment: The revised DEIS claims there would be no adverse natural, socio-economic, or cultural impacts that need addressing despite the fact that, under their plan, they could take all of a particular fish from any reef, bay, or other discrete area. The rapacious greed of the aquarium trade has rarely been more baldly displayed. This DEIS must be rejected.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at email@markschacht.com

From: Henri Etta Schmitz
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 12:33:42 AM

Aloha Mr. Sakoda,

My name is Henri Etta Schmitz and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kohala

Hilo

Hamakua

South Kohala

My additional comment: I believe the comments above are an adequate description of the situation.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at henriettarexroad@hotmail.com

From:	Inez Schultz
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Wednesday, April 7, 2021 11:23:31 PM

Aloha Mr. Sakoda,

My name is Inez Schultz and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Bird Wrasse

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

North Kohala

South Kohala

My additional comment: The quantity of fish have been diminished by pure observation while snorkeling several times a month for over 20+ years . I generally swim mauna lani, puako area.
Our ocean fish are also a big tourist attraction. I have had visitors disappointed that they are

not seeing as many fish as previous years.
It would be worthy to look at how Palau has managed to keep their fish in abundance so their beauty can be enjoyed.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Ischultz@hawaii.rr.com

From: Julie Shattuck
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 3:01:47 PM

Aloha Mr. Sakoda,

My name is Julie Shattuck and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment: The very survival of Hawaii's coral reefs is at stake, because without an increase in fish abundance, the impacts of climate change will be far worse. Reef surveys spanning decades have documented significant impacts to species taken by commercial aquarium collectors.

The revised Draft Environmental Impact Study (DEIS) is aimed at reopening West Hawaii reefs to 7 aquarium collectors to take over 246,000 fish every year for the pet trade. This comes nearly a year after their first DEIS was unanimously rejected, for 14 reasons, by the board that oversees Hawaii's Dept. of Land and Natural Resources (DLNR). Unbelievably, the revised DEIS still fails to address a number of those reasons for nonacceptance.

For the sake of our populations heavily impacted tropical fish and endangered reefs do not open any reefs for commerical purposes in West Hawaii or anywhere else.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at julie@shattuckevaluation.com

From: Shannon Shea
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Saturday, April 3, 2021 8:08:17 PM

Aloha Mr. Sakoda,

My name is Shannon Shea and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

South Kohala

My additional comment: Since the statewide coral bleaching events of 2015, I have seen corals die and be replaced by algae and other plants. Herbivores help to keep these plants from encroaching further on our already fragile corals. Not to mention how inhumane and exploitative aquarium collection is. We need to care for Hawaii's animals and resources by keeping them here in Hawaii!

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at shannon@jacksdivinglocker.com

From: Rachel Silverman
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 3:04:06 AM

Aloha Mr. Sakoda,

My name is Rachel Silverman and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

Puna

Hilo

South Kohala

My additional comment: I believe Hawaiian reefs need intact ecosystems for our future and aquarium fish collection for export runs contrary to this mindset.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at rachelsilverman@verizon.net

From: Alexandria Siwecki
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 12:36:50 PM

Aloha Mr. Sakoda,

My name is Alexandria Siwecki and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: This is crime against nature and will not be tolerated

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Lexibell621@yahoo.com

From: Virginia Small
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Sunday, April 4, 2021 1:22:33 PM

Aloha Mr. Sakoda,

My name is Virginia Small and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native

Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment: Far fewer reef fish than when I moved to Kona in 1975. It was great news when the aquarium fish ban was enacted. This should be even stricter. I snorkel most often at Kahaluu Beach and hope it will be protected.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Bamboohawaii1@gmail.com

From: Pamela Small
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 4:51:29 PM

Aloha Mr. Sakoda,

My name is Pamela Small and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

South Kohala

My additional comment: I am a scuba diver who dives the West Hawaii Island coast approximately fives days a week ranging from South Kona to North Kohala. I have directly seen the impacts of the aquarium collection trade on the reefs over the years and have been thrilled to see a very small recovery over the past year since the ban was enacted. While I say "recovery" I mean that I am FINALLY seeing a small number of baby fish again. I have not seen baby Yellow Tang for years. I have NEVER, ever seen a brown tang or a chevron tang. In fact, the white listed fish are so rare that when diving, if they are seen, we photograph them in excitement not knowing when/if we will see them again.

There are other fish that are collected for the aquarium trade that, although not white listed, are so rare that I can tell you exactly how many times I have seen each one.

I make no bones about it. The aquarium trade has devastated our reefs.

Even with the ban, collectors have continued to collect. I, personally, witnessed one of the biggest offenders (who has made the news on multiple occasions) out on his boat collecting and then packing a shipment. He and his wife fled before DOCARE officers arrived.

The latest DEIS is a farce. It does not address how communities of reef species are disrupted by aquarium collecting or even address restoring diminished supply. How do the collector's plan to replenish the reefs after they have removed the herbivores? These fish are vital for the conservation of coral reefs. Herbivorous fish feed on the algae that grow on corals and compete with them for light and oxygen. By eating the algae, these fish play a big role in the survival of the entire ecosystem. By removing them, the aquarium collectors are killing off an entire underwater ecological community.

The DEIS does not address the unacceptably high mortality rate of these fish after collection and during shipment.

The Hawaiian culture fishes for food. It does NOT collect fish to ship to the mainland for people to keep in aquariums. It is contrary to Hawaiian cultural practices and beliefs.

I will add that with tourism being the number one industry on Hawaii Island, having fish in our ocean is vital for visitors who snorkel and scuba dive.

Our fish need to stay HERE in Hawaii for the benefit of the people in Hawaii. For the benefit of the ocean. For the benefit of the coral reefs and for the beauty of the ocean.

Mahalo for your time.

Pamela Small

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at PamelaBigIsland@gmail.com

From: Dan Smith
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 4:28:34 PM

Aloha Mr. Sakoda,

My name is Dan Smith and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at dreadmanbmf@gmail.com

From: Rebecca Sonnenberg
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 3:36:32 PM

Aloha Mr. Sakoda,

My name is Rebecca Sonnenberg and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Riekrl@gmail.com

From: Joan Sorbets
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Sunday, April 4, 2021 11:28:44 PM

Aloha Mr. Sakoda,

My name is Joan Sorbets and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Bird Wrasse

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

North Kohala

South Kohala

Unfamiliar with these reefs, but still concerned.

My additional comment: Have snorkeled many places over the past 40 or so years with family and friends. Watched the areas near Mauna Lani and Waikoloa decrease in the number and variety of fish especially as I live near there. But have done deep water snorkeling-near Puako- I'm not a diver- and noticed a decrease there, also. We need to preserve these sites and water creatures of all kinds for the upcoming generations to enjoy . Please consider very carefully how you vote!

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Sorbetspauljoan@hotmail.com

From: Bill South
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 5:13:50 PM

Aloha Mr. Sakoda,

My name is Bill South and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment: The bigger issue is that DHHL shows their ignorance of how ocean ecosystems function. Many species of what we may deem as unimportant fish may have a very crucial link in maintaining the structure of the entire ocean ecosystem. It is very possible that if one small link of the chain is severed, the entire coral reef ecosystems could go "tilt." This has occurred and other ocean ecosystems around the world. DNLR does not have the scientific data to back up any of their statements. More independent research needs to be done. I speak is a scientist who has some background in ecosystem management.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at mapinc@aloha.net

From: Sara Sowers-Collison
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 4:20:16 PM

Aloha Mr. Sakoda,

My name is Sara Sowers-Collison and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at sara.sowers747@gmail.com

From:	Donita Sparks
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 7:33:23 PM

Aloha Mr. Sakoda,

My name is Donita Sparks and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Puna

Hilo

South Kohala

My additional comment: Hmm, I'm still astounded that this is still legal. These fish do not belong in aquariums, they belong in beautiful Hawaiian waters. Simply wrong and depressing. I'm a tourist for many reasons but MAINLY THE SNORKELING.
Please keep my tourist dollars coming. No fish, sad reefs, no money or visits from me. Mahalo!

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at sparksfly1@gmaill.com

From: Linda Sparks
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 12:16:15 AM

Aloha Mr. Sakoda,

My name is Linda Sparks and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: I am a underwater photographer and a long distance ocean swimmer. I've spent 37 years in the ocean here and I am severely concerned and sadden by the loss of marine life here in Hawaii. The reefs I see on a regular basis have declined drastically. Where I use to see a abundance of fish there are hardly any. The reefs are already way under populated and will die off if the fish are not protected.
Linda Sparks

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at lindasparky@me.com

From: Whitney Springer
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 9, 2021 3:43:51 PM

Aloha Mr. Sakoda,

My name is Whitney Springer and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Hilo

Unfamiliar with these reefs, but still concerned.

My additional comment: Last year, I did a study investigating Achilles Tang abundance around Hawai'i Island, particularly in North and South Kona. Part of this study not only included snorkeling along various popular reefs, but a deep dive into the literature of the history of the aquarium trade and it's impacts. While Achilles Tangs themselves do not, for some reason, seem to be recovering since the ban on aquarium trade, most other species have. Most notably is the Yellow Tang, whose populations have, in large part, thrived since the ban on aquarium trade was put in place. It is unquestionable that the aquarium trade has a negative impact on Hawaiian coral reefs, and therefore the entire ecosystem. In a world experience raising ocean temperatures, we need to protect and prepare our reefs for the coming bleaching events now more than ever.
A growing number of coral reefs worldwide are experiencing increased levels of heat stress due to climate change, contributing to record high coral bleaching events (Graham et al. 2020). Previous studies have found coral reef resilience to stress events may be increased by higher biomasses of herbivorous fish (Chung et al. 2019; Graham et al. 2020). Herbivores keep macroalgal cover from dominating a reef, increasing coral rates of settlement and survival and, therefore, biodiversity in this key ecosystem (Chung et al. 2019). Overfishing (including recreational, commercial, and aquarium collection) of herbivorous fish may be detrimental to a coral reef's ability to recover after stress events such as coral bleaching (Chung et al 2019). However, it has been found that aquarium collection takes more reef fish per year than fishing because of the high demand for the Yellow Tang in aquariums (Walsh et al. 2020). Many of the species proposed to be allowed for aquarium collection are herbivores at some point in their life history stage, while others play roles just as critical to healthy coral reef. The Yellow Tang is only abundant in Hawaiian waters, and so we should give them a safe and protected place to continue to thrive and contribute to a healthy and balanced reef ecosystem.
There is no doubt that coral reef fishes are critical to maintaining the balance in this complicated ecosystem, and by removing them solely for the economic benefit of aquarium trade, we risk the health and stability of Hawaiian reefs in the coming days (Tissot & Hallacher 2004, Walsh et al. 2019). Please, for the sake of our reefs ability to withstand the heavy impacts of climate change, reconsider allowing the aquarium trade to resume taking key species from our reefs.

References

Chung AE, Wedding LM, Green AL, Friedlander AM, Goldberg G, Meadows A, Hixon MA. 2019. Building coral reef resilience through spatial herbivore management. Frontiers in Marine Science 6:1-12.
Graham NAJ, Robinson JP, Smith SE, Govinden R, Gendron G, Wilson SK. 2020. Changing role of coral reef marine reserves in a warming climate. Nature Communications 11:1-8.
Tissot BN, Hallacher LE. 2004. Effects of aquarium collectors on coral reef fishes in Kona, Hawai‘i. Conservation Biology 17:1759-1768.
Walsh WJ, Cotton S, Jackson L, Kramer L, Lamson M, Marcoux S, Martin R, Sanderlin N. 2019. Findings and recommendations of effectiveness of the West Hawai'i Regional Fishery Management Area (WHRFMA). Department of Land and Natural Resource, Hawaii Division of Aquatic Resources.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at whit77@hawaii.edu

From: Franes Staben
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 3:02:09 PM

Aloha Mr. Sakoda,

My name is Franes Staben and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: Fran Staben

The reefs off south Maui Kamaole I, II, &III have much fewer fish and coral than when we started coming to Maui 40 years ago. Even if that is not changed because of aquarium collecting, it needs to be protected and bolstered.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at fran.staben@gmail.com

From: Gregory Starmer
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 10:27:07 PM

Aloha Mr. Sakoda,

My name is Gregory Starmer and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment: Please Ensure That My Grandchildren Will See The Same Fishes In Hawaii's Beaches As My Parent's Did. I'm 63 And Hawai'I Is My Only Home As Well As My Son's. And Now My Grandchildren Has Taken On The Same Love And Respect For Our Oceans, Shorelines And Beaches Of Hawai'I Islands. Thank You Very Much.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at momivee@gmail.com

From: Marianne Starr
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Monday, April 5, 2021 3:28:19 PM

Aloha Mr. Sakoda,

My name is Marianne Starr and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

My additional comment: I moved to Kona in 2009. I swim regularly in Kona at the pier and also swim and paddle regularly at Keauhou Bay. I definitely believe our that our tropical fish population is diminished.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at mariannestarr@hotmail.com

From:	Linda Sue Sue
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Wednesday, April 7, 2021 10:33:15 PM

Aloha Mr. Sakoda,

My name is Linda Sue Sue and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Thompson's Surgeonfish

My specific concerns about those species include:

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: Aquarium industry should be set to strict limits and high fines if they fail to stick to the laws.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at LGSue8@gmail.com

From:	Kelly Sundberg
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Monday, April 5, 2021 2:21:57 PM

Aloha Mr. Sakoda,

My name is Kelly Sundberg and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at hikellyreilly@gmail.com

From:	Gabriela Taylor
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 3:19:41 PM

Aloha Mr. Sakoda,

My name is Gabriela Taylor and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

Unfamiliar with these reefs, but still concerned.

My additional comment: Gabriela Taylor I support a total ban in Hawai on catching tropical fish for aquarium trade or any other reason..

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at gabrielataylor40@gmail.com

From: Thane Davis
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Monday, April 5, 2021 12:56:13 PM

Aloha Mr. Sakoda,

My name is Thane Davis and I am a Part time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment: Nearly all of a Alii drive has changed dramatically throughout my 20 years of life. The coral, the fish who used to dwell in large numbers, and the biodiversity of this strip of reef has been heavily impacted by the aquarium trade, amongst other human altercations. This is just the tip of the iceberg regarding what we must do to protect our coral reef ecosystems

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at davisthane@gmail.com

From: Madison Thiele
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 10:39:29 PM

Aloha Mr. Sakoda,

My name is Madison Thiele and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

Hilo

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at madison.thiele@gmail.com

From: Vivian Toellner
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Saturday, April 3, 2021 3:26:47 PM

Aloha Mr. Sakoda,

My name is Vivian Toellner and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

Puna

Hilo

South Kohala

My additional comment: Rarely see Puffer fish around Richardson Beach in Hilo.
Wasting our important marine life for a deadly hobby thousands of miles away is not environmentally or ethically justifiable.
Now that these fish can be aquacultured, there is no excuse to take them from the wild.
The only reason the mainland pet trade wants to continue to take Hawaii's fish from the wild is profits: these animals are cheaper to take than they are to aquaculture.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at viviansuet@hotmail.com

From: Linda Toki
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Thursday, April 8, 2021 2:27:40 PM

Aloha Mr. Sakoda,

My name is Linda Toki and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: Waimanalo and North Shore reefs of Oahu have been devastated over the past 45 years from aquarium catchers, overfishing and human impact. I have been diving in Hawaii since 12 years old with my father and have witnessed the catastrophic loss of large communities of marine life & schools of fishes due to overfishing, human greed, aquarium catchers & other human activity. We desperately need to save and protect our ocean & marine life communities & reefs. We need to do much more as a society and government to designate more marine preserves like Hanauma Bay with protections in place as "safe zones" for marine wildlife & reefs to recuperate and thrive once again.

Reopening Hawaii's Reefs to the Aquarium Trade is a travesty bringing more devastation to our vulnerable reefs and marine life. We are going the wrong way with this ruling and action. Please stop this. Our government and people need to be wise guardians of our natural resources and the ocean and not be dictated by business needs. Stop all industrialized commercial fishing in Hawaii's waters that are injuring and killing our whales, dolphins, turtles, manta rays, eagle rays, birds and etc., many which are on the federal endangered and protected species list. Our local marine life communities are critical to the health of the oceans and in reversing climate change. Please protect our ocean life. The ocean saves us. We are one earth.

Aloha,
Linda

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at lctoki@gmail.com

From:	Michele Triplett
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Thursday, April 8, 2021 2:48:50 PM

Aloha Mr. Sakoda,

My name is Michele Triplett and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: I have watched the decline of the reefs in south Maui particularly Ulua and Makena Landing. Please keep our reef fishes safe.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at tfyrchk@gmail.com

From: Cyndy Urry
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Saturday, April 3, 2021 2:08:21 PM

Aloha Mr. Sakoda,

My name is Cyndy Urry and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment: Cyndy Urry ,
Aloha. I am a scuba diver and I have lived in Hawaii for almost 25 years. I have traveled all around the world scuba diving and I cannot begin to tell the DEIS how our reefs are hurting . We have fewer fish than any place I have traveled because we cannot replenish . So many are endemic and once they're gone , that's it . I have seen so few Potter's Angelfish lately that it really saddens me. I cannot believe that the DEIS cannot see this. The FBI is finding out that there is so much corruption in Hawaii over several problems such as building permits, etc. I hope they will look into the DEIS because it's our most important resource we have here and I just can't understand how this can be permitted to go on with so many concerned citizens upset about this permitting of taking of our reef fish.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at cwurry@yahoo.com

From: Christy Vail
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 2:33:44 PM

Aloha Mr. Sakoda,

My name is Christy Vail and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

Unfamiliar with these reefs, but still concerned.

My additional comment: Taking our beautiful, essential, rare little reef fish is akin to taking endangered native birds from our forests. Lets simply end the practice of aquarium collection. Thank you for saving our unique ecology.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at christyv1865@gmail.com

From: Diana Varney
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 2, 2021 8:55:06 PM

Aloha Mr. Sakoda,

My name is Diana Varney and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

My additional comment: Living in south Kona for 14 years I have seen a decrease in tropical reef fish.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Varneydiana@yahoo.com

From: Momi Ventura
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 11:19:18 PM

Aloha Mr. Sakoda,

My name is Momi Ventura and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native

Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Hilo

South Kohala

My additional comment: All Of The Oceans In And Surrounding Hawai'I Nei Is In Dire Need For Exclusive Protection.!!! Being From A Long Line Of Hawaiian Fishermen And Women We've Always Did Our Best To Protect Reefs And Especially Shorelines For Anyone Over-Fishing And Not Caring For The Beach Environment. We Need More And More Help Supervising These Area's And Not So Known Area's As Well.!!! Please Do All You Can And We Will Too.. Mahalomai..

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at momiv808@gmail.com

From: Suzanne Villeneuve Villeneuve
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Sunday, April 4, 2021 12:47:32 PM

Aloha Mr. Sakoda,

My name is Suzanne Villeneuve Villeneuve and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

Hilo

South Kohala

Unfamiliar with these reefs, but still concerned.

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at oceandauphin@gmail.com

From: John Von Schlegell
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Sunday, April 4, 2021 12:09:29 PM

Aloha Mr. Sakoda,

My name is John Von Schlegell and I am a Part time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment: The long term benefit to the local citizens of Hawaii of healthy reefs and fishes far outweighs the economic benefits of a few collectors.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Jevs@endeavourcapital.com

From: Karie Wakat
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 2:43:45 PM

Aloha Mr. Sakoda,

My name is Karie Wakat and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment: We need to end this barbaric practice of aquarium collecting. These fish can be bred in captivity. It's common sense to stop wild capture, when you can successfully breed in capability for trade. We are selling these fishies lives, with no guarantee of export survival.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Kariesmart@hotmail.com

From: Barbara Wallace
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 1:10:29 PM

Aloha Mr. Sakoda,

My name is Barbara Wallace and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native

Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Citanmaui@gmail.com

From: Deborah Wallace
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 5:19:10 PM

Aloha Mr. Sakoda,

My name is Deborah Wallace and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: I am 100% opposed to all aquarium trade. A small number of Aquarists make money from these fish which causes depletion of the health of the reefs. It also negatively impacts tourism because we have fewer fish for snorkelers and divers to enjoy, and our reefs are less healthy. It is mind-boggling that this is allowed.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at 1happygyrl@gmail.com

From: Mildred Walsh
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 4:34:11 PM

Aloha Mr. Sakoda,

My name is Mildred Walsh and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment: Been snorkeling Honaunau bay for 38 years and following this issue. There are not a tenth of the fish anymore. It happened when salt water fish tanks became a popular fad an d collectors came out in droves.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at cindywalsh@hawaii.rr.com

From: STEVEN WARD
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 4:19:08 PM

Aloha Mr. Sakoda,

My name is STEVEN WARD and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment: I have lived in Kailua-Kona almost four decades. I was certified as a NAUI advanced diver in 1984. I also was Captain of the Captain Cook 7 which was a 399 passenger vessel going to Kealakekua Bay until they sold the vessel and it went to the mainland. I have witnessed the decline in reefs here due to the avarice of fish collectors, and hope that this valuable resource will be protected more effectively. These fish on the reefs are part of an ecosystem that is crucial, and an economic driver for every Scuba shop and every snorkel cruise on the Kona coast, and people come here to enjoy our waters and swim with them and the other attractions of said ecosystem, which is under attack already with global warming. Let's not add to the stress, and not kill this economic driver by allowing the return of fish collecting. I do not believe this EIS is adequate or sufficiently addresses the impact of collecting. This reef ecosystem is fragile enough! Mahalo.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at SMW@HAWAII.RR.COM

From:	James ward
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Wednesday, April 7, 2021 8:43:20 PM

Aloha Mr. Sakoda,

My name is James ward and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Kole

Bird Wrasse

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar

with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

My additional comment: Aloha,
As a diver who is very familiar with the waters of West Hawaii I want to add my voice to those who want to continue the ban on collecting of reef fish. Since the ban in 2018 I've witnessed an increase in some species that were all but gone from our reefs. The practice of aquarium industry fish collection depleting the reefs of many species is not the only issue. We are just beginning to see tourists return to our island. what's their favorite activity while here? Snorkeling. As a concierge at local resorts from 2014-2019 the constant complaint was " we don't see as many pretty fish as we used to" Why? because the aquarium industry has no regulation of what and how much they collect.No plan to replenish or manage the reef system they profit from. from a moral standpoint, ecological standpoint, and health of future tourism, we must make the ban permanent.
Mahalo
James Ward 808-895-9656

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at relaxjim@yahoo.com

From:	Jennyvie Ward
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Wednesday, April 7, 2021 11:49:57 PM

Aloha Mr. Sakoda,

My name is Jennyvie Ward and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Jennyvieward@gmail.com

From:	Nancy Ware
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Friday, April 9, 2021 9:06:21 PM

Aloha Mr. Sakoda,

My name is Nancy Ware and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high

mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

Puna

South Kohala

My additional comment: I am a Vet Technician and am particularly concerned about the inhumane practices the fishes are subjected to from the point of collection to the rest of their in many cases, shortened lives. Fizzing, finning, denying food and then restrained in small unnatural tanks is inhumane.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at naneakali@gmail.com

From:	Bruce Watkins
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 7:58:49 PM

Aloha Mr. Sakoda,

My name is Bruce Watkins and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment: Many of these species feed on algae, and are needed to clean the

rocks, to permit hard corals to grow. With less fish, there will be less coral, and less of everything else. I dive frequently at Honokohau Harbor, and local divers generally do not post to Facebook the location when they photograph rare critters. Seems when they do the collectors grab them.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at photobruce@comcast.net

From: Sheryl Weinstein
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 2, 2021 11:52:51 PM

Aloha Mr. Sakoda,

My name is Sheryl Weinstein and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

South Kohala

My additional comment: As a local shore scuba diver I have witnessed the tragic decline of ALL undersea life in the last 40 years. Between the El Niño events & Aquarium Fish Collectors, much of the under water landscape is like a watery "desert." All there is left is rocks with algae growing on it.
One of my favorite dive sites in Kona used to have this little family of flame angelfish—a highly prized fish for collectors. I haven't seen the flame angels for quite some time—& their sitings becoming even more rare than ever.
The entire State of Hawaii should be a fish reserve, banning ALL commercial aquarium fish collections!! Our reefs are hundreds of years away—if ever—from recovering from damage caused by the Human Race!!!

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at mermaids_miracles@yahoo.com

From: Dan Wellert
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 12:38:02 AM

Aloha Mr. Sakoda,

My name is Dan Wellert and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment: I am very concerned the thought would even be entertained to take a quarter million reef fish! I come to the big island 2x per year for two weeks to snorkel and dive. Even at that level, I have seen a steady decrease in fish species and reef health decline. This is purely greed entertaining such a reckless amount higher than zero to take from the ocean. It is well documented our reefs, fish and ocean's health are either near or at collapse. By allowing this not only are you risking my many, many thousands spent each year as a tourist- but more importantly ignoring the health of our planet. Shame on anyone supporting this greedy, disgusting thought of continuing the decline of Hawaiian ocean and reef health.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at danwellert1@hotmail.com

From: Madolin Wells
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 5:43:36 PM

Aloha Mr. Sakoda,

My name is Madolin Wells and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

My additional comment: As a visitor to Hawai'i, Maui, and O'ahu in the 1990's, I was shocked to see the loss of tropical fish 20 years later moving here to Maui to see what's happened to Molokini. I'm concerned about loss of the beautiful exotic fishes like Yellow Tang, Chevron Tang, and Angelfish, but I'm also concerned about the cleaner fishes that groom other fish or the reef itself, providing vital service to the health of many other species.

Short-term profits ignore even the medium- and long-term economic health of the Hawai'i and its visitor industry. But above all, it is morally and ethically reprehensible. Fragile, precious eco-systems cannot survive this kind of looting.

Please stop aquarium plunder!

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at wellsmadolin@gmail.com

From:	Les Welsh
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 2:47:37 PM

Aloha Mr. Sakoda,

My name is Les Welsh and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Puna

Hilo

Hamakua

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Welshl@nwf.org

From:	Laurel Whillock
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Tuesday, April 6, 2021 9:41:15 PM

Aloha Mr. Sakoda,

My name is Laurel Whillock and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

South Kohala

My additional comment: Hawaii's reef and coral populations need every available advantage in order to recover from the current damage they're experiencing and in order to be healthy enough to face future difficulties from rising sea temperatures, higher surf, wind wave erosion and polluted freshwater run-off. A healthy and steadily increasing fish population is integral for this recovery. Taking any reef fish from Hawaiian waters for the tropical fish aquarium trade is detrimental and must be banned.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at lwhillock@hawaiiantel.net

From: James Whillock
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 8:41:44 PM

Aloha Mr. Sakoda,

My name is James Whillock and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native

Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

North Kohala

South Kohala

My additional comment: Why would you even entertain opening up collecting for seven people who could/would significantly damage the system? Allowing this does not help our economy in any way. Let the fish populations continue to grow and our reef system will become healthy again.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Jwhillock@hawaiiantel.net

From: Toni White
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Saturday, April 3, 2021 12:20:11 PM

Aloha Mr. Sakoda,

My name is Toni White and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Unfamiliar with these reefs, but still concerned.

My additional comment: Their revised EIS is not much better than the original:

It still denies the scientifically proven, significant impacts of aquarium collection in West Hawaii
Claims that taking over 246,000 fish each year won't cause population declines
Claims there would be no adverse natural, socio-economic, or cultural impacts that need addressing
Disregards that the largest surge in Yellow Tang abundance ever documented has nothing to do with the closure of West Hawaii aquarium collection in 2018
Prior to the 2018 West Hawaii ban, the aquarium trade reported taking nearly two times more reef fish than all food fishers, combined. 98% of those animals were herbivores, an important fish group that even DLNR admits should be left on the reef to help build resilience to climate change impacts. Yet, under the proposed revised draft EIS, the number of herbivorous fish taken for aquarium hobbyists outside Hawaii would still amount to more than are taken by food fishers.

Further, two of the eight species that would be taken under their new proposal are so fragile in captivity, that they are sold and shipped at retail without any "Arrive Alive" guarantee. Making matters worse, one of those species, Potter's Angelfish, is endemic to Hawaii, found nowhere else on Earth. Of course, this doesn't concern the collectors or the wholesalers who only need to get those fish on a plane and out of Hawaii to make their profit.

Wasting our important marine life for a deadly hobby thousands of miles away is not environmentally or ethically justifiable. Now that these fish can be aquacultured, there is no excuse to take them from the wild.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at toniwhite007@gmail.com

From: Toni White
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Saturday, April 3, 2021 12:20:49 PM

Aloha Mr. Sakoda,

My name is Toni White and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Unfamiliar with these reefs, but still concerned.

My additional comment: Their revised EIS is not much better than the original:

It still denies the scientifically proven, significant impacts of aquarium collection in West Hawaii
Claims that taking over 246,000 fish each year won't cause population declines
Claims there would be no adverse natural, socio-economic, or cultural impacts that need addressing
Disregards that the largest surge in Yellow Tang abundance ever documented has nothing to do with the closure of West Hawaii aquarium collection in 2018
Prior to the 2018 West Hawaii ban, the aquarium trade reported taking nearly two times more reef fish than all food fishers, combined. 98% of those animals were herbivores, an important fish group that even DLNR admits should be left on the reef to help build resilience to climate change impacts. Yet, under the proposed revised draft EIS, the number of herbivorous fish taken for aquarium hobbyists outside Hawaii would still amount to more than are taken by food fishers.

Further, two of the eight species that would be taken under their new proposal are so fragile in captivity, that they are sold and shipped at retail without any "Arrive Alive" guarantee. Making matters worse, one of those species, Potter's Angelfish, is endemic to Hawaii, found nowhere else on Earth. Of course, this doesn't concern the collectors or the wholesalers who only need to get those fish on a plane and out of Hawaii to make their profit.

Wasting our important marine life for a deadly hobby thousands of miles away is not environmentally or ethically justifiable. Now that these fish can be aquacultured, there is no excuse to take them from the wild.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at toniwhite007@gmail.com

From: Lisa Whitten
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 2:22:41 PM

Aloha Mr. Sakoda,

My name is Lisa Whitten and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: Having grown up snorkeling off of Maui's shores, I have noticed a decline in reef health and in overall fish numbers. I would like to see more relation in the collection of reef fish for aquariums.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Jaliwhit333@aol.com

From: Linda Willaby Willaby
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Sunday, April 4, 2021 3:17:57 PM

Aloha Mr. Sakoda,

My name is Linda Willaby Willaby and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

South Kona

Puna

Hamakua

South Kohala

My additional comment: Fragile tropical fish, who were born to dwell in the majestic seas and forage among brilliantly colored coral reefs, suffer miserably when they are forced to spend their lives in glass tanks. Robbed of their natural habitats and denied the ability to travel freely, they must swim around endlessly in the same few cubic inches of water.
The popularity of keeping tropical fish has created a virtually unregulated industry that catches and breeds as many fish as possible with little regard for the animals themselves. While many species of coral are protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora, most of the fish who end up in aquariums are not.
An estimated 95 percent of saltwater fish sold in pet shops come from the wild, mostly from the waters around Indonesia, the Philippines, Fiji, and Hawaii. Half the affected fish die on the reef, and 40 percent of those who survive the initial poisoning die before they reach an aquarium.
I am very familiar with the coral reef off Kehena Beach in lower Puna. In the 12 years that I have lived here I have seen the reef fish populations decline significantly.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at lwparisfrance@hotmail.com

From: Sharon Willeford
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 2, 2021 6:11:04 PM

Aloha Mr. Sakoda,

My name is Sharon Willeford and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

South Kohala

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Slwsurfing@gmail.com

From: Nicole Winegardner
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Friday, April 9, 2021 4:44:23 PM

Aloha Mr. Sakoda,

My name is Nicole Winegardner and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at nwinegardner@gmail.com

From: William Wingert
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Saturday, April 3, 2021 11:18:11 AM

Aloha Mr. Sakoda,

My name is William Wingert and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: Kahaluu Two Step, Puako. I'm familiar by being in the water at the first two locations many times. I've noticed way less fish at bothe places over these last 11 years. Also coral dying out. Only familiar with the reef fish being taken for off island aquariums since my friend forwarded this to me but I find it appealing that commerce is being allowed to destroy the beauty that is here in Hawaii in this way. I hope it's not foolish to think that Hawaii's legislators will protect the island and the Aina over the destructive and short sighted business interests outlined in these pages.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at frozenmusic2003@yahoo.com

From:	Anita Wintner
To:	david.sakoda@hawaii.gov
Cc:	lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject:	Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date:	Thursday, April 8, 2021 1:49:54 PM

Aloha Mr. Sakoda,

My name is Anita Wintner and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

Unfamiliar with these reefs, but still concerned.

My additional comment: No more aquarium fish collecting

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at anitabanana@hawaiiantel.net

From: Sharin Woloshin
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 12:49:47 PM

Aloha Mr. Sakoda,

My name is Sharin Woloshin and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: I have been free diving the Maui area 2-3 times a week for 6 years. This year seems to be one of the worst years for the reef fish. The decline in what I see is startling. I'm not sure if it's because of a bycatch for shore fisherman or not. But this is not a good year to start having an outside collection interest. Number are down all over Maui.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Ssjordal@gmail.com

From: Angela Woolliams
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 1:56:12 PM

Aloha Mr. Sakoda,

My name is Angela Woolliams and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: We need to be better stewards of our oceans and do more to protect the fragile ecosystems within it. For too long humans have treated it like a garbage bin and have been blasé about the demise of species due to human activity like shark finning, aquarium collecting, and overfishing. It needs to end.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at Awoolliams1@yahoo.com

From: Jill Wright
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 3:45:54 PM

Aloha Mr. Sakoda,

My name is Jill Wright and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment:

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at flippersvim@yahoo.com

From: John Wright
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 9:01:45 PM

Aloha Mr. Sakoda,

My name is John Wright and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Ka`u

North Kohala

Puna

Hilo

Hamakua

South Kohala

My additional comment: I've been a physician resident of Hawaii since 1982, having lived in Honolulu, Maui, Hilo, & most recently Kona. I noticed a severe and drastic decline in coral reef fish over several decades. This is not the Hawaii that my children once knew, nor what I want my grandchildren to experience. HAWAII REEF FISH BELONG IN HAWAIIAN WATERS, not in the exotic fish tanks of the "rich & famous" on the mainland, nor beyond that. I have personally seen, the last couple years, an improvement in reef fish populations, again while snorkeling, in South Kona, since the Hawaii Supreme Court's moratorium on reef fish "harvesting" (I'd call it slaughter by willful neglect, and not "harvesting"). REEF FISH ARE NOT A CROP TO BE HARVESTED. I have personally witnessed, on several occasions, the last 2 years, the continued & illegal "harvesting" of reef fish in South Kona. Unfortunately, Hawaii State DLNR cannot respond fast enough to reported poaching. Making it easier for poaching, or for "harvesting" IS NOT THE ANSWER. Please save our reef fish for future generations. We wouldn't think of "harvesting" Native Hawaiian Birds, would we? Of course not. Hawaii Reef Fish MUST HAVE State protection!. Thank You, John Paul Wright, M.D. (808) 281-0419

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at hijohn@prodigy.net

From: Linda Wright
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 5:48:49 AM

Aloha Mr. Sakoda,

My name is Linda Wright and I am a Part time Hawaii resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment: In the thirty years I have been diving in Hawaii the decline of the reef life has been alarmingly noticeable. I am concerned that we are on the threshold of the death of our oceans. As stewards of our planet we owe it to our future generations to begin to mend the destruction of our planet's oceans. It does not take a scientist to see that we are gambling with a our own survival as a species when we see the diminishing returns of our practices. Please pay attention to what we are witnessing in our own lifetime. Make a change and save our reefs.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at thatswright@sbcglobal.net

From: Jim WYBAN
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 9:25:27 PM

Aloha Mr. Sakoda,

My name is Jim WYBAN and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

Puna

Hilo

My additional comment: I owned a shrimp breeding company based at NELHA in Kona for

20 years. Whenever we would deliver our live, farm-raised shrimp broodstock to Kona airport to ship to Asia, we would be far outnumbered in boxes to ship by the reef fish collectors shipping out. Their catch reports are, for sure, massively underreported. All of these reef fish could be produced by aquaculture but as long as collectors can catch them off the reef, aquacultured-fish can't compete on price. Aquarium fish aquaculture could be a great sustainable industry for Hawaii, we just need to ban ocean collections. In addition, I'm an avid snorkeler on Big Island since early 1990s and have observed a radical decline in reef fishes in both Kona and Hilo. Hawaii's reef fish are far more valuable in their natural habitat than the little money made by off-shore collector brokers. Reef fish collecting is a not sustainable - it is extractive and should be left behind in the 20th century.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at jim@hiplan.biz

From: Marla Wynn
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 2:51:43 PM

Aloha Mr. Sakoda,

My name is Marla Wynn and I am a Full time Hawaii Island resident. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

My additional comment: I am a recently certified Scuba Diver. Prior to getting certified, I had only snorkeled in Hawaii, but still felt we need to protect our reefs for the survival of our planet and the humans living on it. Now that I am certified and have had an opportunity to observe ocean wildlife and explore our reefs, I am more convinced than before we need to stop harming our reefs. Allowing the collection of our reef fish for private aquariums seems very selfish and irresponsible. The benefits definitely do not outweigh the costs in my opinion.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at mjywnn0903@gmail.com

From: Mike Young
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Wednesday, April 7, 2021 4:24:57 PM

Aloha Mr. Sakoda,

My name is Mike Young and I am a Full time resident of Maui, Oahu, or Kauai. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

Unfamiliar with these reefs, but still concerned.

My additional comment: I have been snorkeling in Oahu bays regularly for more than 20 years. I had noticed the decline in those species.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at hippiepriest@gmail.com

From: Jeffrey Zankel
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on Revised DEIS for Commercial Aquarium Collecting in West Hawaii
Date: Tuesday, April 6, 2021 8:18:01 PM

Aloha Mr. Sakoda,

My name is Jeffrey Zankel and I am a Visitor/non-resident/concerned citizen. I am concerned about the impacts of the aquarium trade on the following species:

Yellow tang

Potter's Angelfish

Orangespine Unicornfish

Kole

Chevron Tang

Bird Wrasse

Brown/Lavender Tang

Thompson's Surgeonfish

My specific concerns about those species include:

The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.

The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.

The DEIS did not describe how abundance is diminished by aquarium collecting.

The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.

The DEIS minimized the impacts of aquarium collecting on these species.

The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species

The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.

Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.

The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.

The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,

The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.

I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s):

North Kona

South Kona

Hilo

South Kohala

My additional comment: I come to Hawaii to scuba dive. My interest is in seeing healthy reef fish populations. Hawaii's reputation in the scuba diving community has gone down over time because the reefs have been overfished by the aquarium trade. If you can protect these reefs there will be more interest in diving there. This has proven bring far more jobs and revenue than removing the fish can.

The DEIS failed to accurately describe the undeniable and significant environmental, socio-economic, and cultural impacts of what it proposed.

I can be reached at granpajeffrey@gmail.com

From: William Walsh
To: david.sakoda@hawaii.gov
Cc: lynchjm.wa@gmail.com; VanDeWalle, Terry
Subject: Comments on WHRFMA Commercial Aquarium Permits-Revised Draft EIS
Date: Tuesday, April 6, 2021 4:06:33 PM

Aloha. I am submitting the following comments in strong support of the Applicant's action to allow continued commercial aquarium collection in the West Hawai'i Regional FMA (WHRFMA). The following points are from the DLNR/DAR Nov. 2019 Report to the Thirtieth Legislature 2020 Regular Session - Findings and Recommendations of Effectiveness of the West Hawai'i Regional Fishery Management Area (WHRFMA).

* In 1998, The West Hawai′i Regional Fishery Management Area (WHRFMA), which spans the entire coastline of West Hawai′i, was created by Legislative Act 306 (1998) largely in response to long-standing and widespread conflict surrounding commercial aquarium collecting.
* To accomplish the mandates of Act 306, a community advisory group, the West Hawai′i Fishery Council (WHFC) was convened by the Division of Aquatic Resources (DAR) in 1998. The first accomplishment of the WHFC was the designation of a network of nine Fish Replenishment Areas (FRAs), in which aquarium collecting was prohibited. The FRAs, along with other existing aquarium protected areas, comprise 35% of the coastline.
* The Hawai′i marine aquarium fishery has been the most economically valuable commercial inshore fishery in the State with Fiscal Year 2017 average reported landings greater than $2.2 million.
* In West Hawai′i, the aquarium fishery has undergone substantial and sustained expansion over the years. Total catch and market value increased by 29% and 143% respectively since FY 2000. Approximately 26% of both the total number of aquarium fish caught in the State and value of the catch was from West Hawai′i in FY 2017.
* Concerns over continued expansion of the West Hawai′i aquarium fishery and over-harvesting in the open areas prompted DAR in 2013 to establish a 'White List' of 40 species which can be taken by aquarium fishers. All other species of fish and invertebrates have been off-limits to aquarium collectors in West Hawai′i since that time.
* Of the 40 collected aquarium species taken prior to the closure of the fishery, Yellow Tang comprise 82% and Kole 9% of the total catch (FY 2017).
* DAR has been monitoring West Hawai′i reefs and populations of reef fishes for over 20 years. Over this period, 82 survey divers have conducted over 8,700 underwater transects at more than two dozen sites along the coast.
* The FRA network has successfully driven an increase in the population of Yellow Tang. In the 20 years after the closure, the population of Yellow Tang has increased 165% in the FRAs, 74% in existing Marine Protected Areas (MPAs) and 101% in the Open Areas.
* Overall Yellow Tang abundance in the 30'-60' depth range over the entire West Hawai′i coast has increased by over 3.4 million fish (150%) from 1999/2000 to 2017/2018 to an estimated population of 5.7 million fish.
* A 2009 study of adult Yellow Tang in their shallow water habitats (10'-20' depths) found no significant differences in the abundance of adult Yellow Tang in open vs. closed areas.
* Yellow Tang populations at two of three long-term monitoring sites in South Kohala (Puakō) and South Kona (Ke′ei) have recovered to levels found over three decades ago, prior to the expansion of commercial aquarium collecting in West Hawai′i.
* Comparative surveys utilizing DAR and NOAA data subsequent to FRA establishment, indicate Yellow Tang are substantially more abundant in West Hawai′i over most size ranges than in any of the other islands in the Main Hawaiian Islands and the Northwestern Hawaiian Islands.
* The FRAs have also been very successful in increasing Kole populations. In the 20 years after FRA closures, Kole populations have increased 85% in the FRAs, 120% in the MPAs and 97% in the Open Areas.
* Overall Kole abundance in the 30'-60' depth range over the entire West Hawai′i coast increased by almost 5.2 million fish (118%) since FRA establishment on 31 December 1999, with a current estimated population of about 9.6 million fish.
* As with Yellow Tang, DAR and NOAA data indicate Kole are substantially more abundant in West Hawai′i over most size ranges than in any of the other islands in the Main Hawaiian Islands or the Northwestern Hawaiian Islands.
* Six of seven of the top 3-10 collected species had long-term population increases in one or more of the

management areas since FRA establishment (1999/2000). The notable exception was Achilles Tang (Acanthurus achilles) which declined in all areas, significantly so in Open Areas and FRAs.

* Achilles Tang is the fourth most collected species in the West Hawai′i aquarium fishery although relative to Yellow Tang and Kole, the numbers collected are low, representing only 1.7% of the total FY 2017 catch.
* Commercial aquarium landings of Achilles Tang have been declining in West Hawai′i over the past two decades. This has occurred in association with a 192% increase in the ex-vessel value of the fish since 2008, suggestive of declining availability (i.e. abundance).
* DAR Shallow Water Resource Fish (SWRF) surveys indicate a significant (90%) decrease in Achilles Tang biomass in their primary adult habitat since 2008 when the surveys were first conducted. Achilles Tang were observed on 73% of transects in 2008 but only on 38% in 2018.
* Given the overall evidence for a marked decline in the population of Achilles Tang in West Hawai′i, a reduction in the aquarium bag limit or a moratorium on aquarium collecting for this species, in conjunction with a conservative bag limit for other fishers should be considered and implemented.
* For most of the species on the White List, collecting impact, in terms of the estimated percentage of the Open Area population being removed annually by aquarium collectors, is relatively low with nine species having single digit percent catch and 21 species having catch values of <1% of the total estimated population in the Open Areas (30'-60' depth range).

* Benthic monitoring at West Hawai′i sites indicates that commercial aquarium collecting is not having a measurable negative impact on percent coral cover or change in coral cover over time.
* In West Hawai′i, the aquarium fishery took 1.8X the number of total reef fishes taken by recreational and other commercial fishers combined. However, if Yellow Tang, which is primarily harvested at small sizes and not targeted by other fishers, is excluded, the recreational and commercial fisheries took 3X the total number of reef fishes caught by aquarium collectors.
* The effectiveness of the West Hawai′i FRAs for aquarium fish suggests it would be prudent to establish MPAs for other resource species throughout Hawai′i as a precautionary measure against overfishing and for restoration of marine resources. Currently, less than 1% of nearshore areas in the Main Hawaiian Islands are fully protected by MPAs.

The scientific findings of over 20 years of coral reef monitoring clearly show that the existing network of Fish Replenishment Areas (FRAs) has led to the sustainable management of the West Hawai'i aquarium fishery and resulted in substantial population increases of most of the most heavily collected species. The Revised Draft EIS proposes substantial reductions in overall catch both in terms of numbers of fish and the species which can be collected. Thus, there is strong scientific support for continuance of the proposed scaled down WHRMA aquarium fishery.

Mahalo,

William j Walsh PhD.

Aquatic Biologist Retired

Hawaii Division of Aquatic Resources

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808-328-8041 home

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April 8, 2021

Marie Aguilar
P.O. Box 1874
Kailua Kona Hawai`i 96745

DLNR
David Sadoka
1151 Punchbowl Street Room 300
Honolulu, Hawai`i 96813-3088

Re: Issuance of Commercial Aquarium Permits of Marine Licenses for West Hawai`i Regional Fish Management - Revised EIS - Party submitting - Pet Industry Joint Advisory Council

Aloha Mr. David Sadoka,

I am a long-time resident of Hawai`i Island and know first-hand the conditions of the impact of fish collection on my island. First, the seriousness of the loss of our coral on the Hawai`i coasts is listed as severe and may not recover anytime soon. The State of Hawai`i has a responsibility to protect Hawai`i's natural resources. The tropical fish of Hawai`i are declining year after year. and I have seen the decline from 1988 through 2021. Yellow tang swam along the Kailua Pier and their visual presences created the name "Gold Coast" of the Big Island.

The effects of environmental conditions have to be taken into consideration for the future of maintaining the population of our tropical fish populations. The recent Revised Draft Environmental Impact Statement from Pet Industry Join Advisory Council continues to be flawed. First, there is an impact of a collection of tropical fish collecting on the population. The population of reef fish is declining due to serious ocean warming waters which affect coral life. The damage is severe to our coral from the warm waters several summers and needs to replenish or recover if it is possible. Our coral reefs live symbiotically with tropical fish to flourish and nurture.

The Supreme Court in 2017 held that collection without environment review violates the Act, and DLNR later ordered to cease issuing further aquarium collection permits until the environmental effects of aquarium collection are fully and publicly vetted through the HEPA process. Previously the heaviest impact to our fish collection is the lack of holding the permit holders with a limit to their taking aquarium fish. Now the new revised EIS states the eight species collected per month. The eight species being requested for collection are extremely high.

The collection of 200,000 yellow tangs can not be allowed through seven permittees, it does not access those that died in transport. If each of these operators owns two boats and has staff using that license, they could collect in South Kau and North Kohala each day. The fish population could not possibly be restored monthly while being collected each day, weekends included. There is no expiration on these permits and could run collectively year after year.

Today, the same permit holders want to be able to take aquarium fish with limits, this is not acceptable for our ecosystem. State of Hawai`i, DLNR does not have the staff to monitor these seven permits and get actual limits accounted for each day and monthly. This most definitely will not support what the Supreme Court ruled. There is no management of the fish collection limits demonstrated in this summited EIS. Self-monitoring is not acceptable.

The most startling outcome of this Revised Draft Environment Impact Statement written by the Pet Industry Joint Advisory Council is this Council has a conflict of interest in presenting a proposal for the whole benefit for the retailing of our reef fish. They support aquarium fish pet stores throughout the mainland. Their impact statement is false, their statements do not provide the actual outcomes. of the fish population from fish collecting. They have deleted facts. The collection of Hawai`i's natural resources cannot be open for sale to the mainland aquarium trade. The going prices for these fish start at $60.00 for a yellow tang. What gain is Hawai`i's residents gaining for allowing the collection of their natural resources? No revenue can replace our ocean ecology. Do not accept this bargain hunter's profitable business for mainland commerce. PIJAC's study does not support factual counts of tropical fish in WHRFD.

In their Revised EIS, there is no mention of who the seven (7) permit holders are and who they represent. Are these permit holders, actual residents of Hawai`i? Can we seriously trust the permittees who have access to our reef fish for three hundred sixty- five days? There are weekends that DLNR would have issues with patrolling all of the west coasts of Hawai`i Island. Is DLNR requiring bonds for each of the permit holders? Our fish population will not recover. Recently, the County of Hawai`i and Mayor Roth presented a Sustainability Summit. The Summit successfully showed community leaders what sustainability means in the scope of all of our resources. Among our resources, the County of Hawai`i presented Waste Management, Sustainable Tourism, Technology, Preserving the Environment, Energy, Health Care, Education, Affordable Housing, Economy, Transportation, Food Security, Aloha + Challenge.

Greg Asner, scientist of Global Institute of Sustainability Airborne Observatory (University of Arizona State) understands conservationism through his scientific

approach to mapping the coral reefs of the Hawaiian Islands. Through Asner Labs, using Global Airborne Observatory technology to generate a mapping of the coral health, beginning in mid- 2019. This technology and its mapping will save our coral reefs in the future. The Hawaiian Islands are globally important case-in-point. In less than fifty years, Hawai`i's unique and highly endemic coral reefs have undergone alarming losses in coral extent and health as well as in fish populations. The Hawaiian Islands are now in a state of extremely variable reef conditions driven by a complex mosaic of coastal development, overfishing, and ocean warming. In response to these alarming losses, Hawai`i Governor David Ige announced a new effort in 2016 to manage and conserve at least 30% of Hawaii's reefs by 2030, known as the Marine 30x30 Initiative. Currently, Hawaii's reefs remain unmanaged. He is based here in Hawai`i, and showed maps of depletion of the tropical fish using his satellite imagery showing ten years of depleted sea life on the west coast of the Island of Hawai`i. Those images do not lie, they show the loss of our natural resources – tropical fish and the ocean coral reefs. Sustainability does not include fish collection. The State of Hawai`i through the direction of Governor David Ige has granted the Marine 30x30 Initiative in 2016, and it is the responsibility of DLNR to follow the protocol of this important mapping and study for our coral reefs and its tropical fish population. Hawai`i is sustaining its resources and must continue the protection of its marine life.

Each member of our County government knows the importance of Sustainability in each area of government. Our island and our ocean must be protected by the State of Hawai`i and the County of Hawai`i. Please reject this EIS for Pet Industry Joint Advisory Council. Their trade is not needed. Tropical fish are now being raised at the State of Hawai`i -Natural Energy Labs for that purpose. Their breeding system is working, so please leave our natural resources alone. It is your responsibility.

I oppose any fish collections on the Island of Hawai`i, specifically the West Hawai`i Regional Fish Management (west coast) especially as the Revised EIS Draft indicates from Ka`u to Kohala. Our island depends on economically sustainable tourism where tour operators bring visitors to snorkel, dive and swim and view our pristine waters. We cannot have seven permit holders taking our natural resources for their economic benefit. It is true, third world countries protect the collection of their reef fish, and Hawai`i must continue the restriction on any fish collection for years to come.

The Board of Land and Natural Resources voted anonymously for the dis-allowance of the previous Draft EIS, and if they voted again, they would vote the same. Not much has changed, illegal collectors have been caught red-handed in collecting our tropical fish and tried in the courts. Penalties were severe in some

cases, however, were they ever collected and paid to the State of Hawai`i? The fish collector applicants can find another form of economic standing, not at the cost of our resources that are currently being protected by our Governor. Hawai`i residents, its sea life tour boat owners, and operators depend on these natural resources. They protect our environment and are invested in our community. Most of our businesses on Hawai`i Island flourish with tourism.

Our economy is semi-dependent on eco-tourism, sustainability tourism, and agri-tourism. We have learned a hard lesson with the COVID 19 Pandemic. Our islands flourish with visitors who support our state. These visitors support our economy, enjoying our environmental friendliness, and expect us to care for our resources. Hawai`i's economy does depend on tourism. Aloha + challenge remains a part of our Hawaiian lifestyle.

Thank you for reading my comments and recording the receipt of this letter.

Mahalo

Respectfully,

Marie Aguilar

Additionally, presenting the Native Hawaiian culture in fishing, fish netting, and its marine tools was educational to the reader, however, there is no similar correlation to the Revised EIS to those collecting tropical fish. Native Hawaiians were fishing, fish netting fish for human consumption for their families. They are living sustainably, providing for their families.
Mahalo

DAVID Y. IGE
GOVERNOR OF
HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF AQUATIC RESOURCES
1151 PUNCHBOWL STREET, ROOM 330
HONOLULU, HAWAII 96813

April 9, 2021

Pet Industry Joint Advisory Council
c/o Mr. James Lynch
1615 Duke St., #100
Alexandria, VA 22314

Comments on Revised Draft Environmental Impact Statement: Issuance of Commercial Aquarium Permits and Commercial Marine Licenses for the West Hawai‘i Regional Fishery Management Area

The Department of Land & Natural Resources (DLNR), Division of Aquatic Resources (DAR) submits the following comments on the Revised Draft Environmental Impact Statement (RDEIS) on the Issuance of Commercial Aquarium Permits and Commercial Marine Licenses for the West Hawai‘i Regional Fishery Management Area.[1]

DAR has critically examined the RDEIS submitted by Pet Industry Joint Advisory Council (PIJAC). Our goal was to assess whether or not it adequately discloses impacts associated with the proposed issuance of 7 aquarium fishing permits for the West Hawai‘i Regional Fishery Management Area (WHRFMA). For this effort, we began with the points raised by the Board of Land and Natural Resources (BLNR) in their Findings and Reasons for Non Acceptance of Final Environmental Impact Statement (FEIS) Regarding Proposed Issuance of Commercial Aquarium Permits, Commercial Marine Licenses, and West Hawai‘i Aquarium Permits for the WHRFMA, issued May 30, 2020. We evaluate whether the RDEIS adequately addresses these concerns.

1 As the approving agency, DLNR is responsible for determining whether the Environmental Impact Statement (EIS) adequately discloses the reasonably anticipated impacts of the proposed action. The EIS need not be exhaustive to the point of discussing all possible details bearing on the proposed action but will be upheld as adequate if it has been compiled in good faith and sets forth sufficient information to enable the decision-maker to consider fully the environmental factors involved and to make a reasoned decision after balancing the risks of harm to the environment against the benefits to be derived from the proposed action, as well as to make a reasoned choice between alternatives. Finding that the EIS adequately describes the environmental impacts of a project does not mean that the project must be approved. As stated above, it just provides information on which the agency can make a reasoned decision.

Findings and concerns raised by the Board of Land and Natural Resources

Many of the issues brought up by the BLNR have been addressed in the RDEIS by the addition of a new preferred alternative that incorporates individual catch quotas and a reduced white list. These two conditions were designed to clarify questions surrounding estimated future take and mitigate concerns regarding collection of species in decline or those with little data. Here, we provide comments on how the RDEIS addresses each of the points raised by the BLNR.

1. In order to properly assess the likely impact of the proposed take of the aquarium fish, the FEIS should contain a reasonably reliable estimate of the amount of future take.

    - This point has been addressed via the suggestion of catch quotas for each species. The applicant now discusses impacts in relation to the maximum allowable catch under this quota system.

2. Except for the pākuʻikuʻi, or Achilles tang, the FEIS does not contain any daily bag limits on any of the "White List" species which the fishers are allowed to take, and there are no annual limits on the take of any species except that the total take of pākuʻikuʻi would be limited by the fact that only ten permits with a daily limit of five each would be allowed under the proposed action. In addition, there is no scientific basis provided for reducing daily take of pākuʻikuʻi from ten to five per permit, nor any analysis of the impact of that level of take on the population of pākuʻikuʻi.

    - This point is also addressed by the creation of species-specific catch quotas. There are now annual limits for each species on a per-fisher basis. The issue regarding pākuʻikuʻi is addressed via the reduced white list of 8 species. Under this proposed alternative, no take of pākuʻikuʻi would be allowed.

3. The existing regulations of the WHRFMA do not contain any daily or annual bag limits other than for the pākuʻikuʻi, a "slot limit" for yellow tang, and a limit on kole over 4" long. To project how many fish are likely to be taken, the FEIS relies completely on the historical catch records of these ten fishers for the forty "White List" species. See Tables 5-2 and 5-11. The FEIS concludes that 160,832 fish would be taken annually, based on the maximum number taken by the ten permittees in any year, during the 2000-2017 period. See §5.4.1.5.

    - The new preferred alternative that includes catch quotas addresses this by setting a cap on allowable take in a given year.

4. It appears that no more than 8 of the 10 fishers were active in any previous year. See Table 4-2. It seems likely that all ten fishers will be active, given they had sufficient interest in the permits to fund the EIS, and that they will have a monopoly on the use of fine-mesh nets to collect fish in the WHRFMA.

- This point was determined to be arbitrary and capricious by the Office of Environmental Quality Control.

5. The FEIS has no information about the level of effort of these 10 fishers in prior years, i.e. whether they collected 100, 200, or 300 days a year, for example, and the amount of time spent collecting. It is possible that they could significantly increase their collection efforts and total take.

    - This point is addressed via the creation of individual catch quotas. Under this alternative, fishers would be limited to their yearly quota for each species regardless of their level of effort.

6. The fishers could also or alternatively change what species they target for collection and increase the impact on some species.

    - The yearly quota system proposed sets a per-fisher limit on each species. Under this system, a fisher changing which species they target would not alter the impact disclosed in section 5.4.1.7 of the RDEIS.

7. The data in the FEIS show that these ten fishers take some species at a very different rate than the fishery as a whole. For example, although the percentage taken of all species by the ten in the WHRFMA varies from a low of 7.0% in FY2000 (when only two were active) to 46.4% in FY2017 (Table 5-2), their percentage of take of individual species, at least in certain years, has been much higher. Table 5-11 gives the maximum catch in any one year for each of the "White List" species, and the maximum catch in any one year by the ten. The ten fishers took 83.7% of the lei triggerfish (252/301), 95.5% of the milletseed butterfly fish (402/421), and 89.2% of the Fisher's angelfish (257/288), and 54.6% of the kole (23,014/42,122.) On the other hand, they took only 9.1% of the ornate wrasse (1130/12,445). This demonstrates that collectors can, and do, selectively target some species more than others. (It is not clear whether the maximum year given for all collectors is the same year as that given for the maximum by the ten fishers. The basic point made here is valid in either case, however.)

    - The yearly quota system proposed sets a per-fisher limit on each species. Under this system, a fisher changing which species they target would not alter the impact disclosed in section 5.4.1.7 of the RDEIS.

8. In order to assess the likely impact of the take, the FEIS should adequately analyze the sustainable level of take. The FEIS relies on Ochavillo and Hodgson (2006) for the proposition that 5-25% of a population is a sustainable level for annual take. The FEIS has an inadequate justification for the reliance on this publication as the best available science. The FEIS does not provide data for nor statistically analyze the sustainability of that level of take for each type of fish, given each fish species' life span, population size, reproductivity rates and age at first reproduction.

- In comparison to the 2020 FEIS, the RDEIS relies more heavily on population trend data to determine sustainability of take, particularly in their criteria for species inclusion in the revised white list. There remains, however, a heavy emphasis on the Ochavillo and Hodgson (2006) paper to justify the proposed level of take. There are several issues with the use of this document in the RDEIS including the lack of peer review, unclear sampling and analysis protocols, and the study location (Philippines). Further, this document is specifically looking at total allowable catch, rather than catch from a single fishery. Therefore, even if take by the aquarium fishery is below the "sustainable level", a species could still be in decline due to the combined effect of all types of fishing. A better approach for this RDEIS would be to assess sustainability by utilizing trend data and simply report the proposed take as a percentage of population estimates without suggesting that this percentage is sustainable based on Ochavillo and Hodgson (2006).

9. In §5.4.1.5, the FEIS uses Table 5-11 to compare the take of various species to the CREP population estimates, to show that they are well below the claimed 5-25% sustainable level. In Table 4-5, however, the harvest/population ratios of four or five species (depending on the year) in the West Hawai'i open areas at 30'-60' depth exceeded 5% for several species, and are as high as 39.67% for the paku'iku'i in 2017-2018. The West Hawai'i open area population estimates may be more relevant than the island-wide CREP data.

    - The RDEIS utilizes the PIFSC-ESD (formerly CREP) dataset to give a population estimate limited to the WHRFMA, which is more applicable than the previous island-wide estimates given in the 2020 FEIS. The applicant also includes estimates from DAR Kona's West Hawai'i Aquarium Project data for open areas as well as throughout the WHRFMA.
    - The revised white list in the preferred alternative no longer includes paku'iku'i.

10. The FEIS has an inadequate discussion of the role of herbivores. Many of the "White List" species are herbivores.

    - The applicant has revised their section on impacts to biological resources to include a discussion on the role of herbivory. While this section does state the importance of herbivores to coral reef systems, the authors conflate ideas of resilience and recovery, indicating that there is "conflicting data on the role of herbivores on reef resiliency". While there is less evidence for the role of herbivores in allowing a reef to fully recover to its precise original state, there is ample support for their role in creating a reef system that is resilient to perturbation.

11. The FEIS does not adequately discuss relevant negative findings, for example, the reduced numbers of aquarium fish at collection sites found by Tissot and Hallacher (2003). The FEIS need not agree or disprove the negative findings, but it should discuss them.

    - This point was determined to be arbitrary and capricious by the Office of Environmental Quality Control.

12. The extreme threat of climate change on our reefs warrants extreme caution in reviewing activities that may affect them. The FEIS should further discuss potential effects of present and future levels of climate change including ocean warming, ocean acidification, coral bleaching, extreme storms, and resulting reef destruction and algae growth, and the potential for mitigating harm (i.e. further regulation) if the proposed fishery has unanticipated or greater negative effects with climate change.

    - The RDEIS includes a more in-depth discussion on the effects of climate change on coral reefs as well as an overview of the Coral Bleaching Recovery Plan developed by DAR in 2017. Similar to the discussion on herbivores, the applicant suggests that "protection of herbivores is unlikely to improve coral reef resilience to climate change" and that "current fishing pressure only slightly affects herbivorous fish communities". These statements are based on a study in New Caledonia (Carassou et al., 2013) and are not representative of West Hawai'i's ecosystem, fisheries, and management regime. While the section does briefly discuss unanticipated or greater negative effects in the light of climate change, there is no mention of options for mitigating harm via additional regulations in this section, as requested by the BLNR. We suggest including language found elsewhere in the RDEIS that states that, as aquarium permits come up for renewal each year, DLNR can evaluate whether there are significant new circumstances or information relevant to environmental concerns and bearing on the commercial aquarium fishery or its impacts requiring further mitigation measures or supplemental HEPA review.

13. The FEIS failed to sufficiently consider cultural impacts. The FEIS improperly concluded that the impacts to cultural resources under any of the proposed alternatives would be less than significant based on the flawed premise that cultural impacts would only occur if the proposed action would cause a significant decline in the population of a White List Species considered to be a cultural resource. A number of testimonies expressed misgivings from a cultural standpoint with the proposed activity itself, regardless of impact on resources, and this was not adequately considered in concluding no significant impact.

    - This point is primarily addressed by the removal of statements of significance regarding cultural impacts. The applicant also notes that some interviewees stated that they view any collection for aquarium purposes as contrary to their cultural

practices. The RDEIS then concludes that all six action alternatives may impact cultural practices.

14. The FEIS does not adequately discuss the effect of illegal aquarium fishing on the numbers of projected sustainable take of fish species.

    - This point was determined to be arbitrary and capricious by the Office of Environmental Quality Control.

April 9, 2021

David Sakoda
Department of Land and Natural Resources
State of Hawai'i
1151 Punch Bowl Street Rm 300
Honolulu, Hawaii 96813

Dear Mr. Sakoda,

Please accept this letter in support of the Applicant's request to allow continued lawful, sustainable commercial aquarium fish collection of 8 aquarium fish species from nearshore habitats of the West Hawai'i Regional Fishery Management Area (WHRFMA).

As Marine Biologists and long-time curators of respected public aquariums, we know first-hand the importance of sustainable fisheries and the impact that they have not only on the natural environment, but on the local fishers whose livelihoods depend upon them. We have displayed Hawaiian fishes in our facilities for many years and they not only serve as important ambassadors for the beauty of the Hawaiian Islands, but also reinforce to our visitors the importance of well-managed sustainable fisheries to the coral reef ecosystem.

We believe that common sense, science based approaches to fisheries management are vital and support the data that the Division of Aquatic Resources (DAR) has gathered in their more than 20 years of monitoring West Hawai'i reef fish populations.

We support the Applicant's request to revise the previous White List established in 2013 from 40 to 8 species, and to implement individual catch quotas for the 8 species remaining on the proposed Revised White List.

Allowing for sustainable aquarium collections in the West Hawai'i Regional Fisheries Management Area will ensure that public aquariums can continue to inspire and educate millions of visitors promoting sound science based fisheries and coral reef conservation in one of the world's most beautiful marine ecosystems.

Thank you for the opportunity to comment on this important matter.

Sincerely,

Paula B. Carlson
Paula B. Carlson
Director of Husbandry
The Dallas World Aquarium

Chris Coco
Chris Coco
Sr. Director, Zoological Operations
Georgia Aquarium

Tim Carpenter
Tim Carpenter
Curator of Fish and Invertebrates
Seattle Aquarium

Becky Ellsworth
Becky Ellsworth
Curator
The Columbus Zoo and Aquarium

From: Sakoda, David
To: VanDeWalle, Terry
Subject: FW: [EXTERNAL] RDEIS WHRFMA AQ fish Collection in support of No Action Alternative
Date: Friday, April 9, 2021 9:14:38 PM

From: Diane Ware [mailto:volcanogetaway@yahoo.com]
Sent: Friday, April 9, 2021 3:57 PM
To: lynchjm.wa@gmail.com
Cc: Sakoda, David <david.sakoda@hawaii.gov>
Subject: [EXTERNAL] RDEIS WHRFMA AQ fish Collection in support of No Action Alternative

To:
Hawaii Department of Land and Natural Resources
David Sakoda
david.sakoda@hawaii.gov
1151 Punchbowl St. Room 330
Honolulu, HI 96813

Pet Industry Joint Advisory Council (PIJAC)
Via Jim Lynch 206-370-6587
1615 Duke St #100
Alexandria VA 22314
lynchjim.wa@gmail.com

Re: Revised DEIS WHRFMA Aquarium Fish Collecting Permits

Sierra Club strongly believes that "the No Action Alternative regarding open-ocean aquarium collecting is the best and only acceptable alternative". I concur with this evaluation and support research to develop and sustain captive breeding for species used in the aquarium trade.

The applicant did not adequately address several concerns of BLNR's denial of the first DEIS. In particular the deficiencies include #13 regarding adverse cultural impacts revealed and confirmed by numerous Kanaka Maoli. The dismissal of impacts and devaluing of the Hawaiian culture and its practices has been ongoing for 200 years of white colonial domination. As quoted in the CIA , "Kānaka Maoli participation gradually waned (Glazier 2007). As the commercial fishing industry continually expanded to meet the demands of the growing consumer population in the islands, the fish and

other marine resources became more scarce. With the shift to a market economy and a commercial fishery these marine resources were valued mostly for their economic potential, and little to no regard was paid to the myriad of traditional values and more that emphasized the spiritual, cultural, familial, and ecological importance of the fish and other marine species. Maly and Maly (2003:ix) contend that “this trend has continued through the present-day and fostered the decline in health and well-being of the broad range and diversity of Hawaiian fisheries”. Key words here are “more scarce”, “shift to a market (profit) economy” and “no regard to the myriad and ecological importance of the fish.” This process of diminishing the indigenous culture for the profit and control of land and resources has had the effect of a “knee on the neck” of the Hawaiian culture and the few kanaka maoli who have survived two centuries of western supremacy. I would suggest a very comprehensive and inclusive ho’oponopono to achieve some degree of reconciliation and repair of injustices incurred. Making a pause in the practice of aquarium reef fish extraction would be a genuine beginning of the process and result in a return to natural abundance of the reef ecosystem.

Regarding the inadequacy of the RDEIS to address the cultural impacts past, present and future, the document states correctly, "...the Preferred Alternative may impact cultural practices, the extent of the impact is unknown". Furthermore the precautionary principle now applies since the RDEIS does not identify the degree of impact, which will preclude the accepting agency from meeting the requirements of Act 50 and the subsequent state Supreme Court ruling. Since “No cultural impacts would occur under the No Action Alternative”, this action is the best choice.

Re: the 14th reason for non acceptance of the FEIS by BLNR statements made by the applicant regarding poaching seem disingenuous or feigned ignorance of the circumstances of the arrest of 6 collectors over the past year for poaching and at least 1 other collector for boat and safety violations. It is true that many complaints have been made by community members for years but many of the complaints were ignored or acted upon too late. It seems that DOCARE has been more willing to respond since the lawsuits and as complaints have been more insistent although sometimes anonymous. I see no reason to believe the applicant’s statement “In the case of the aquarium industry, community-based enforcement (backed by state regulations) has been adequate to ensure compliance with FRA.” I see no assurance that poaching in FRA’s will not occur under the proposed system of annual quotas. What will deter a collector to continue collecting past the limit and shipping the fish disguised as some other commodity?

Re: #10 and #8 of BLNR denial of acceptance in regard to the inadequate discussion of the role of herbivores and sustainability of collection, I will deflect to the scientific study and evaluation of Greg Asner. The continued reliance on the outdated data by Ochavillo and Hodgson are inexcusable and irrelevant to the Hawaiian reef system.

Re: Cumulative effects of collection are inadequately addressed in the discussions about climate change and the environmental effects of inhumane practices in the warehousing, shipping out of state and placement in hobbyist’s tanks. The applicant falsely claims the trade will lawfully execute their extraction of our precious resources. In reality the trade violates the constitution’s Public Trust Doctrine in Article XII, and the rules overseeing aquarium collection during the warehousing phase. This phase has been ignored by applicant and DLNR which has difficulty enforcing any rules on the books. I am referring specifically to Hawai’i Cruelty to animals Statute 711-1109 and the Aquarium

collection permitting rule 1.2.2–"Except as prohibited by law, the permits shall be issued only to persons who can satisfy the department that they possess facilities to and can maintain fish and other aquatic life alive and in reasonable health."
There is also a law against breaking or damaging coral that is dismissed or ignored by the applicant and DLNR. The applicant proposes that coral damage is infrequent and inadvertent while repeated complaints often accompanied by photos demonstrate the occurrence is quite common. It is rather obvious that coral would frequently be adversely damaged during the practices of collection.

For these reasons and more I urge No Action Alternative as the only environmentally sound course of action.

Sincerely,

Diane Ware
808-967-8642
P. O. Box 698
99-7815 Kapoha
Volcano HI 96785

From:	Sakoda, David
To:	VanDeWalle, Terry
Subject:	FW: [EXTERNAL] RE: RDEIS for WHRFMA - Commercial Aquarium Permits
Date:	Thursday, April 8, 2021 1:05:41 AM

From: Robert Culbertson [mailto:dancingcloudrefuge@gmail.com]
Sent: Wednesday, April 7, 2021 4:41 PM
To: Sakoda, David <david.sakoda@hawaii.gov>
Cc: lynchjim.wa@gmail.com
Subject: [EXTERNAL] RE: RDEIS for WHRFMA - Commercial Aquarium Permits

April 7, 2021

Hawaii Department of Land and Natural Resources
David Sakoda
david.sakoda@hawaii.gov
1151 Punchbowl St. Room 330
Honolulu, HI 96813

Pet Industry Joint Advisory Council (PIJAC)
Via Jim Lynch 206-370-6587
1615 Duke St #100
Alexandria VA 22314
lynchjim.wa@gmail.com

Individual Comments

The proposed regulatory scheme of the Revised Draft Environmental Impact Statement (RDEIS) is as unworkable as any prior submissions and/or actual agency provisions underwritten by DAR. It also continues to fail any test of intellectual integrity and can only hope to succeed through institutional connivance.

The commercial aquarium trade has long operated with fewer regulations, oversight and compliance-verification mechanisms than those that commercial food fisheries must adhere to. The effect has been to create unwarranted 'benefit of the doubt' advantages for both legal and illegal (poachers) collectors. And yet, assertions (without data or evidence) that 'food fishers' may be to blame for some admitted reductions are scattered about in this document. This 'blame shifting' scheme does not belong in such a document.

The data submitted through the RDEIS continues to make a 'shell game' of numbers that fail to account for actual reductions and harms to target species in specific coastal 'neighborhoods'. Meaningful limits should be based on specific areas and biological communities rather than at island wide scale. This complaint has been made by many reviewers in past editions and yet must be made again.

The socio-economic analysis is faulty on several grounds and ignores recent research that poses compelling evidence contrary to the document's stated conclusions ie:, '***Managing Near-shore Fisheries in Hawai'i: A Policy Analysis of the State's Marine Aquarium***

Fishery', (Schaar, 2020). I call on the accepting agency to incorporate by reference this study and ask that it be addressed in any succeeding effort by the applicant.

The RDEIS uses misleading statements such as from page 164: "The Coral Bleaching Recovery Plan looked at a **temporary** moratorium on aquarium collecting as a management action for increasing herbivores, but it was one of the lowest ranked management actions for effectiveness (19th of 22 management actions) (University of Hawai'i 2017). **It should be noted that among the top 10 management actions was prohibition of all take (commercial and non-commercial) of herbivorous fish (ranked 4th)**."
(My emphasis in **bold** is to indicate the modifier '***Temporary'*** is not a lessening of the quality of the action as apparently represented. Rather, it is automatically superseded within the higher rating, as with the taking of any and all herbivores.)

On page 177, the document proclaims, "The Preferred Alternative was specifically designed to help buffer climate change by creating individual catch quotas (i.e., hard upper limits on the number of individuals that could be collected) and implementation of a Revised White List limiting the number of species that could be collected."

It is impossible to understand any 'take' as a 'buffer to climate change'. On the contrary, **every fish** on the reef **already serves** as a tool for reef recovery AND as a buffer to climate change. Therefore, they. should all be conserved!

But perhaps the biggest lie that needs to be challenged is this;
"Research suggests collection of between 5%-25% is sustainable for various reef species similar to those on the White List (e.g., tang, wrasse, butterflyfish, angelfish, triggerfish), and that *collection below 10% of the biomass can increase reef resilience."* (Italics added)
This wild assertion needs to be backed up, but in truth can't be!

Finally, this industry is defined by waste and destruction. And the drive to scarcity for increased value and profitability should be seen as part of its 'business model'.

In pursuit of target species from the reef, the collector's 'pattern and practice' *necessarily* damages living coral and disrupts other living organisms as they plant and then move their feet and gear around the reef.

Then too, at every step up the captivity chain, from puncturing swim bladders, to confinement in holding tanks, to shipping via air freight, losses are built in as part of the market pricing system. But no accounting is attempted in the current or proposed system.

The 'tragedy of the commons' is on clear display!

Since no individual permittee knows to what extent other permittees are taking and perhaps approaching theoretical regulatory limits on a yearly basis, the 'tragedy of the commons' promotes unrestrained taking at every opportunity by individuals in the

water.

This motivation is deeply offensive and completely at odds with a conservation ethic and restraint built into centuries old Hawai'ian cultural traditions.

For these reasons, the accepting agency, on behalf of the public's interest, rights and responsibilities, should reject this Revised Draft Environmental Impact Statement.

Mark O. Tang

Waimea

From: Sakoda, David
To: Jim Lynch; VanDeWalle, Terry
Subject: FW: [EXTERNAL] Revised Draft EIS for aquarium fish collection, West Hawaii
Date: Monday, April 5, 2021 2:16:22 PM

From: Judith Graham [mailto:judithwgraham@gmail.com]
Sent: Saturday, April 3, 2021 2:46 PM
To: Sakoda, David <david.sakoda@hawaii.gov>
Subject: [EXTERNAL] Revised Draft EIS for aquarium fish collection, West Hawaii

Thank you for this opportunity to comment. I'm Judith Graham from Waimea, and have thoughts in three areas.

MAJOR FINANCIAL ELEMENTS OF AN ACCEPTABLE EIS ARE MISSING

The applicant, Pet Industry Joint Advisory Council, is a commercial enterprise although parts of its mission statement are altruistic. It represents retailers, wholesalers and manufacturers in the aquarium industry, and its true basic interest in preparing this revised draft is to ensure that its membership has a supply of Hawaiian reef fish, an important part of the world market. The applicant's final EIS acknowledged that most of Hawaii's reef fish are shipped out and sold to the mainland US, Europe and Asia.

But despite the fundamental and underlying commercial trajectory here, **there is no market analysis or cost/benefit analysis.** These have been standard elements in Hawaii EISs for years.

Below is a chart showing the current retail prices quoted by US mainland online retailers. These online sites are set up similarly to Amazon, and their algorithms now follow me repeatedly online after only a brief inquiry. In short, a sophisticated business.

Species	**Retail**	**Sources**
Orange spine surgeon	$130 - $650	bluezooaquatics.com freshmarine.com
Bird wrasse	80 - 150	Google; Indopacific only
Thompson 's surgeon	55 - 75	Google; all Indopacific
Lavender tang	85	saltwaterfish.com
Black tang	800	amongthereef.com freshmarine.com
(Chevron tang)	240- 250	bluezooaquatics.com freshmarine.com
Potter's angelfish	140- 180	bluezooaquatics.com
Kole	40- 180	petesaquariums.com freshmarine.com liveaquaria.com
Yellow tang	70- 550	saltwaterfish.com

bluezooaquatics.com
Google

(Chevron tang are juvenile black tang--the same species.)

Why are these prices important? Because this represents the true value of what the State of Hawaii is virtually giving away to this extractive industry. But none of this appears in the revised draft, despite the fact that PIJAC, through its membership, would have market values easily accessible.

The revised draft sets an upper limit on fish to be collected annually under the preferred alternative. It is 246,560 (3.7.1). Lowballing for simplicity an average price per fish as $100, the total is then $24.7 million.

The price spreads above mostly reflect fish size, although often vendors' varying prices. And some fish not on the "approved" list are considerably more valuable and are reasonably likely to be snagged in the 30 x 6 foot nets that collectors set. Will the collectors let them all go? Here are some samples--I'll skip the vendors.

Tinker's butterfly	$600- 900
Bandit angel	2,000- 2,500
Achilles tang	250- 800
Flame wrasse	700- 1,200
Crosshatch triggerfish	4,500

A market analysis is within PIJAC's easy reach. It would have national scope at least, including prices and projected price increases over the five-year timeframe of the revised draft EIS. A little more complex is a Hawaii-centered cost/benefit analysis. The multiplier effect counted on the benefit side needs more detailed and authoritative treatment than is given in the current document.

PIJAC has done such a thorough job of correlating marine studies and numbers (a valuable contribution) that it could bring its revised draft into conformity with Hawaii standards by adding these analyses. It should do so.

THE PROPOSED MONITORING PLAN IS SKETCHY AND INADEQUATE

The applicant, PIJAC, has put forth a preferred alternative to address many concerns expressed by the Board of Land and Natural Resources. This new alternative includes a rather elaborate count and number system, and has limited the number of collectors.

Seven collectors will receive permits
Eight fish species can be legally collected
An annual limit is set on the number of each species collected
An annual limit is set per species per collector

Obviously, to ensure the implementation of this proposal, monitoring has to be top-notch (and incidentally would entail extra work for DLNR staff). The monitoring plan (3.7.2) describes a triplicate form to be signed off on by the collector, the dealer **and a State Department of Agriculture inspector at the airport.** There is at least one major problem here, and perhaps more.

The Department of Agriculture will require statutory authority to do this, which it does not now have; and may require federal concurrence and/or extra staff. This analysis was provided to me by an Aquatics Specialist at the Department by telephone on March 12, 2021.

A second problem, about which I am uncertain, is that **the DLNR may not legally be able to delegate its monitoring function in this way.** I recall a state Land Use Commission reclassification case in the 1990s when it was ruled that the DLNR's Historic Sites Division could not legally delegate its oversight of historic sites to the County of Hawaii, which was seeking a large land reclassification. The Native Hawaiian Legal Corporation provided the decisive brief.

The applicant will want to propose a different monitoring plan in a final EIS. However, to come up with something workable, given the complexity of its preferred alternative, may be a challenge.

CULTURAL ATTITUDES NEED MUCH MORE ATTENTION

The Cultural Impact Assessment here (appendix A) is very well done. However, interviews of 53, mostly ethnic Hawaiians are not analyzed and reported in the revised draft main text. For example, of the 53, 35 individuals opposed this industry, 5 supported it, and the rest expressed diverse thoughts including misgivings. (My counts.)

The BLNR drew to the applicant's attention a too-limited approach to misgivings about the industry itself from a cultural standpoint (p. 8). Hawaii's environmental law, HRS 343, and Hawaii Administrative Rules 11-200 both convey that cultural concerns may extend beyond an ethnic group, to the welfare of the wider community.

PIJAC candidly acknowledged that "many local residents hold a negative view of the aquarium industry" and that it 'has a long and contentious history, and it remains a point of conflict" (5.3.1). But the applicant's revised draft section, intended to address the BLNR's observation, is but two pages in a main document of some 200 pages. This is not thorough or sufficient

Main themes of Hawaiian respondents were the industry's lack of *malama aina*, or care for the land and ocean; and taking without giving back. Some quotations:

"Why should people take our fish just for pleasure?"--Leslie, 114

What [is] the aquarium fishing industry's contribution to the public trust, that includes aquatic resources?--Springer, 113

. . . during the late 1980s when aquarium fishing began to expand, there were huge public rallies where people paraded through the streets of Kona to stop taking the fish for the aquarium industry--

Repogle, 122

. . . in some smaller Hawaiian communities, especially in South Kona where traditional methods of harvesting fish are still practiced, the aquarium industry has created serious discord and tension amongst its members--Nakachi, 125

"there's a long history of mistrust and no openness between local fishers and aquarium collectors"--Cho, 132

I have selected points representing dislike, perhaps not sufficiently emphasizing other thoughtful points raised. However, to the extent that the broader community is aware of this industry and its practices (and as a longtime resident I know that many citizens are unaware), **polls show that the public would like the practice banned.**

A 2012 poll was reported in the *Hawaii Tribune Herald* of Hilo*:* 66% wanted to end the trade (*HTH* 6/14/12). In another poll in 2017, 83% statewide supported a ban (humanesociety.org/news/poll-shows-near-total-support-legislation-protecting-hawaii's-reef-and-marine-life) . The Humane Society of the United States commissioned both polls, by two different Honolulu firms. It has also been a plaintiff in the recent court case on this matter.

A remarkable marine science article, several times cited in the revised draft, Rossiter and Levine (2013), actually makes quite a point of how "social pressure" effectively enforces the West Hawaii Regional Fishery Management Area. The DLNR lacks funds and staff to enforce, the authors say. But: "community enforcement works in this context because the local community does not favor aquarium fishing." The authors comment on the "social marginalization" of collectors who "cannot easily hide" because the DLNR requires their boats to be marked.

Note that the community-pressure approach will not serve to enforce the applicant's preferred alternative because citizens have no way of observing the species collected or how many there are. The WHRFMA is much easier to monitor.

I might add several other instances--an underwater attack by a collector on a supposedly interfering scuba diver (5/8/14); or the extraordinarily bitter comment by the president of Snorkel Bob's business on the applicant's draft EIS: "**The PIJAC PROMO piece supports a mainland amusement industry that condemns reef wildlife to a vicious cycle of replacement."** (pdf p. 2112)

It's clear that attitudinal concerns and misgivings of ethnic Hawaiians and the wider public deserve to be brought forward in a prominent way in the revised draft EIS. They are a significant adverse effect from a cultural standpoint.

Analysis of the
Revised Draft Environmental Impact Statement

Regarding Issuance of Commercial Aquarium Permits and Commercial Marine Licenses for the West Hawai‘i Regional Fishery Management Area
Submitted by the Pet Industry Joint Advisory Council

Gregory P. Asner PhD, Shawna A. Foo PhD,
Rachel R. Carlson MS, Roberta E. Martin PhD

ASU Center for Global Discovery and Conservation Science
Hilo, Hawai‘i

07 April 2021

The Pet Industry Joint Advisory Council submitted a Revised Draft Environmental Impact Statement (RDEIS) based on their analysis of the ecological and cultural impacts of issuing aquarium collection permits for the West Hawaiʻi Regional Fishery Management Area. Our review focuses on the scientific integrity and validity of data and conclusions provided in the RDEIS. We do not address cultural issues in our review.

The RDEIS has not adequately represented fish population trends in Hawaiʻi, has ignored public comments in response to past DEIS and FEIS that requested more information, and omits certain facts and data that would allow an objective overview of the impacts of permitting aquarium fish collection.

I. Problems with fish population trends, reporting and analyses

In response to the 2020 FEIS, we asked the applicant to present both the WHAP and CREP (now referred to as PIFSC-ESD in the RDEIS) datasets equally to allow a visualization of population trends over the total length of the survey years. Despite citing the full PIFSC-ESD dataset, the new 2021 RDEIS only presents 2019 surveys for this dataset, only a subset of the 257 surveys cited on RDEIS page 115. Furthermore, for the WHAP data, the RDEIS presents 1999/2000 data and 2017/2018 data to estimate population trends for the white-list species. There are two issues with this: 1) Population data after January 2018 should be excluded from trend estimates because no legal aquarium collecting occurred after January 5th 2018, and 2) Analysis of annual, long-term data is needed to understand population trends, not just a comparison of a few years.

The RDEIS presents a reduced whitelist of eight species, where the species chosen were based on:

"Additionally, these impacts would be limited to only eight species, all of which have had stable or increasing populations under even higher rates of historical collection." (Page 176)

All available survey years of data for Hawaiʻi Island should be considered using both WHAP and PIFSC-ESD datasets to determine whether populations are stable or increasing (**Figure 1, Figure 2**). To allow an assessment of survey trends across both datasets, we plotted all available data for West Hawaiʻi from WHAP and PIFSC-ESD.

For WHAP data (**Figure 1**), aquarium fish show extremely variable decreases and increases across survey years, indicating they are not necessarily stable. In particular, Bird Wrasse, Orangespine Unicornfish, and Thompson's Surgeonfish do not show an increasing trajectory.

To make PIFSC-ESD data comparable to WHAP, we only show West Hawaiʻi data, where open collection areas and areas that ban aquarium fishing were delineated (**Figure 2**). In PIFSC-ESD, not all reduced white-list species show a trajectory of increasing abundance. Of note, the two top aquarium fish species, Yellow Tang and Kole, both show decreases in abundance between 2016 and 2019 in open collection areas in the PIFSC-ESD data.

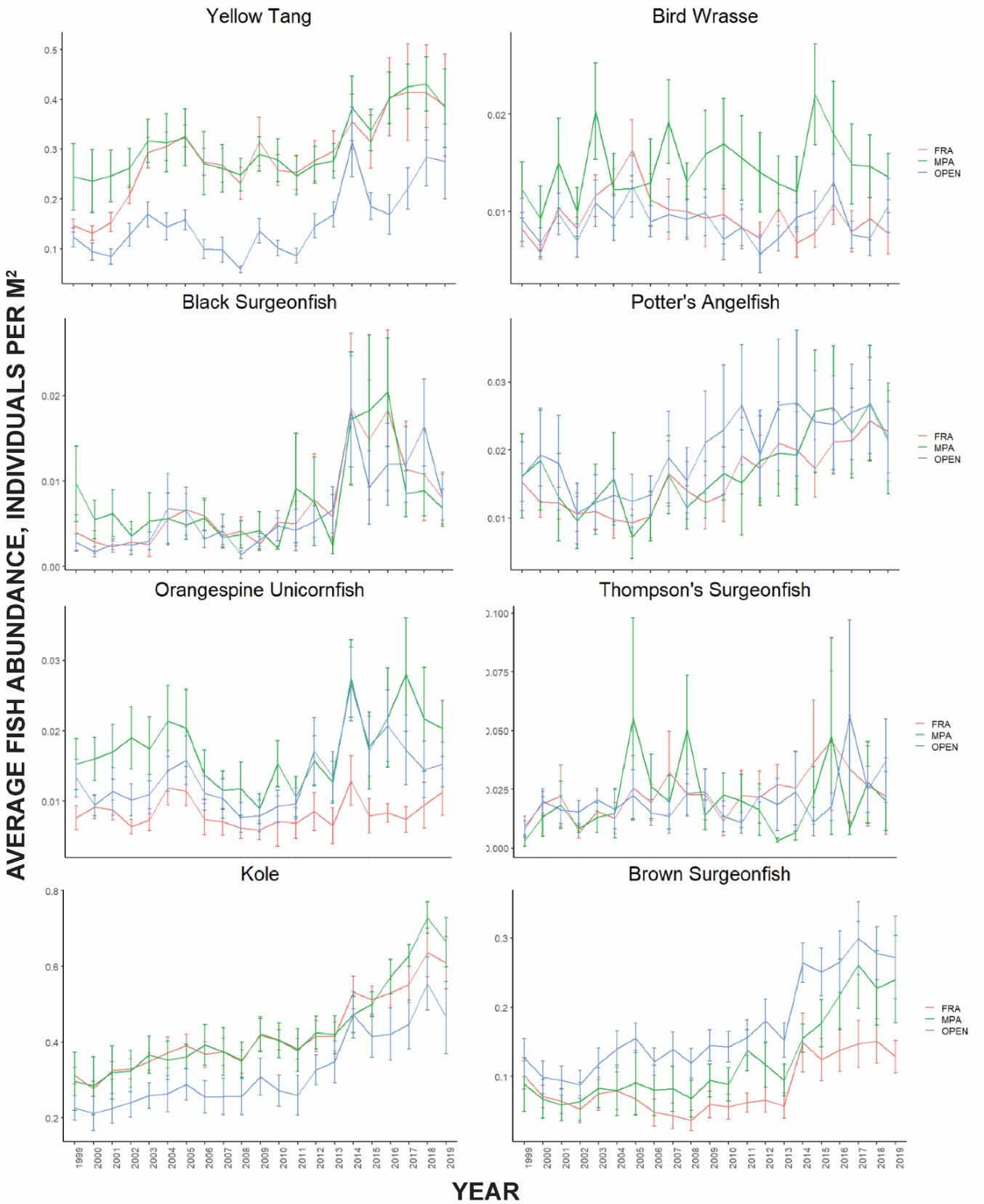

Figure 1. Annual site means for WHAP data for the reduced white-list species. Averages for abundance data across all sites per management type are displayed ± standard error. Survey details - from 1999-2004: FRA (n=9), MPA (n=5), OPEN (n=9), 2005-2006: FRA (n=9), MPA (n=5), OPEN (n=10), 2007-2019: FRA (n=9), MPA (n=6), OPEN (n=10).

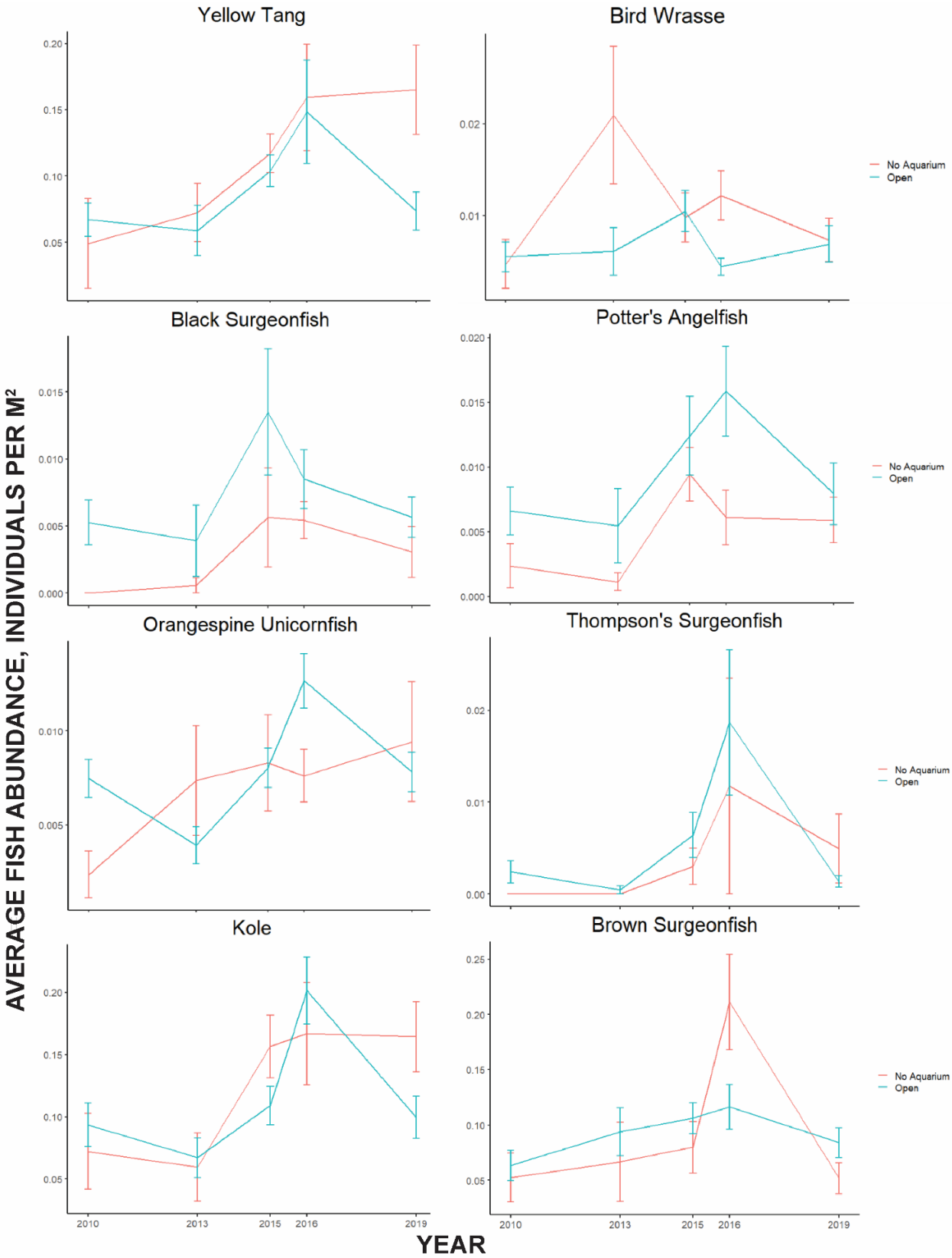

Figure 2. Annual site means for PIFSC-ESD data for the reduced white-list species in West Hawai'i. Averages for abundance data across all sites per management type are displayed ± standard error. Survey details - 2010: No aquarium (n=3), Open (n=18), 2013: No aquarium (n=5), Open (n=13), 2015: No aquarium (n=15), Open (n=50), 2016: No aquarium (n=13), Open (n=23), 2019: No aquarium (n=12), Open (n=25).

The RDEIS does not provide the raw data, or full calculations of population estimates. The RDEIS explains:

"PIFSC-ESD provided the Applicant with the estimated population size for each White List Species for the island of Hawai'i by converting survey counts to abundance per unit area, and then multiplying by the estimated area of hardbottom habitat in <30 meters of water (8,995 Ha in East Hawai'i and 5,727 Ha in the WHRFMA). Approximate confidence intervals (95%) were estimated using two times the standard error of the estimated population size, as provided by PIFSC-ESD, with the lower bound set to zero when needed since populations cannot be negative." (Page 114)

The RDEIS should provide West and East Hawaiʻi means for the survey data, with the confidence intervals calculated from the original dataset with the number/replicates of surveys included. Long-term data (WHAP and PIFSC-ESD) exist for the reduced whitelist of aquarium fish species and are publicly available.

Additionally, extrapolating population estimates based on hardbottom area is an inaccurate method for estimating island-wide populations, which ignores basic fish ecology because the extrapolation assumes that fish equally inhabit all hardbottom habitat area across all of Hawaiʻi Island. Prior studies (e.g., Friedlander and Parrish 1998; Wedding et al. 2008), as well as a recent analysis by Donovan et al. (2020), for Hawaiʻi Island show that fish have a highly variable distribution across Hawaiʻi (**Figure 3**). The analysis, which combines all available fish surveys from multiple organizations throughout Hawaiʻi, shows enormous spatial variability in herbivorous fish populations across hardbottom habitat around the island (**Figure 3**).

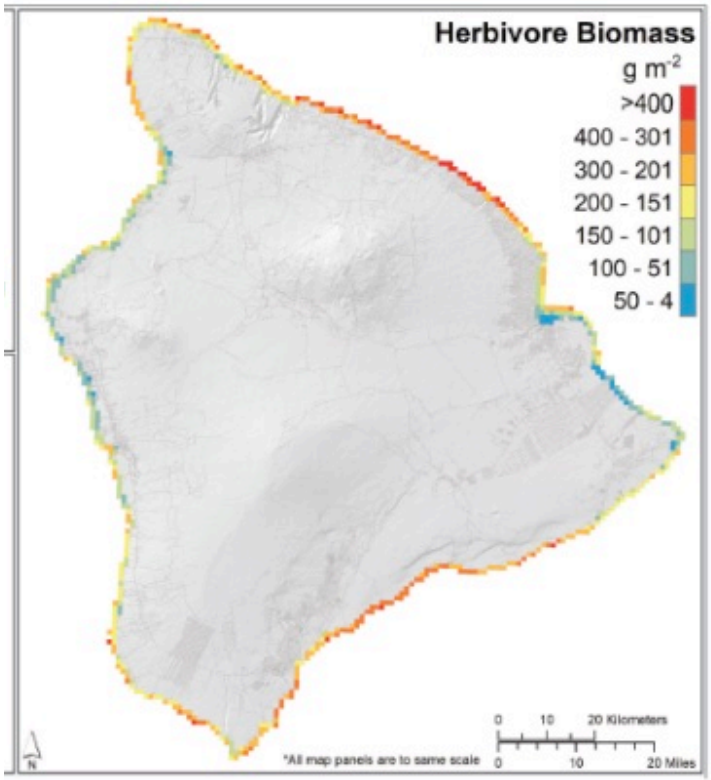

Figure 3. A recent HIMARC report spanning 1993 to 2016 shows the variability in herbivore biomass across Hawaiʻi Island (figure from Donovan et al. 2020).

Lastly, the RDEIS heavily bases its "sustainable" levels of catch on one manual focused on species from the Phillipines (Ochavillo and Hodgson 2006). The manual gives a list of total allowable catch (TAC) values for common species in the Philippines, which the RDEIS uses directly for Hawaiian species that never appear in the guide. Determining sustainable catch rates is not a straightforward process and involves a deep understanding and long-term record of population size, recruitment, mortality and growth (as considered for Hawaiian species in Nadon et al. 2017). Other methods using size-structure abundance data and a more data-limited approach, rather than catch-per-unit methods, have been developed, but still vary on a species-by-species basis (Jerald et al. 2018). Thus, directly borrowing values for species in the Philippines is not an adequate method to determine whether aquarium collection catch rate is sustainable for Hawaiian species, especially as TAC will be specific for each species. To be scientifically defensible, the RDEIS should conduct stock assessment modelling for target species. Strong resources exist for this, such as Nadon et al. (2017), which provides stock assessment methods and examples for coral reef fishes of Hawaiʻi.

Without a statistical analysis of population growth, reproduction and mortality rates, TAC cannot be calculated and the true impacts of aquarium fishing, including sustainable levels for Hawaiʻi Island, cannot be determined. Population modelling is absent in the RDEIS and is critically needed to allow appropriate estimation of the impacts of aquarium fishing.

II. Inadequate justification of proposed individual catch quotas

Critical information needed to understand impacts of aquarium fishing, and whether proposed individual catch quotas (**Table 1**) are appropriate, were missing. For example, what is the total open area that could be fished, and what size classes are expected to be targeted? What reef area would be affected based on fishing effort?

Table 1. Proposed individual catch quotas for the revised white-list. Annual limit from January 1 through December 31 of each year (Table 3-2 from the RDEIS, page 51).

Species	Individual Catch Quota (per fisher)	Total Potential Catch (all 7 fishers)
Yellow Tang	28,571	200,000
Black Surgeonfish	450	3,152
Orangespine Unicornfish	838	5,872
Kole	4,285	30,000
Bird Wrasse	49	344
Potter's Angelfish	625	4,376
Thompson's Surgeonfish	288	2,016
Brown Surgeonfish	114	800

Importantly, to put the proposed total potential catch numbers into perspective, we present the total reported catch for the past 20 years for all of Hawaiʻi Island nearshore (0-2 nmi) waters for the reduced white-list species, with the total potential catch indicated on the graph (**Figure 4**). For five species, the proposed catch is higher than the annual catch data previously reported in the majority of the last 20 years. Of note, for Potter's Angelfish (*C. potteri*) and Thompson's Surgeonfish (*A. thompsoni*), the total proposed catch is much higher than all previously reported catch numbers. For *A. thompsoni*, the limit is twice as high as the

maximum reported catch in 20 years. Therefore, even if only seven aquarium fishers are permitted, they will still be impacting the system similarly, and in some cases, more than previous years.

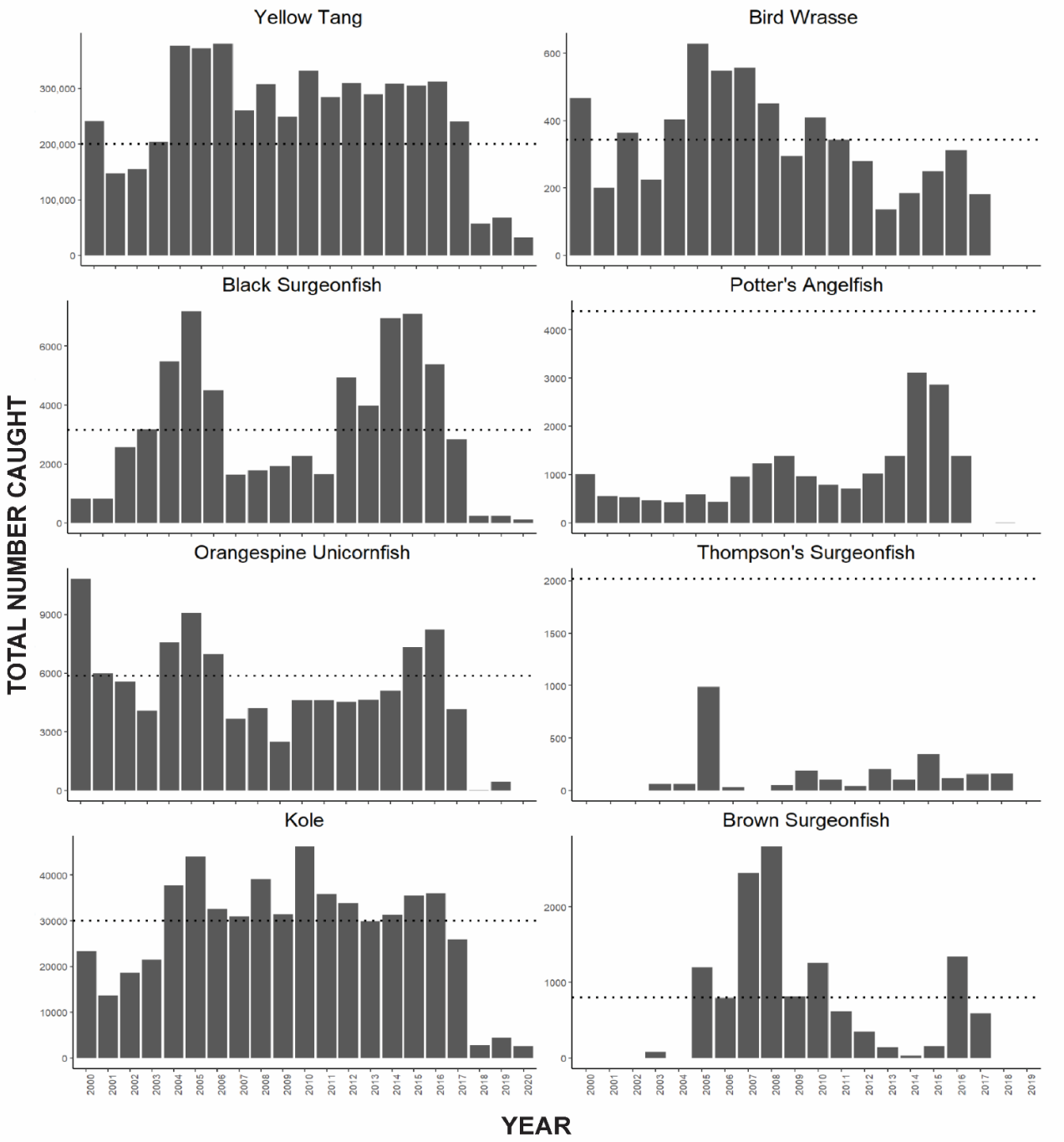

Figure 4. Annual reported aquarium catch data for all of Hawai'i Island nearshore (0 – 2nmi) waters for the reduced white-list species for the past 20 years, compared to total proposed catch limit for 7 fishers from the RDEIS (dotted line). Note that some data was withheld from annual reported aquarium catch to protect fisher confidentiality resulting in years that appear to have zero catch.

III. Inaccurate coverage of relevant literature with biased selection of specific findings

The RDEIS does not adequately cover relevant scientific literature, especially Hawai'i-specific examples, thereby ignoring the impacts of aquarium collection on the Hawaiian reef system. We base the examples we discuss here on the main justifications of the applicant for allowing aquarium collection.

IIIa. Reporting insufficient information about fish in relation to herbivory

Herbivores are critically important for resisting coral to algae regime shifts (Graham et al. 2015), and scientific data show that appropriate herbivore management maintains coral reef resiliency through frequent bleaching events (Chung et al. 2019). Hawai'i has suffered multiple bleaching events in the past decade, and the U.S. federal government and international organizations predict more frequent and severe bleaching events in the future (van Hooidonk et al., 2016; Hughes et al., 2017). Therefore, retaining strong populations of herbivores on Hawai'i's reefs must become a top priority to maintain reef condition and associated economic and cultural benefits over the next several decades.

The RDEIS acknowledges the importance of herbivores for coral resilience but does not fully quantify aquarium fishing impacts on herbivory. Using the reduced white-list aquarium species provided in the RDEIS, we indicate which are herbivores, classified using data from Heenan et al. (2016) (**Table 2**). Herbivorous fish can be categorized into various groups depending on their feeding preferences such as grazers, detritivores, and browsers, indicated in **Table 2**.

Table 2. The reduced white-list of aquarium species indicating which are herbivores and what type of herbivore they are.

Common Name	Scientific Name	Type of herbivore
Orangespine Unicornfish	*Naso lituratus*	Browser
Black Surgeonfish	*Ctenochaetus hawaiiensis*	Detritivore
Kole	*Ctenochaetus strigosus*	Detritivore
Yellow Tang	*Zebrasoma flavescens*	Grazer
Potter's Angelfish	*Centropyge potteri*	Grazer
Bird Wrasse	*Gomphosus varius*	Non-herbivore/invertivore
Thompson's Angelfish	*Acanthurus thompsoni*	Non-herbivore/zooplanktivore
Brown Surgeonfish	*Acanthurus nigrofuscus*	Grazer

As shown in **Table 2**, six out of eight of the reduced white-list species are herbivores. In addition, the *non-herbivorous* species on the reduced white-list represent only 1% of the total proposed annual catch (2360 out of 246,560 aquarium fish). The new, reduced white-list primarily targets herbivorous fish, where each species has a different and important role in maintaining Hawai'i's coral reef ecosystem.

IIIb. Ignoring fish size-specific impacts

"Two studies have concluded that the aquarium fishery has no significant impact on coral or shery the reef ecosystem. In addition, herbivores collected by the aquarium fi consist of the smaller size classes which are the least effective sizes for typically cropping algae. One study found there were no increases in the abundance of macroalgae where the abundance of herbivores was reduced by aquarium collecting." (Page 16)

There are two problems with this statement. First, targeting mostly immature fish has huge implications for sustainable usage of the resource. Protecting immature fish is key to keeping any fishery sustainable in the long term where catching juvenile fish removes them, and future offspring. In aquatic systems, body size and individual trophic level are tightly linked (Jennings et al. 2001; Barnes et al. 2008), where size-targeted fishing degrades the variation in size structure in coral reef fish (Robinson et al. 2017). Moreover, smaller fishes are important dietary resources for predatory species. Furthermore, in Hawai'i, there are highly seasonal peaks in fish recruitment in June/July and February/March (Walsh, 1987) – if aquarium fishing peaked during these times of the year, impacts on population dynamics would be magnified.

Multiple studies show the importance of small herbivorous fish to reef ecosystem balance. Despite small body sizes, small grazers can have disproportionately large impacts on plant and algal biomass (Silliman et al. 2013), where smaller herbivores can occur in higher densities, having disproportionately higher impacts on algae in comparison to larger, less abundant herbivores (Ng and Micheli, 2020). Therefore, targeting only small fish is not a good justification for allowing aquarium collection. Further, there is no reporting of the size of aquarium fish that are caught and therefore size-specific impacts cannot be assessed.

IIIc. Biased selection of specific findings and ignoring negative impacts of aquarium fishing

The RDEIS only presents part of the results from prior, peer-reviewed literature on the aquarium industry. One example is its use of Tissot and Hallacher (2003). Despite the RDEIS citing this reference at least eight times, the RDEIS fails to acknowledge the primary finding of Tissot and Hallacher (2003): that seven of the ten aquarium fish species surveyed were significantly reduced by collecting. This missing information is presented below. In sites which permitted aquarium collection, aquarium fishes were significantly reduced, up to 75% lower than control sites where no aquarium fishing was permitted (**Figure 5**).

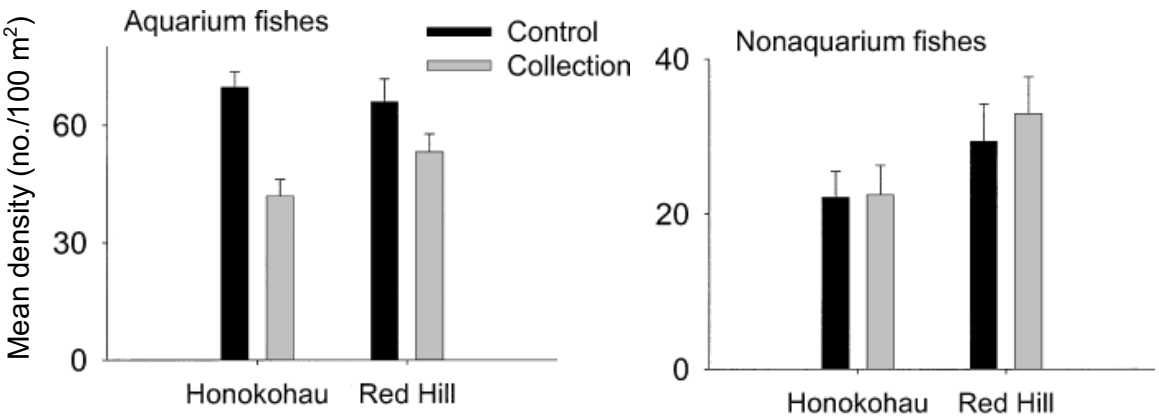

Figure 5. Figure 2 from Tissot and Hallacher, 2003 show sites that allow aquarium fishing (collection) have a significantly lower density (no./100m^2) of fish than sites that prevent aquarium fishing (control). Nonaquarium fishes are showed for comparison which show similar densities across collection and control sites.

Although aquarium fishing may not directly damage coral, the study found significant effects of aquarium collectors on the abundance of aquarium fishes. We indicated these findings in our reviews of the DEIS and FEIS, yet the authors of the RDEIS continue to select and report partial information rather than acknowledge the primary conclusions of this study.

IV. Conclusions

The RDEIS is biased in the presentation of facts and figures in favor of aquarium collectors in a number of ways:

- The available monitoring data have not been represented sufficiently and has not adequately estimated fish populations from all available data; the RDEIS is based on a reduced list of species which have been misrepresented.
- Although limiting the number of aquarium fishers to seven, the RDEIS has proposed high annual catch limits, and in cases, higher than any previous years for specific aquarium fish. Catch limits have not been calculated for target species using best available methods.
- The RDEIS does not include a proper literature review of Hawai'i-specific findings, instead selecting a few results that support their viewpoints and omitting results that indicate impacts of aquarium fishing.

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April 9, 2021

Philip S. Mosher

P.O. Box 1874

Kailua Kona Hawai'i 96745

DLNR – Aquatic Dept

Mr. David Sadoka

1151 Punchbowl Street Room 300

Honolulu, Hawai`i 96813-3088

Dear Mr. Sadoka,

Re: Revised EIS for Pet Industry Joint Advisory Council 2021

I am a resident of Hawai`i Island for twenty-seven years and know first- hand on the conditions of the impact of fish collection on my island. When I first vacation here in 1988, I was swimming at the Kailua Pier and the tropical fish were surrounding the coastal shores. The yellow yang fish were so abundant that the water were gold. Kailua Kona "Kona" was known as the Gold Coast of Hawai`i Island. Yes, my history from 1988 to 2021 there is a remarkable difference in the number of tropical fish.

Allowing the collection of tropical fish in the West Hawaii Regional Fish Management Area would be a mistake. Our nation, our State and our County are advocating sustainability and restoration of the natural resources. The State of Hawai`i entered into the Paris Accord to be a partner in managing its energy and its resources. We can not allow the depletion of our natural resources like tropical fish. Tropical fish and our coral reefs are the living organisms that keep our oceans alive. To deplete the population is wrong. They crucial loss of the coral reefs in 2015 – 2017 with coral bleaching – warming of the oceans were documented.

Allowing seven (7) permits with licenses to collect eight of the oceans most treasured fish is wrong. The counts for each species can not be allowed. The number of these counts translates to how much income these permits can earn. Our coastal area has already shown depletion of the coral reefs, and the tropical fish in this regional area. No, its time to finalize this issue and reject this Revised EIS.

Today, the State of Hawai`i's Natural Energy Lab allows contractors to breed tropical fish for aquarium owners. This is sustainable and will be the best way to acquire tropical fish. The history of those who have caught tropical fish either illegally or legally have demonstrated to the residents and the officials at DNLR that their actions are despicable. The losses from the catches are extremely high and our population of tropical fish are depleted. I can attest to having visitors who come back to Hawai`i each year remind me that the fish count is low during snorkeling.

Fish collection is disallowed in all Hawaiian Islands at present and most of the third world recreational areas. The DLNR has overwhelming mandate to regulate both land and ocean resources. They cannot regulate the fish collectors as to the numbers caught by each permit, let alone the "rebel fish catchers". The recent arrests of illegal catches indicates the need for larger scale enforcement. The unseen losses from fish collection are a disaster. Scores of fish are lost before shipping and upon arrival at the pet stores. These fish will not be counted on the collector's quotas.

Fish Collection benefits the very few at the cost of the rest of Hawai`i 's residents and visitors. The Native Hawaiians were conservators, taking only what they needed. It is our kuleana to do the same. Please reject the EIS and the Fish Collection Practice.

I appreciate the opportunity to give testimony for the opposing side of this issue. Thank you for reading my comments and recording the receipt of my letter. Please copy my letter and record it as received on April 9, 2021. Mahalo

Sincerely,

Philip Mosher
Kailua Kona Hawai'i

April 9, 2021

To: David Sakoda:

My name is Marjorie Awai and I **support** the Revised Draft Environmental Impact Statement prepared for the West Hawaiʻi Aquarium Fishery.

I have worked as:
- Curatorial Assistant to Dr. John Randall at the Bishop Museum;
- Aquarium Biologist at the Waikiki Aquarium,
- Senior Aquarist at the Georgia Aquarium;
- Curator of The Florida Aquarium;
- and Manager of reef fish exhibits at Disneyʻs Aulani Resort.

I have worked with aquarium fish collectors in Hawaiʻi for many years and I have an excellent understanding of the techniques and people involved with the aquarium fishery. The conclusions in the RDEIS coincide with my own experience and observations that this fishery is sustainable and poses little to no harm to coral reefs.

I urge you to approve the RDEIS and allow the aquarium fishermen in West Hawaiʻi to resume their livelihoods.

Marjorie Awai
Ewa Beach

PACIFIC WHALE FOUNDATION

Protecting the ocean through science and advocacy and inspiring environmental stewardship

Hawai'i Department of Land and Natural Resources
Division of Aquatic Resources

Pacific Whale Foundation
300 Ma'alaea Road, Suite 211, Wailuku, HI 96763

Friday, April 9th 2021
RE: Issuance of Commercial Aquarium Fishing Permits for the West Hawai'i Regional Fishery Management Area
HRS Chapter 343-5(a)

Pacific Whale Foundation opposes the issuance of commercial aquarium fishing permits for WHRFMA outlined in HRS Chapter 343-5(a)

Pacific Whale Foundation (PWF), a 501 (c)(3) nonprofit organization has a mission is to protect the ocean through science and advocacy and to inspire environmental stewardship. The objective of the proposed action is for the Department of Land and Natural Resources (DLNR) to issue 7 Aquarium Permits and 7 corresponding Commercial Marine Licenses (CMLs) for the West Hawai'i Regional Fishery Management Area (WHRFMA), to revise the White List from 40 to 8 species, and to implement individual catch quotas for the 8 species remaining on the proposed Revised White List. PWF opposes the issuance of these aquarium permits and supports a No Action Alternative, where no commercial aquarium collection would occur within the WHRFMA and East Hawai'i.

Hawai'i's DLNR Division of Aquatic Resources has approved the Pet Industry Joint Advisory Council (PIJAC) to apply for the issuance of Commercial Aquarium Permits for the WHRFMA. This project involves review of both the use of state lands and the use of conservation districts that are involved in the proposed permitting areas.

Implementation of the Preferred Alternative, according to this DEIS, would ensure the lawful, responsible, and sustainable commercial collection of 8 fish species deemed "White List Species" from the WHRFMA. While we commend the PIJAC for integrating catch limits for all species, as well as reducing number of species able to be caught, without a complete understanding of a sustainable catch limit, imposing a limit on 8 species leaves room for excessive take of all other species.

Pacific Whale Foundation acknowledges that the best available science indicates less than significant direct and indirect impact on reef fish populations with the Preferred Alternative outlined in this DEIS. Although the Coral Reef Ecosystem Program (CREP) data are the most comprehensive data publicly available in fish populations estimates, certain limitations of the surveys may lead to an underestimate of some populations. Short period of survey effort, exclusive survey

zone and the misidentification of fish disallow this survey from collecting accurate fish population numbers. Determining actions based on these numbers can lead to an overestimation of population numbers and misidentifying take limits.

The draft EIS states that the research suggests collection between 5%-25% is sustainable to reef species *similar* to those on the White List. We believe this is too large a range to use as a guide and without a verification system to ensure accuracy of self-reported data, there is no way to know what the sustainable catch limit is. In addition, these data come from fish exclusive from the target fish of these permits, further reducing their accuracy in application. Using the precautionary approach, the maximum take should be the lowest estimated percentage of sustainable take (5%) for all species, in all areas open to collection.

This DEIS outlines calculated economic benefits based on a 17-year time frame between 2000 and 2017 and creates a 5-year analysis period, inflation-adjusted, to these permits which under the Preferred Alternative, work out to be approximately 0.06% of Hawai'i's ocean economy, and an even smaller percentage of the overall economy in the State. With such a minute economic benefit, the purpose of this permit issuance is unclear.

PIJAC serves as the legislative voice for retailers, animal suppliers, manufacturers, wholesale distributors, pet hobbyists, and other trade organizations. Given the educational value of aquariums, PWF supports the display of fish, coral, and invertebrates for educational purposes under the following conditions: The aquarium has (1) collected fish under appropriate permits and management plans; (2) a goal of promoting ocean literacy; (3) active conservation efforts to engage the public. We cannot verify that the fish collected under these permits will be used for such purposes, and therefore cannot support the issuance.

There are a number of impacts outside of aquarium fisheries that are affecting coral reefs, including recreational aquarium fish collection, non-aquarium fishing, tourism and climate change. Under the climate change umbrella there includes additional stressors such as coral bleaching and ocean acidification, which lead to coral death. We believe that these cumulative impacts outweigh a single stressor. Using the precautionary principle, without a complete understanding of the environmental stressors on reefs in relation to climate change and other impacts, there should be no introduction of additional stressors to the reef ecosystem.

Due to the near negligible economic benefit and the introduction of a new stressor on a currently stressed ecosystem, we suggest a precautionary approach and oppose the issuance of the 7 aquarium permits and & corresponding CMLs and support a No Action Alternative, where no commercial aquarium collection would occur within the WHRFMA or East Hawai'i.

Thank you,
Shelby Serra
Conservation Coordinator

Commentor	Comment	Response
Website Template; each commenter could select any or all of these items	I am concerned about the impacts of the aquarium trade on the following species: Yellow Tang Potter's Angelfish Orangespine Unicornfish Kole Chevron Tang Bird Wrasse Brown/Lavender Tang Thompson's Surgeonfish	Your comment has been forwarded to the decision makers. All 8 species on the Revised White List would have individual catch quotas, placing an upper limit on the number which could be collected within any given year. Existing size and bag limits would also remain in effect, as would existing MPAs and FRAs.
Website Template; each commenter could select any or all of these items	The DEIS did not accurately describe how taking the fish reduces the beauty of coral reefs.	Your comment has been forwarded to the decision makers.
Website Template; each commenter could select any or all of these items	The DEIS did not describe the increases in some or all of these species that have occurred since AQ was banned in 2018.	Your comment has been forwarded to the decision makers. The EIS used the best available data, including the most recent population estimates from 2018 (PIFSC-ISD) and 2017-2018 (WHAP).
Website Template; each commenter could select any or all of these items	The DEIS did not describe how abundance is diminished by aquarium collecting.	Your comment has been forwarded to the decision makers.
Website Template; each commenter could select any or all of these items	The DEIS did not describe how communities of reef species are disrupted by aquarium collecting.	Your comment has been forwarded to the decision makers.
Website Template; each commenter could select any or all of these items	The DEIS minimized the impacts of aquarium collecting on these species.	Your comment has been forwarded to the decision makers.
Website Template; each commenter could select any or all of these items	The DEIS did not have a plan to restore depleted abundance and ensure future generations may encounter these species.	Your comment has been forwarded to the decision makers.
Website Template; each commenter could select any or all of these items	The DEIS downplayed the importance of the herbivores taken by aquarium collectors. Hawaii reefs need more herbivores and aquarium collectors should not take them.	Your comment has been forwarded to the decision makers.
Website Template; each commenter could select any or all of these items	Hawaii needs these fish more than ever before. The DEIS did not explain why people with personal aquariums outside the state deserve these fish more than Hawaii does.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Website Template; each commenter could select any or all of these items	The DEIS did not provide a cost/benefit analysis that showed an aquarium collecting benefit to Hawaii Island residents that outweighs the costs.	Your comment has been forwarded to the decision makers.
Website Template; each commenter could select any or all of these items	The DEIS did not adequately address the fact that aquarium collecting is contrary to native Hawaiian cultural practices and beliefs,	Your comment has been forwarded to the decision makers. The EIS states "given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, all six action alternatives may impact cultural practices".
Website Template; each commenter could select any or all of these items	The DEIS did not adequately address the animal welfare issues and unacceptably high mortality rates linked to their practices.	Your comment has been forwarded to the decision makers. Post-collected mortality is discussed in Section 5.4.2.
Website Template; each commenter could select any or all of these items	I believe some or all of the species identified above have been impacted on reefs I am familiar with in the following Hawaii Island district(s): North Kona South Kona Hilo North Kohala Hamakua Puna Ka`u South Kohala Unfamiliar with these reefs, but still concerned.	Your comment has been forwarded to the decision makers.
Website Template; each commenter could select any or all of these items	The DEIS failed to accurately describe the undeniable and significant environmental, socioeconomic, and cultural impacts of what it proposed.	Your comment has been forwarded to the decision makers.
Yasamin Alarab	See above comments (template format)	Your comment has been forwarded to the decision makers.
Lynn Allen	See above comments (template format)	Your comment has been forwarded to the decision makers.
Lynn Allen	Given the uncertainty of the upcoming effects of climate change on our oceans, reefs and reef fish we need to ensure as best as possible that the reef ecosystem maintains its integrity. The extraction of fish to support a trade (involving very few people) that has no regard for its impact on an environment (impacting many people and multiple generations). We can't afford to not get this right!	Your comment has been forwarded to the decision makers.
Geri Allison	See above comments (template format)	Your comment has been forwarded to the decision makers.
Carla Alvarado	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Carla Alvarado	The beautiful "golden" waters off Kona were just coming back and need to be protected. Kealakekua was teaming with these species and suddenly they were diminished. Now they are finally repopulating. The aquarium trade MUST be stopped.	Your comment has been forwarded to the decision makers.
David Anderson	See above comments (template format)	Your comment has been forwarded to the decision makers.
David Anderson	I come to Hawai'i to dive and enjoy the underwater flora and fauna...I believe this activity is far more valuable to the economy and life in the State than any amount of aquarium fish collecting. I will be there again next February for a month...please leave the fish alone for everyone to enjoy in their natural habitat and state.	Your comment has been forwarded to the decision makers.
Caroline Azelski	See above comments (template format)	Your comment has been forwarded to the decision makers.
Caroline Azelski	Events over the last year have proven that leaving stressed species alone (especially aquatic ones) leads to populations rebounding. Self healing problems are a rare opportunity.	Your comment has been forwarded to the decision makers.
Jeff Babcock	See above comments (template format)	Your comment has been forwarded to the decision makers.
Tim Bailey	See above comments (template format)	Your comment has been forwarded to the decision makers.
Kerri Ballard	See above comments (template format)	Your comment has been forwarded to the decision makers.
Kerri Ballard	Our reefs in general are under great stress. The improvement seen during Covid without the extra impact from tourism showed that, if left alone, even gross damage can begin to heal. We need to do everything we possibly can to help. Economic benefit to a very few people shouldn't outweigh our responsibility to protect our ocean .	Your comment has been forwarded to the decision makers.
Joseph Balsimo	See above comments (template format)	Your comment has been forwarded to the decision makers.
Joseph Balsimo	Aloha, I have been a Resident of South Kona in the last 20 years I have seen the disappearance of the yellow tang and many other near shore species at our local beaches. I realize there's been a moratorium on aquarium collecting, however I haven't seen a return of the nearest sure species in question. Aquarium fishing only benefits the person taking the fish, people of Hawaii have no benefit. Thank you Sincerely Joe Balsamo	Your comment has been forwarded to the decision makers.
Anita Barker	See above comments (template format)	Your comment has been forwarded to the decision makers.
Anita Barker	Fish do not belong in aquariums.	Your comment has been forwarded to the decision makers.
Carlos Barrios	See above comments (template format)	Your comment has been forwarded to the decision makers.
Carlos Barrios	The 1st time I flew to the Island of Hawaii`i, I looked down and saw a "coast of yellow," which I later learned was called the "Gold Coast." No longer can you call it that since collectors have taken Yellow Tangs. I have witnessed algae increasing at many of the local reefs off of Kona, at the same time I've noticed a decrease of herbivore fish that once inhabited those reefs.	Your comment has been forwarded to the decision makers.
Marion Bennett	See above comments (template format)	Your comment has been forwarded to the decision makers.
JoAnn Bertram	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
JoAnn Bertram	I am a tourist to Hawaii and I am very concerned about this "harvesting" of reef fishes. One of the joys of visiting Hawaii is snorkeling and being able to see an abundance and a variety of reef fishes. Please stop this "harvesting". It damages the ecosystem and will strongly affect the willingness of tourists to come to Hawaii	Your comment has been forwarded to the decision makers.
Angie Bezhenar	See above comments (template format)	Your comment has been forwarded to the decision makers.
Angie Bezhenar	Kua bay reef is where I dive all the time and I would be devastated to see any harm come to that reef. Fish do not need to be pets. They need to be free	Your comment has been forwarded to the decision makers.
Rebecca Bicker	See above comments (template format)	Your comment has been forwarded to the decision makers.
Rebecca Bicker	I scuba dive almost daily in Maui.I have spent time diving in the Big Island as well. We need to protect our reefs from the depletion of fish. This is a natural resource , not a source for aquariums.	Your comment has been forwarded to the decision makers.
Lisa Bishop	See above comments (template format)	Your comment has been forwarded to the decision makers.
Lisa Bishop	Friends of Hanauma Bay strongly opposes this revised Draft Environmental Impact Study (DEIS) aimed at reopening West Hawaii reefs to seven aquarium collectors to take over 246,000 fish every year for the pet trade. This revised DEIS fails to address most of the fourteen reasons that DLNR unanimously rejected the original DEIS submitted almost a year ago. Reef surveys spanning decades have documented significant impacts to species taken by commercial aquarium collectors. The most impacted species including Yellow Tangs, certain butterflyfishes, and other rare native fishes, experienced population declines ranging from 60 – 99% in the areas hardest hit by the trade. In 2018, when the trade was closed, that trend finally began reversing, and abundance of Yellow Tangs and other fishes began to come back. The unacceptably high mortality rates and inhumane practices of the Aquarium Pet Trade are tragic for Hawaii's marine wildlife. It is well past time to ban this horrible business!	Your comment has been forwarded to the decision makers. The Revised White List includes only 8 species, all of which have had increasing or stable populations within the WHRFMA based on data from the DAR. Post-collection mortality is discussed in Section 5.4.2 of the EIS.
Moana Bjur	See above comments (template format)	Your comment has been forwarded to the decision makers.
Paul Blessington	See above comments (template format)	Your comment has been forwarded to the decision makers.
Paul Blessington	As a past resident of Kona from 2009 to 2019, I witnessed the decline of Big Island's reefs. From Mau Mai to Kiholo, the reefs have gone from predominantly healthy to predominantly unhealthy. In an age where fish can be bred in captivity, and at a time when the reefs are disappearing due environmental toxification and climate stress, it is barbaric to continue the practice of aquarium collection.	Your comment has been forwarded to the decision makers.
Gregg Blue Blue	See above comments (template format)	Your comment has been forwarded to the decision makers.
Gregg Blue Blue	PLEASE STOP THIS NEEDLESS DECIMATION OF OUR FISH AND ALL ITS EFFECTS ON THE ECO SYSTEM	Your comment has been forwarded to the decision makers.
Warren Blum	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Warren Blum	I have been a working divemaster on Maui for the past 20 years. I have seen the fish population on our reefs decline from a number of factors, one of which is the fish collection industry for the aquarium trade. Diving and snorkeling is a huge economic driver in the Hawaiian economy. We should protect it for all locals and visitors to the islands. Mahalo.	Your comment has been forwarded to the decision makers.
Nate Blumenthal	See above comments (template format)	Your comment has been forwarded to the decision makers.
Ryan Boerema	See above comments (template format)	Your comment has been forwarded to the decision makers.
Ryan Boerema	Years back, 30+, just south of Kealakekua, I came across a number of Naso literatus 'herding'--there is no better term--almost a hundred smaller, younger orangespine unicornfish. I dove the same site recently and saw less than two dozen. My dive buddy, when I recounted this, told me it had been worse in recent years. Please don't put profit before the planet. This is going to be a tough century and we'll all, not just a few guys trying to make money, need help from nature.	Your comment has been forwarded to the decision makers.
Ted Bohlen	See above comments (template format)	Your comment has been forwarded to the decision makers.
Ted Bohlen	Hawaii Reef and Ocean Coalition (HIROC) is a group formed to address the crisis on our coral reefs. HIROC is deeply concerned about the impact of aquarium fishing on the our coral reefs, especially from taking of herbivores that clean the reefs and improve reef resiliency that is so needed with climate change. Maintaining the current level of fish biomass is insufficiently “sustainable” when reefs are in crisis. Dismissing the moratorium on herbivores alternative alone renders this DEIS inadequate. I personally have substantial experience with EISs. In my opinion, this pet industry’s DEIS is wholly deficient in its discussion of impacts of removing almost 250,000 fish each year, the benefits of alternatives, particularly the no action and no herbivores take alternatives, and mitigation, as required under HAR 11-200.1-24. Please reject this inadequate DEIS! Hawaii Reef and Ocean Coalition (by Ted Bohlen)	Your comment has been forwarded to the decision makers.
Anne Borman	See above comments (template format)	Your comment has been forwarded to the decision makers.
Anne Borman	I vigorously oppose Aquarium Fish Collecting in the Hawaiian Islands. We have been visitors for over 40 years and now residents for over 15 years and have enjoyed the beauty and abundance of the reefs while snorkeling everyday. We have notice a big decline in the many reef fish species over the years and grateful the Aquatic fish collecting practice was stopped in 2018. The revised Deis does not address the environmental impacts on the reefs AND the fish themselves. Please do not allow Aquarium fish collecting in Hawaii. Thank you for your time.	Your comment has been forwarded to the decision makers.
Megan Bouch	See above comments (template format)	Your comment has been forwarded to the decision makers.
Don Bowers	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Don Bowers	The taking of reef fish by the aquarium trade is no more than trophy taking to satisfy ego or obtain profit. It does not benefit nature. As bad as trophy taking is, in Africa the fees benefit the animal refuges and the remaining animals. Aquarium collecting benefits only the profit for collectors and the ego of customers. There is no benefit to nature. There needs to be give and take balance between mankind and nature.	Your comment has been forwarded to the decision makers.
Tony Brioso	See above comments (template format)	Your comment has been forwarded to the decision makers.
Tony Brioso	I have been coming to Hawaii multiple times per year since 2016 and as a PADI scuba professional spend considerable time exploring Hawaiian reefs. Since the ban there has been slow increases in the number of fish. Please do not let the aquarium trade to again decimate the fish population. Our reefs are vital to our planet and fish are an important factor in having healthy reefs. Sincerely, Tony Brioso	Your comment has been forwarded to the decision makers.
Harriet Burkholder	See above comments (template format)	Your comment has been forwarded to the decision makers.
Jeri Burnside	See above comments (template format)	Your comment has been forwarded to the decision makers.
Jeri Burnside	I have traveled to Kona many times to dive the reefs on the western side of the main island of Hawai'i, both from beach and boat. The beautiful abundance of fish species found there is the main reason divers like myself travel to Hawai'i, and even "common" species like yellow tangs, the various wrasses, and the surgeonfishes are an essential component of the unique Hawaiian SCUBA experience that draws divers from around the world. Allowing the resumption of taking these species for the aquarium pet trade would be a terrible mistake.	Your comment has been forwarded to the decision makers.
Jeri Burnside	I am not only a SCUBA diver, but I also have a bachelor's degree in Biology; I have worked for several years as a diver volunteer for the Aquarium of the Pacific in Long Beach, CA, and for a time I also owned a retail pet store that sold tropical fish. Once I saw the terrible mortality and morbidity for the wild-caught marine tropical fish species due to the stresses of capture and shipping, I refused to stock those species in my shop. I only sold captive-bred freshwater species for that reason. A wild fish captured for the marine fish pet trade is very likely to die even before it makes it to the tank in a retail pet store; and even if it does survive long enough to be sold, its unique genetic makeup will never be available in the wild to contribute to the essential genetic diversity needed to maintain a robust, healthy wild population. Just because a species is abundant now, does not mean it will remain so in the future - especially with the looming issue of ocean warming and acidification and the potential loss of coral reef habitat.	Your comment has been forwarded to the decision makers. A discussion on post-collection mortality is included in Section 5.4.2 of the EIS.
Jeri Burnside	There is NO compelling reason to condemn hundreds of thousands of wild fish to a certain genetic dead end and death in captivity. These fish are not feeding hungry people; they are simply ornaments in a collector's tank. Opening up the Hawaiian reefs to the hunting of "common" fish species for the tropical fish trade will undoubtedly feed the black market for forbidden species as well; who will be policing the collection bags of every hunter on the reef? How will you prevent the rare and threatened species from being taken as well? The answer is, you can't.	Your comment has been forwarded to the decision makers. The Preferred Alternative included additional enforcement and compliance measures outlined in Section 3.7.2 of the RDEIS, but this section has been revised in response to comments received on the RDEIS.

Commentor	Comment	Response
Jeri Burnside	It's quite a treat for divers in Hawaii to catch a glimpse of a bandit angelfish or a Tinker's butterfly; but you can bet that once "legal" collecting of other species for the pet trade is permitted again, these rare species will become targets for the illicit rare fish trade. The prices that people are willing to pay for rare specimens will trump whatever laws are in place to protect them, and by opening up Hawaiian waters to hunting for the pet trade you will make the taking of these species even easier. https://reefbuilders.com/2021/02/10/10-rare-hawaiian-aquarium-fish/	Your comment has been forwarded to the decision makers. The Preferred Alternative included additional enforcement and compliance measures outlined in Section 3.7.2 of the RDEIS, but this section has been revised in response to comments received on the RDEIS.
Jeri Burnside	DO NOT re-open Hawaiian reefs to hunting for the pet trade. Protect the unique and exquisite populations of Hawaiian reef fish for future generations of divers and snorkelers to enjoy, and protect the genetic diversity and health of the species that make Hawaiian reefs a magnet for tourists from around the globe. Thank you.	Your comment has been forwarded to the decision makers.
Donna Burrows	See above comments (template format)	Your comment has been forwarded to the decision makers.
Michael Carlson	See above comments (template format)	Your comment has been forwarded to the decision makers.
Brent Carman	See above comments (template format)	Your comment has been forwarded to the decision makers.
Lynn Chapman	See above comments (template format)	Your comment has been forwarded to the decision makers.
Lynn Chapman	I snorkel a few days a week in Makawai Bay off the south Kohala Coast and over the last 10 years I have noted a definite decrease in colorful reef fish. These precious fish are a treasure and should not be exploited for commercial profit. I believe there should be a full, permanent ban on aquarium fish harvesting. Lynn Chapman	Your comment has been forwarded to the decision makers.
Ryan Christopher	See above comments (template format)	Your comment has been forwarded to the decision makers.
Ryan Christopher	I have been enjoying the reefs of the Big Island for over 20 years. I have personally seen the decline of the reefs first hand. Why would we exacerbate the problem by allowing 250,000 fish a year to be taken off our reefs. This will be profitable for a few people yet the entire island will suffer. What happens when the reefs are empty and tourists don't want to visit any longer. This is a valuable asset we must protect.	Your comment has been forwarded to the decision makers.
Adam Clark	See above comments (template format)	Your comment has been forwarded to the decision makers.
Jill Nadine Clements	See above comments (template format)	Your comment has been forwarded to the decision makers.
Jill Nadine Clements	I have been snorkeling and diving the Hawaiian islands since late '80's In just this last year I have seen a huge!!! Drop in fish-Kehei, Mauna Lani coast!! Please think of the future for our children/Kekiki	Your comment has been forwarded to the decision makers.
Vivian Cohen	See above comments (template format)	Your comment has been forwarded to the decision makers.
Vivian Cohen	Do not allow the aquarium trade to remove our fishes from their natural habitat. Snorkelers and divers come to see these wonders and have noticed the depletion. Aquaculture can satisfy the hobbyist. Leave our fishes to thrive in Hawaii.	Your comment has been forwarded to the decision makers.
Radine Coopersmith	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Radine Coopersmith	Return the golden coast.... we get a lot of money from Tourism that loves snorkelling and scuba diving... Healthy reef support the sport fishing industry as well. Spare our reef fish that do not help anything other than individuals interest Watching them through glass.	Your comment has been forwarded to the decision makers.
Kacey Coyle	See above comments (template format)	Your comment has been forwarded to the decision makers.
Sarah Crawford	See above comments (template format)	Your comment has been forwarded to the decision makers.
Sarah Crawford	My additional comment: I began snorkeling and diving in West Hawaii as a visitor in 1990 and returned many times before moving to North Kona full-time in 1997. At that time, I had been certified as a rescue diver and later I became a divemaster. When my three children were old enough, each of them became divers, as well. Two are certified rescue divers and one is an advanced diver.	Your comment has been forwarded to the decision makers.
Sarah Crawford	During my visits from 1990 to 1997, I noticed how the fish population dwindled with each visit. After becoming a resident and while earning my divemaster rating and beyond, the fish population became more and more sparse. As a result, other animals were affected -- many of the creatures underwater have symbiotic relationships with others. For example, cleaner wrasses clean the teeth and scales of other underwater animals. Yellow tang clean the shells of green turtles. I'm sure you've heard all this before, but it's a reminder that life underwater is delicately balanced.	Your comment has been forwarded to the decision makers.
Sarah Crawford	Our oceans are under attack from many sources, from oceanic temperature increases to disturbances in the global conveyor belt, from widespread and devastating plastic and chemical pollution to industrial transnational overfishing, among others. I hope you realize that the ocean, which has served to save humans from so much of their carbon atmospheric pollution, and its native inhabitants need all the help we can give to make them healthy again. The good news is that the ocean can replenish its own riches if we stop interfering with destructive actions.	Your comment has been forwarded to the decision makers.
Sarah Crawford	Please do all you can to minimize, or, better yet, eradicate the aquarium trade from Hawaii. We need the fish wild and in the ocean, not in tanks in doctors' offices and Chinese restaurants.	Your comment has been forwarded to the decision makers.
Lois Crozer Crozer	See above comments (template format)	Your comment has been forwarded to the decision makers.
Lois Crozer Crozer	It's so sad to see the depletion of the fish because of climate change and pollution and then the added stress of aquarium collecting.	Your comment has been forwarded to the decision makers.
Judith Cucco	See above comments (template format)	Your comment has been forwarded to the decision makers.
Judith Cucco	I have done more than 1,000 species and abundance survey counts for REEF on Oahu since 2010 and I have seen a trend of fewer fish and fewer species over time. The aquarium trade steals our natural resources and sells them for profit. We need to protect our fish from exploitation.	Your comment has been forwarded to the decision makers.
Joe Culbertson	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Joe Culbertson	This industry is defined by waste and the drive to scarcity for increased value and profitability. In pursuit of target species from the reef, the collector's 'pattern and practice' necessarily damages living coral and disrupts other living organisms as they plant and then move their feet and gear around the reef. At every other step up the captivity chain, from puncturing swim bladders, to confinement in holding tanks, to shipping via air freight, losses are built into a market pricing system. And according to a recent documentary film, 99% of all wild Hawaiian reef fish die within 1 year of taking and shipping overseas. This is no sustainable fishery or for that matter, any kind of business plan…(except that the natural resources are free and unlimited after a $50 permit from the state!)	Your comment has been forwarded to the decision makers. A discussion on post-collection mortality is included in Section 5.4.2 of the EIS.
Joe Culbertson	The 'tragedy of the commons' is on clear display by this industry. Since no individual permitee knows to what extent other permittees are taking and perhaps approaching theoretical regulatory limits on a yearly basis, the 'tragedy of the commons' promotes unrestrained taking at every occasion by individuals when opportunities present themselves. This motivation is deeply offensive and completely at odds with a conservation ethic of restraint built into centuries old Hawaiian cultural traditions.	Your comment has been forwarded to the decision makers. The preferred alternative includes individual catch quotas that place a hard upper limit on the number of individuals of each of the 8 species on the Revised White list which could be collected within any given year. Existing size and bag limits would also remain in effect, as would existing MPAs and FRAs.
Piper Davies	See above comments (template format)	Your comment has been forwarded to the decision makers.
Piper Davies	Piper Davies. Just in the time of Covid the reefs were thriving with many more fish than when there are so many tourists.	Your comment has been forwarded to the decision makers.
Michael Denney	See above comments (template format)	Your comment has been forwarded to the decision makers.
Michael Denney	Aquariums are nothing more than residential fish zoos that most owners lose interest in. Better to see colorful fish in their natural environment at Kahalu'u Bay.	Your comment has been forwarded to the decision makers.
Steven Dennis	See above comments (template format)	Your comment has been forwarded to the decision makers.
Steven Dennis	We are homeowners in South Kohala on the beautiful Big Island. We have been diving and snorkeling the reefs here since 1982. We also have a home aquarium on the mainland. We ONLY buy tank raised fish for our home aquarium and there is no reason why ever home aquarium owner can't do the same. On behalf of our 6 grandchildren, please protect our reef fish and reef eco-systems for all future generations of Hawaiians and visitors.	Your comment has been forwarded to the decision makers.
Fred Dente	See above comments (template format)	Your comment has been forwarded to the decision makers.
Fred Dente	I am a snorkeler and I see the barren and empty reefs, compared to just a few years ago. Do NOT allow the taking of any more reef fishes for aquarium collecting or for any other reason.	Your comment has been forwarded to the decision makers.
Suzanne Dmytrenko	See above comments (template format)	Your comment has been forwarded to the decision makers.
Russell Drakeley	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Russell Drakeley	Have been a regular visitor to Kona coast of Hawaii for three decades. Have explored these reefs as a diver many times and I'm appalled that DLNR would even consider overturning the ban. Yellow tang retail at over $450 each. There's a reason for this - they are nothing more than "trophies" to be collected by the morons that support the aquarium trade. Leave these fish where they are for benefit of the environment, the people of Hawaii and visitors to these islands - and not least for the fish themselves.	Your comment has been forwarded to the decision makers.
James Duff	See above comments (template format)	Your comment has been forwarded to the decision makers.
James Duff	I am extremely concerned about the general situation of stripping the reefs of the only caretakers of the reefs health which are these fish people have been exhaustively removing for their short term personal gains. We are losing the reef caretakers for a few dollars to people who have made it their career. This is unacceptable and it has to stop. The fact is that nobody is doing anything to help these corals except for the reef fishes. The fish are the best caretakers of the coral reefs. I'm completely disgusted with the aquarium industry using these fish as their personal banking accounts. Free money for the taking with the assistance of the DLNR. The fact is that nobody needs the fishes more than the corals. Please Stop the theft of the keystone species of the coral reefs ecosystems.	Your comment has been forwarded to the decision makers.
Jeanne Duning	See above comments (template format)	Your comment has been forwarded to the decision makers.
Jeanne Duning	South Maui- I have noticed a marked general decrease in reef fish, especially the yellow tang over the 13 years I have been snorkeling and diving this area.	Your comment has been forwarded to the decision makers.
Medford Dyer	See above comments (template format)	Your comment has been forwarded to the decision makers.
Medford Dyer	There is no logical or rational reason that collecting of fish for aquariums should be allowed. Fish are a part of the 'aina and should be afforded at least the minimal protection of not being pulled out to go in aquariums. That this is even being debated is crazy in my opinion. Leave the fish where they legally, morally, and rightfully belong.	Your comment has been forwarded to the decision makers.
McKee Eileen	See above comments (template format)	Your comment has been forwarded to the decision makers.
Granger Eltringham	See above comments (template format)	Your comment has been forwarded to the decision makers.
Kenzie Erickson	See above comments (template format)	Your comment has been forwarded to the decision makers.
Kenzie Erickson	Fish belong in the ocean. They should not be exploited, used and abused by humans.	Your comment has been forwarded to the decision makers.
Donald Erway Erway	See above comments (template format)	Your comment has been forwarded to the decision makers.
Marjorie Erway	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Marjorie Erway	I personally became aware at how many more Yellow Tang there were after the ban went into affect. I suppose they were more noticable because they are so colorful that they can be seen in waves as they're breaking in the deeper waters. It's understandable that putting any businesses out of business, esp. right now during the very low economic problems the nation is having, but this fish collecting business absolutely needs to be stopped. Ocean water fish aquariums should not be filled with fish from Hawaii.	Your comment has been forwarded to the decision makers.
Michelle Estling	See above comments (template format)	Your comment has been forwarded to the decision makers.
Michelle Estling	In years past Molokini was abundant with every species of fish. These days certain species are seldom seen. Molokini used to have an abundance of Opihi and now you are lucky to see one. We are a Scuba diving and snorkeling shop and our livelihood and the ocean's ecosystem rely on a balance of all species of fish to keep the ocean healthy.	Your comment has been forwarded to the decision makers.
Scott Fallon	See above comments (template format)	Your comment has been forwarded to the decision makers.
Scott Fallon	I have been a saltwater aquarium enthusiast in the past so I know firsthand that collection in the wild is unnecessary. Wild-caught fish have a very poor survival rate after capture--they end up being more expensive for hobbyists than aquacultured fish because so many purchased die prematurely (often within a week or two of purchase because of the trauma from their capture...which is not including the high death rate before even making it to hobbyists). With aquaculture of even iconic Hawaiian fish such as the Yellow Tang now successful there is simply no reason for wild-caught practices to continue. An aquacultured fish is more expensive than wild-caught, but not in the long-run given that it has a much, much higher survival rate, meaning the hobbyist is not constantly replacing dying fish (with more wild-caught fish that will then die in a never-ending cycle). If you also factor in the externalities (damage to reefs, etc.) the cost of wild-caught can no longer be justified whenaquaculture is now so hugely successful and environmentally friendly.	Your comment has been forwarded to the decision makers.
M Kim Ferris	See above comments (template format)	Your comment has been forwarded to the decision makers.
M Kim Ferris	I grew up on the island of O'ahu and as a young child could remember the many different species of fish that would swim in our coral reefs. I enjoyed each adventure snorkeling to marvel at this abundant marine life. As an adult now I live on the island of Maui. It makes me so very sad indeed to see that there are barely fish, if any at all living among the coral. Recently I Went snorkeling at a spot called, "Coral Gardens" in south shore Maui. It was once a beautiful, gorgeous reef; so colorful and full of life. Now it is literally a 'dead zone' - no fish and brown, dead coral. I oppose taking any marine life for commercial use from the ocean surrounding the Hawaiian islands.	Your comment has been forwarded to the decision makers.
Kathy Flynn	See above comments (template format)	Your comment has been forwarded to the decision makers.
Georgie Fong	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Georgie Fong	Snorkeling and swimming with coral fishes is one of the most rejevenating activity. In my 20 years experience, I feel that the abundance of coral fishes has diminished by 50%. Please protect our coral fishes, they are the steward of the health of the coral "ecosystem". Our coral fishes DESERVE to live their "God Given " Natural Free life in the ocean and NOT in a Glass container as a "JAIL FISH" for no CRIME committed other than to financially benefit a group of UNSKILL greedy people who wants to make money. Those people should acquire a skill and get a DECENT JOB.	Your comment has been forwarded to the decision makers.
Judy Forehand	See above comments (template format)	Your comment has been forwarded to the decision makers.
Neil Frazer	See above comments (template format)	Your comment has been forwarded to the decision makers.
Neil Frazer	I have personally witnessed the decline in reef fishes over the last 40 years of my full-time residency at Kailua O'ahu. The decline of reef fishes in that time has been both striking and heart-breaking. We need these fish. Please put an end to aquarium fishing.	Your comment has been forwarded to the decision makers.
Neil Frazer	With regard to fishing generally, I would like you to know that since 1954 at least, fisheries economists have been vigorously pointing out that fishermen fish until their costs exceed their revenue. By subsidizing fishing in any way, we incentivize fishermen to fish longer and harder. In other words, if we want there to be any fish left in the sea, we should be taxing fishermen not subsidizing them. Moreover, there should be no fishing at all on the high seas.	Your comment has been forwarded to the decision makers.
Shirley Fritz	See above comments (template format)	Your comment has been forwarded to the decision makers.
Shirley Fritz	We swim at Kailua-Kona Bay where the number of fish has increasingly gone down.	Your comment has been forwarded to the decision makers.
Kevin Galloway	See above comments (template format)	Your comment has been forwarded to the decision makers.
Kevin Galloway	As members of society we should take responsibility and ownership for our ecosystems especially in Hawaii where we cherish protecting our islands natural resources. The answer is so simple, we need to be putting our resources before someone making a buck. It is our duty and should be obvious, both morally and scientifically.	Your comment has been forwarded to the decision makers.
Benjamin Garfinkle	See above comments (template format)	Your comment has been forwarded to the decision makers.
Benjamin Garfinkle	I have dove/fished/snorkled in west hawaii constantly since 2005 and have seen the rapid decline in the reef quality /fish devisrsity/how much smaller the fish are and how few fish are here since I started diving here in 2005. I am on the board of the nature conservancy Hawaii and we study the science and fish counts and know how bad the situation is there is absolutely no need to open the aquarium trade to take fish that most die shortly after be taken this MUST stop premantely . We also have the science and data that shows that the TRY WAIT AREaA is improving very quickly since it was closed 3.5 years ago certain fish have recovered up to 40% since the closure we dove the try wait area this week and can first hand see the improvement in the ref/fish quantity and diversity	Your comment has been forwarded to the decision makers.
Emily Garland	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Emily Garland	I am an avid snorkeler. Snorkeling for me is a peaceful meditation that allows me to appreciate Hawai'i's underwater beauty. I have lived in Hawaii since 2015. Since the aquarium trade ended in 2018, I have noticed an increase in the number and diversity of marine life. Please help continue to protect this life and all the benefits it brings to Hawai' nei. Mahalo.	Your comment has been forwarded to the decision makers.
JoAnn Garrigan	See above comments (template format)	Your comment has been forwarded to the decision makers.
JoAnn Garrigan	I am totally against this business on our island. I have recently visited 69 Beach, A bay, Hapuna and I have visited Hilo Beach recently. Fish types and amounts still look scarce. I have heard the stories about how it used to be This Island needs its beautiful reef fish left in, on, about their homes, their reefs. This is not a business that the island of Hawaii should be proud of. Wild fish belong in the sea. The stress of mailing them around the world to the mainland, wherever they are going, is reprehensible. Tourists and residents alike need to be able to see the beauty of the local reef fish while swimming in the waters. It's embarrassing when there is less to see when I take visitors to the beach to see our reefs. Leave the reefs and their cohort fishes to heal and to thrive and make Hawaii island a true paradise for all.	Your comment has been forwarded to the decision makers.
Kevin Gavagan	See above comments (template format)	Your comment has been forwarded to the decision makers.
Kevin Gavagan	This is nothing but exploitation of our natural resources. This activity adds nothing to our Economy and our marine environment pays the heavy price.	Your comment has been forwarded to the decision makers.
Judith Gentzel	See above comments (template format)	Your comment has been forwarded to the decision makers.
Judith Gentzel	Keei Beach in south Kona is a place where many folks enjoy snorkeling, fishing and surfing. The fish need to stay in our ocean. They are such an important part of the water habitat. If this is challenged with reef fish capture by the thousands, you tell me what the ecological benefits are. I do not know of any. Sincerely, Judith Gentzel	Your comment has been forwarded to the decision makers.
Venus Glavor	See above comments (template format)	Your comment has been forwarded to the decision makers.
Venus Glavor	I have lived in kihei maui for over 40 years and have seen the decline in all of these reef fish along all of maui's coast along with our reef. Please don't allow the mass taking of our reef fish.	Your comment has been forwarded to the decision makers.
Cathy Goeggel	See above comments (template format)	Your comment has been forwarded to the decision makers.
Cathy Goeggel	When I dive on O'ahu, where I live, comparing the numbers and variations of fishes that I see, compared to 50 years ago, when I first came to Hawai'i- the loss of diversity and color is appalling. The DEIS does not offer any hope for the future health of the ocean. Please protect what your department is mandated to- without the ocean, Hawai'i will perish. Mahalo!	Your comment has been forwarded to the decision makers.
Janet Goodmanson	See above comments (template format)	Your comment has been forwarded to the decision makers.
Janet Goodmanson	Please protect our reefs and underwater wildlife to the fullest extent.	Your comment has been forwarded to the decision makers.
Dan Gordon	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Dan Gordon	What other wild animals do we trap and put in cages in our homes - because that is what the aquariums are they are cages. We feed foods to them that do not nourish them. Most of them die in transport or shortly after being bought. These fish are part of a very complicated environment that we are polluting enough as it is. Let them live wild!	Your comment has been forwarded to the decision makers.
Jamie Gottlieb	See above comments (template format)	Your comment has been forwarded to the decision makers.
Jamie Gottlieb	Please continue to ban taking these fish. There is no reason to take them (other than $). Not banning would harm the fish, our reefs, and possibly make some of them be extinct. We need Nature as it is. Thank you.	Your comment has been forwarded to the decision makers.
Cat Gould	See above comments (template format)	Your comment has been forwarded to the decision makers.
Cat Gould	As an Australian who has spent the last 50 years on and off the Great Barrier reef I know full well the impact that collecting has made. Please protect the Hawaiian reefs, they need our protection now more than ever as they struggle with the impacts of climate change and pollution.	Your comment has been forwarded to the decision makers.
John Graves	See above comments (template format)	Your comment has been forwarded to the decision makers.
John Graves	I only came to Hawaii last year as a graduate student at UH Hilo, but I have been absolutely captivated by the beauty of this islands reef ecosystems. I am currently working on a project investigating the impacts of herbivores on reef resilience on the Kona coast. There is strong evidence from literature on coral reefs throughout the world, showing that herbivore abundance and diversity are not only fundamentally important indicators of reef health, but can also increase resilience in the face of anthropogenic pressures and coral bleaching. Our reefs are under pressure from pollution, agricultural runoff, plastic accumulation and especially increased sea surface temperatures. The negative impacts of the aquarium trade on targeted species far outweigh the economic benefits. The moratorium on the aquarium trade is one of the few bright spots for coral conservation here in Hawaii, and I urge the DLNR to keep this ban in place so that our reef ecosystems here may continue to thrive for generations to come.	Your comment has been forwarded to the decision makers. Reef resilience and herbivores are discussed in Section 5.4 of the EIS.
Michael Greenspan	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Michael Greenspan	I have been coming to Hawaii since 1981. I would say the fish population has diminished by at least 80% since that time on the reefs that I snorkel. Back then clouds of all types of fish were present. Now it is so sad what has happened. Hardly any fish left. If the tropical fish collecting is allowed to continue, there will be no fish left in the ocean. How could anyone let this happen, knowing how the hawaiian people depend on fish for food! There has been a slight uptick in fish at Mahukona beach park in North Kohala where I snorkel mostly, but hardly noticeable. It will probably take decades to bring the number of fish back to where it was in l981. And even then the hawaiian people were telling me how much the fish have gone away. How can we let a few people rape our beautiful fishes for there profit and leave the rest of us citizens with nothing to see in the ocean anymore and no fish to reproduce new fishes. Please stop this destructing business from ruining Hawaii's tourist industry, because if there are no fish who will come here to dive and snorkel. Also I used to snorkel around the Mexican rivera back in the day and this has already happened there, no fish left at all, and all the reefs are dead. Please protect Hawaii from this horrible threat. Thank you for your consideration.	Your comment has been forwarded to the decision makers.
Edward Grella	See above comments (template format)	Your comment has been forwarded to the decision makers.
Edward Grella	Please keep the reef beautiful and don't fill pockets of greedy business owners	Your comment has been forwarded to the decision makers.
Laura Grote	See above comments (template format)	Your comment has been forwarded to the decision makers.
Laura Grote	When speaking with long time residents, I heard stories of watching the populations of fish decrease by the year. I myself document the bleaching and death of coral reefs. THE PLANET DEPENDS ON ITS DELICATE ECOSYSTEM. We al need to work together, as a system.	Your comment has been forwarded to the decision makers.
Gregg Gruwell	See above comments (template format)	Your comment has been forwarded to the decision makers.
Gregg Gruwell	I have been snorkeling Kona since 1988 I moved to Kona in 1999. Being a US Naval Officer for 14 years, I think I am a good judge of what I see. And that is 75%+ of the Aquarium collected fish are gone. I just had friends visit from Seattle. From Captain Cook, to North Kohala, they snorkeled and were saddened and shocked by the lack of fish. This will affect our post Covid economy. Kona was once the Gold Coast but that gold has been extracted by the aquarium trade. Please stop this practice once and for all!	Your comment has been forwarded to the decision makers.
Matthew Gurewitsch	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Matthew Gurewitsch	I have lived in Hawaii full time for ten years. During this time, I have seen fish populations on Maui (where I snorkel at least 300 days a year) and the Big Island (which I visit occasionally) dwindle--in all too many cases to the point of complete disappearance. On no account should we stand idly by while our aina is plundered. Nor should we condone the ongoing attempts of short-sighted commercial interests and their self-serving, transparently specious "Environmental Impact Statements" to whitewash their extractive, unsustainable, selfish practices.	Your comment has been forwarded to the decision makers.
Gary Gustafson	See above comments (template format)	Your comment has been forwarded to the decision makers.
Gary Gustafson	The revised draft DEIS does not include consideration of using private aquaculture facilities to propagate tropical fish for aquariums instead of allowing aquarium collectors to adversely impact wild fish stocks. In addition, the impacts of aquarium collecting on endangered monk seals and the sport fishing community need to be more thoroughly described.	Your comment has been forwarded to the decision makers. Captive breeding would not meet the purpose and need of the EIS. See edits made to Section 3.8 of the RFEIS to address captive breeding.
Linda Gustafson	See above comments (template format)	Your comment has been forwarded to the decision makers.
Linda Gustafson	The amount of tourism and dollars that come from people viewing reef fish and the joy they bring far outweighs the few people who benefit from aquarium collecting. Don't spoil reef fish viewing for many so a few can make money and destroy this wonderful resource of the sea!	Your comment has been forwarded to the decision makers. As stated in the EIS, Hawaiʻi's tourism industry achieved new records in total visitor spending and visitor arrivals in 2017, marking the sixth consecutive year of record growth in both categories. This occurred while commercial aquarium collection was also occurring.
Geoffrey Hajim	See above comments (template format)	Your comment has been forwarded to the decision makers.
Geoffrey Hajim	With the reef system under stress from climate change, now is the time to shut down all industries that have negative impacts on the reef!	Your comment has been forwarded to the decision makers.
Taylor Hall	See above comments (template format)	Your comment has been forwarded to the decision makers.
Taylor Hall	I've witnessed fish diversity all over the reefs of Oahu, and outer islands, disappearing and I'm gravely concerned. We need to protect our fish and reefs before it's too late!! Our government must take action now to stop the damage that is being done by aquarium trade.	Your comment has been forwarded to the decision makers.
Suzanne Hammer	See above comments (template format)	Your comment has been forwarded to the decision makers.
Suzanne Hammer	I have been swimming snorkeling daily in Hawaii for forty five years 25 of those every am in Hanauma Bay where aquarium hunters even come at night and take fish I have swam Honolulu, Kailua , Waimanalo and Hanauma Bay in succession and outer island occasionally I have watched the take of fish and have experienced the robbing of our reefs Chevron butterfly fish, reticulated butterfly fish, and pyramid butterfly fish all taken	Your comment has been forwarded to the decision makers. The three butterflyfish mentioned are not on the Revised White List, and would not be collected under the Preferred Alternative.
Suzanne Hammer	The aquarium hunters seem interested in money and have the political connections to ravage Hawaiian waters to depletion without allowing the reefs to rebound It is tragic for those of us watching the devastation this practice causes	Your comment has been forwarded to the decision makers.
Phyllis Hanson	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Phyllis Hanson	This has been an ongoing battle since I moved here, in 1988. It's ridiculous to think 1000s of fish can be removed from our near waters without an impact. It's also ridiculous that a few people should benefit (from fish collecting) at the expense of the many people who live or visit this area. Please, do NOT open this area up to more commercialization.	Your comment has been forwarded to the decision makers.
Dan Harrang	See above comments (template format)	Your comment has been forwarded to the decision makers.
Dan Harrang	Neither the arguments pro or con mention that up to 2/3 of the fish (or more) may die in transit; yet it's still profitable for the shippers to take as much as they can. A few individuals take what belongs to all of us. And, removing just a few species can cause a reef community to collapse. This is proven!	Your comment has been forwarded to the decision makers.
Penelope Hazzard	See above comments (template format)	Your comment has been forwarded to the decision makers.
Penelope Hazzard	Again, this is of little economic benefit to Hawaii, and benefits very few residents. Meanwhile the damage may be irreparable.	Your comment has been forwarded to the decision makers.
Jeannette J Heidrich	See above comments (template format)	Your comment has been forwarded to the decision makers.
Jeannette J Heidrich	We live on the Kona Coast. We have seen fewer fish on these reefs over the last several years. Only recently, has the population shown a slight increase. These fish are needed for the health of the reef. these fish are needed for the economy of Hawaii, so that tourists will come visit the state to see the beautiful fish IN THE WATER	Your comment has been forwarded to the decision makers.
Karen Heifet	See above comments (template format)	Your comment has been forwarded to the decision makers.
Karen Heifet	I have seen a decline in fish at Molokin and south Maui snorkeling areas over the 21 years I have lived here. Please protect our reefs and fish from commercial selling of tropical fish.	Your comment has been forwarded to the decision makers.
Vicki Hendrix	See above comments (template format)	Your comment has been forwarded to the decision makers.
Vicki Hendrix	I have seen decline over the years and am very concerned about the possible impact of future removal.	Your comment has been forwarded to the decision makers.
David Hill	See above comments (template format)	Your comment has been forwarded to the decision makers.
Ryan Hill	See above comments (template format)	Your comment has been forwarded to the decision makers.
Ryan Hill	Puako reefs have less and less diversity of fish.	Your comment has been forwarded to the decision makers.
Scott Hill	See above comments (template format)	Your comment has been forwarded to the decision makers.
Scott Hill	Puako reef needs to maintain its reef abundance and diversity. 246,000 reef fish per year for aquariums seems like too much. I also think reef fish should not be caught for food either.	Your comment has been forwarded to the decision makers.
Fern Holland	See above comments (template format)	Your comment has been forwarded to the decision makers.
Fern Holland	As a scientist with a marine biology major and a thorough understanding of the importance of healthy fisheries and marine ecosystems I am gravely concerned about the survival of Hawaii's coral reefs and the species that inhabit them.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Fern Holland	As a Kaua'i resident who has supported the subsistence fishing project on our far north shore and in recent years, due to decreased impact, have seen (and heard a great deal about) the increased abundance and assemblage of fish already returning in a short period to this area. This has given me renewed hope that correct management can strengthen fisheries and species chance of survival in even a short period of time.	Your comment has been forwarded to the decision makers.
Fern Holland	I am very concerned about the failure of this DEIS to properly assess the true impacts associated with the aquarium trade in our waters. The revised DEIS fails to acknowledge the depletion of natural abundance the trade has caused, and would continue to cause, as well as all the impacts that result from that depletion.	Your comment has been forwarded to the decision makers. Collection under the Preferred Alternative would be limited to the 8 species on the Revised White List, all of which have had stable or increasing populations in the WHRFMA under historic aquarium collection.
Fern Holland	The DEIS fails to include the scientifically proven impacts of collection for the aquarium trade as though their stance is the totally inaccurate position that depleted abundance is now the new natural state of our reefs.	Your comment has been forwarded to the decision makers.
Fern Holland	Reef surveys spanning decades have documented significant impacts to species taken by commercial aquarium collectors. The most impacted species including Yellow Tangs, certain butterflyfishes, and other rare native fishes, experienced population declines ranging from 60 – 99% in the areas hardest hit by the trade. In 2018, when the trade was closed, that trend finally began reversing, and abundance of Yellow Tangs and other fishes began to come back.	Your comment has been forwarded to the decision makers.
Fern Holland	Without an increase in fish abundance, the entire fisheries have decreased resilience and the impacts of climate change are likely to be far worse. In a time where our marine ecosystems and fisheries are under such extreme pressure it is completely irresponsible to approve an assessment that falls so short of providing an accurate reflection of the true impact of this industry on our fisheries.	Your comment has been forwarded to the decision makers.
Ryan Holmboe	See above comments (template format)	Your comment has been forwarded to the decision makers.
Ryan Holmboe	I can't support the fish collecting industry, that takes important creatures from the natural reefs for purely selfish reasons, and monetary gain. As a local scuba diver that has been diving on the local reefs of the west coast for 10 years I've seen the special/rare species disappear and not return. I can't see any compelling argument for any continued fish collecting for the aquarium trade.	Your comment has been forwarded to the decision makers.
Mark Howard	See above comments (template format)	Your comment has been forwarded to the decision makers.
Mark Howard	I am a long time diver and SCUBA instructor and have been diving Hawaii for over twenty years. I own a house in Wailuku. My son is a marine scientist - graduated UH Hilo'09. We have seen firsthand the effects of commercial exploitation of reef fish, such as yellow tangs, and how that adversely affects reef health. There is no reason to have commercial reef fish collection anywhere in Hawaii. 90% of captive fish never see a mainland owner - and even there, can expect a very short lifespan. We have maintained saltwater tanks, and I can tell you it difficult to maintain a healthy environment for a small group of fish; much less hundreds. Please do not allow senseless exploitation of my granddaughter's future.	Your comment has been forwarded to the decision makers.
Alice Hughes	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Brent Humble	See above comments (template format)	Your comment has been forwarded to the decision makers.
Brent Humble	40 years ago when I would snorkel the reef would be teaming with fish and I've seen a drastic decline over the years. I've seen more species showing back up and the aquarium collection trade is no longer appropriate here in Hawaii	Your comment has been forwarded to the decision makers.
David Hunt	See above comments (template format)	Your comment has been forwarded to the decision makers.
David Hunt	Stealing and enslaving our native reef fish for the ignorant "enjoyment" of non-islanders is unethical and barbaric. Our reefs and our reef fish have inherent RIGHTS to live and thrive without suffering the consequences of human greed and ignorance.	Your comment has been forwarded to the decision makers.
Jacqueline Hunter	See above comments (template format)	Your comment has been forwarded to the decision makers.
Jacqueline Hunter	If you touch these fish I am going to commit a HECKIN murder because seriously?? Leave the fish alone. No fish mean less food for predators. No fish means more algae and other things they eat. If you fuck up this food chain you're further fucking up the ocean and I *will* be outraged because how *dare* you ruin these regions for the generations to come, for the people who like to swim and see the fish now, just so someone can capture twenty fish (most of which will die in the process) and someone else can have a pwetty wittle fishie in their tank that'll probably die in a few weeks. They belong in Hawaii. Keep them there.	Your comment has been forwarded to the decision makers.
Alexis Iacuzzo	See above comments (template format)	Your comment has been forwarded to the decision makers.
Alexis Iacuzzo	I work on boats doing ocean tours along the Kona coastline. I frequently dive and snorkel many reefs in a 20 mile stretch along the coast. In the 6 years that I've lived here, I have noticed a decline in fish. I always love pointing out the "Gold Coast" of yellow tang and will tell my guests how amazing it is to see the large schools of bright yellow. Then when I am in the water to show, my heart sinks to see such small clusters. Some schools are less than 10 fish. I've had guests comment frequently how they are amazed at how much less fish are here than 5, 10 , 15, 30 years ago. There is absolutely no sustainability for our reefs. Here is also minimal to no enforcement of boats , public and private. From engaging n illegal activities. When someone does get caught, it ends up being such a minimal fine that there is no reason to even worry about being caught. We are destroying Hawaii. We need to take responsibility and start acting differently to preserve the beauty of Hawaii.	Your comment has been forwarded to the decision makers.
Betsy Jewett	See above comments (template format)	Your comment has been forwarded to the decision makers.
Betsy Jewett	It has been a great joy to see more numbers and larger specimens of many reef fish we love and watch during our snorkeling swims. We now want to snorkel on the reefs more than ever!	Your comment has been forwarded to the decision makers.
Mary Johnson	See above comments (template format)	Your comment has been forwarded to the decision makers.
Gary Johnson	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Gary Johnson	I have lived on Maui for 8 years and snorkel neatly everyday. It is shocking how few fish are left .Permitting profit by further loss of fish is spalling and will also impact tourism. Tourists ask me where are the fish? I have to say I am sorry. Please don't sell our fish to aquariuns	Your comment has been forwarded to the decision makers. The Proposed Action does not inlcude issuance of permits for aquarium collection on Maui. This EIS is limited to the island of Hawai'i, and does not analyze impacts of collection on Maui. Any requested Aqaurium Permits for Maui would need to complete their own HEPA review.
Jennifer Johnson	See above comments (template format)	Your comment has been forwarded to the decision makers.
Mark Johnson	See above comments (template format)	Your comment has been forwarded to the decision makers.
Makana Kadooka	See above comments (template format)	Your comment has been forwarded to the decision makers.
Etta Karth	See above comments (template format)	Your comment has been forwarded to the decision makers.
Etta Karth	As a resident and employee on the Island of Hawaii I've followed the fish collecting situation since about 2006. The laws that are already in place for these fish and many many other biota have not and are not being enforced very well. I know people who break the rules all the time. Even if someone like me reports violations, its rare that the authorities act on it, especially if locals are violating these rules :/	Your comment has been forwarded to the decision makers. The Preferred Alternative included additional enforcement and compliance measures outlined in Section 3.7.2 of the RDEIS, but this section has been revised in response to comments received on the RDEIS.
Donna Kauhane	See above comments (template format)	Your comment has been forwarded to the decision makers.
Donna Kauhane	As a fifty plus year resident of Maui, I have seen how the reef and fishes have changed over the years. Please be a force for the good of Hawaii's natural beauty and living treasures. Please do not allow the aquarium trade to continue to deplete our wonderful fishes. Please reinstate the ban on taking these beautiful creatures from their home here in Hawaii. Mahalo. Donna Kauhane	Your comment has been forwarded to the decision makers. The Proposed Action does not inlcude issuance of permits for aquarium collection on Maui. This EIS is limited to the island of Hawai'i, and does not analyze impacts of collection on Maui. Any requested Aqaurium Permits for Maui would need to complete their own HEPA review.
Karina Keith	See above comments (template format)	Your comment has been forwarded to the decision makers.
Karina Keith	Taking this many fishes from their natural habitat will disrupt the beautiful and natural state of our reefs which we continue to work so hard to protect because we know how important they are for not only the marine life but for the human life on the island as well.	Your comment has been forwarded to the decision makers.
Anita Kelleher	See above comments (template format)	Your comment has been forwarded to the decision makers.
Cynthia Kennedy	See above comments (template format)	Your comment has been forwarded to the decision makers.
Kathryne Kent	See above comments (template format)	Your comment has been forwarded to the decision makers.
Kathryne Kent	Please stop this barbaric practice of taking and selling our beautiful reef fish. It's outrageous to have a business like this still being considered in these days of climate change and coral die off. Enough!!	Your comment has been forwarded to the decision makers.
Risa Kuroda	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Risa Kuroda	Adjusted to 2019 dollars, Hawaii's coral reefs were estimated at a conservative $14.8 billion, bringing $534 million per year directly to the state and the tourism industry just by the fact of the reefs being there and alive. https://scholarspace.manoa.hawaii.edu/bitstream/10125/2723/1/vol58n2-231-242.pdf. Majority of all coral reefs globally are also expected to die off in the next century, and the aquarium industry simply need not exacerbate ecological collapse and hinder Hawaii's longterm economic recovery in the aftermath of COVID-19. These environmental and economic externalities are not adequately outlined in the DEIS. If this industry is to be supported by the state, they must positively contribute to the state or else it is just embarrassing sanctioning of highway robbery.	Your comment has been forwarded to the decision makers.
Wendy Lafer	See above comments (template format)	Your comment has been forwarded to the decision makers.
Wendy Lafer	Scientific data clearly supports severely limiting or eliminating tropical fish collecting during current climate change. The misbehavior of those in the aquarium business have added to the egregiousness of the situation. As a user of the reefs, I can attest to the almost complete devastation of living coral during this year and previous years. The ocean as a food source is considerable while the necessity for catching fish for aquariums is an unnecessary devastation that should not be allowed during these current conditions.	Your comment has been forwarded to the decision makers.
Sally Lambert	See above comments (template format)	Your comment has been forwarded to the decision makers.
Sally Lambert	I have spent 45 years in the ocean around Kona and Kohala. I have enjoyed snorkeling among the coral reef and shorelines of this area where I have observed the beauty and behaviors of these and other marine animals. It is difficult to understand why the DLNR is once again considering an unacceptable DEIS from fish collectors whose economic needs will never be more important than the ecological need to keep these fish where they have been born and should continue to live out their lives. There is no reason that anyone should feel they have a right to remove these fish from their reef. They obviously need our protection and the pet trade will have to survive without these White List species.	Your comment has been forwarded to the decision makers.
Antoinette Lang	See above comments (template format)	Your comment has been forwarded to the decision makers.
Antoinette Lang	I am concerned with all the reefs in Hawaii. I lived on big island for 15 years and my friend witnessed from her home people coming withlarge tanks on a truck and stealing fish in the middle of the night from Kapoho reefs Wai'Opea. This reef was a preserve which is now covered in lava. Please stop these people from taking what few fish are left.	Your comment has been forwarded to the decision makers.
Nicole Larson	See above comments (template format)	Your comment has been forwarded to the decision makers.
Geoffrey Lauer	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Geoffrey Lauer	Hawaii's Dept. of Land and Natural Resources (DLNR)issued a revised draft EIS with comments welcome through April 9, 2021. This EIS is deeply flawed and does NOT SUPPORT the need, cost, impact, sustainability, cultural considerations, or rebound of fishes since the closure of 2018. Specifically the EIS: 1) still denies the scientifically proven, significant NEGATIVE impacts of aquarium collection in West Hawaii 2) FALSELY and with the weakest evidence (if any) Claims that taking over 246,000 fish each year won't cause population declines 3) FALSELY Claims there would be no adverse natural, socio-economic, or cultural impacts that need addressing and 4) Disregards that the largest surge in Yellow Tang abundance ever documented resulted from the closure of West Hawaii to aquarium collection in 2018 Leave the reefs to recover and be a natural and wonderful resource to us all.	Your comment has been forwarded to the decision makers.
Brian Lawes	See above comments (template format)	Your comment has been forwarded to the decision makers.
Laura Legge	See above comments (template format)	Your comment has been forwarded to the decision makers.
Laura Legge	Please, the time left to do the right thing is NOW. We need all our reefs protected to save our beautiful coastal waters, and the health of our oceans, for the generations to come. I'm an avid diver who spends a lot of money on Hawaiian small businesses supporting my beloved time in the ocean. How will these family owned businesses be impacted if our reefs are depleted? Do the right thing NOW and let's stop this irresponsible trade. Do NOT let future generations look back at ours in despair wondering why we didn't malama aina/kai when we had the opportunity to do so. Mahalo	Your comment has been forwarded to the decision makers.
Shelby Leicher	See above comments (template format)	Your comment has been forwarded to the decision makers.
Shelby Leicher	As a Scuba Diving professional, my livelihood depends upon the multi-million dollar diving business that only flourishes if our reefs flourish. Hawaii stands to make much more money by keeping its fish in their ocean where they belong so tourists can come see them in their wild beauty - not in an aquarium.	Your comment has been forwarded to the decision makers.
Sammarye Lewis	See above comments (template format)	Your comment has been forwarded to the decision makers.
Sammarye Lewis	Extinction is forever! When the coral reefs are gone because of greed and profit, the ocean and it's creatures will die... When the Ocean dies, we die...	Your comment has been forwarded to the decision makers.
Sammarye Lewis	See above comments (template format)	Your comment has been forwarded to the decision makers.
Sammarye Lewis	Remember: Extinction is Forever.... When the Oceans die, we die	Your comment has been forwarded to the decision makers.
Kurt Lieber Lieber	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Kurt Lieber Lieber	I have been scuba diving in the waters around Kona since 1984. I'm a photographer and have been distraught by the change in reef fish abundance. In the 80's I'd see Yellow Tangs in schools of hundreds. Large parrot fish, where now I haven't seen a 3 footer in a decade, at least. Another fish that has disappeared is the Flame Angel, used to see several on each dive and now it is big news if I see just one! The lack of the herbivores is leaving the corals with no defense against invasive sea weeds, and in some spots you can see large mats of the stuff smothering the coral heads. Because of the decline in abundance I stopped visiting Hawaii in the 90's. My friends and I went to places that had better protections for the reef fish, places like Fiji, the Philippines, the Maldives and Australia. I don't feel that your evaluation of the costs that the aquarium trade have on dive tourism takes in to account all of us that have taken our dollars elsewhere. I started going back to Hawaii in 2016 because I decided that I want to help the place that has fascinated me since my first dive there in 1984. Please do NOT allow any take of the reef fishes anymore. I visit Kona 3-4 times a year now, and can see glimpses of what it used to look like. I hope my kids and grand-kids get the opportunity to witness the beauty of the Hawaiian underwater world.	Your comment has been forwarded to the decision makers.
PaulaKay Lindauer	See above comments (template format)	Your comment has been forwarded to the decision makers.
PaulaKay Lindauer	I have property in Hawaiian Acres. I love the Hamakua coast and all the big island. I believe that none of these fish should be taken for any type of pet trade. I heard they are now breeding fish just for aquariums so the wild are left alone. I have a friend from Hawaii who lived in the mainland for years. He used to buy rare fish and have them sent in the mail and when he was done with his aquarium, he just flushed them down the toilet. Cruel. Just plain cruel. We need to save these fish.	Your comment has been forwarded to the decision makers.
Jodi Loetscher	See above comments (template format)	Your comment has been forwarded to the decision makers.
Jodi Loetscher	I am just concerned that human beings care more about their superficial desires than they do about preserving the planet and it's wildlife.	Your comment has been forwarded to the decision makers.
Meizhu Lui	See above comments (template format)	Your comment has been forwarded to the decision makers.
Meizhu Lui	As we try to make an economic recovery, tourism will still be important. A main attraction is our beautiful and diverse species of fish. Let fish lovers come and see the fish in their native habitats; a much better than owning a few and watching them swim circles in a tiny tank. And rather than allowing just a handful of collectors to make money by exporting this important resource, let the many who work in the tourism industry keep their jobs in part because people want to come and enjoy our waters and the life that is naturally teeming within it.	Your comment has been forwarded to the decision makers. As stated in the EIS, Hawai'i's tourism industry achieved new records in total visitor spending and visitor arrivals in 2017, marking the sixth consecutive year of record growth in both categories. This occurred while commercial aquarium collection was also occurring.
Meizhu Lui	For locals and tourists alike, it was wonderful to see the yellow tangs return to Mahukona. Many of us also swim at Laupahoehoe Point where fish are not as abundant as they could be. We are critical of other countries for their trade in endangered or wild animals; we need to be mindful of the harm we do to nature ourselves when we allow the balance of nature to be upset. Please do not allow the return of the aquarium trade!	Your comment has been forwarded to the decision makers.
Lyn N	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Diana Madaras	See above comments (template format)	Your comment has been forwarded to the decision makers.
Diana Madaras	Where are the Yellow Tang?	Your comment has been forwarded to the decision makers.
Elizabeth Mantone	See above comments (template format)	Your comment has been forwarded to the decision makers.
Cheryl Manuel	See above comments (template format)	Your comment has been forwarded to the decision makers.
Matthew Martin	See above comments (template format)	Your comment has been forwarded to the decision makers.
Marty Martins	See above comments (template format)	Your comment has been forwarded to the decision makers.
Marty Martins	I have snorkled the 'Ulua-Mokapu reef on Maui since 1999 and have watched the number of reef fish, especially Yellow Tang and Moorish Idols, diminish to where there are no Yellow Tang left. I know trappers are to blame.	Your comment has been forwarded to the decision makers. The Proposed Action does not inlcude issuance of permits for aquarium collection on Maui. This EIS is limited to the island of Hawai'i, and does not analyze impacts of collection on Maui. Any requested Aqaurium Permits for Maui would need to complete their own HEPA review.
Nancy Maupin	See above comments (template format)	Your comment has been forwarded to the decision makers.
Nancy Maupin	I have been snorkeling at Makaiwa and Waianae Bays for years and have seen a steady decline in the reef fish populations. This not only affects the tourism but the health of the reef as well.	Your comment has been forwarded to the decision makers.
Alma Mcgoldrick	See above comments (template format)	Your comment has been forwarded to the decision makers.
Alma Mcgoldrick	I have snorkeled many of the Hawaiian Island reefs for 50 years and have been concerned for many years past to see the lack of reef fish in many places, not just Hawaii island. why should aquarium fish hunters be allowed to steal the fish that are needed for balance and care of the reefs, cleaning them from algae etc?? With seas warming and coral bleaching even more need to keep the fish on the remaining reefs Often the fish taken die before they even reached the mainland. and they are treated to horrible conditions on the way. Its is no good giving half measures, the takers will not police themselves with how many they take. I think there MUST be complete ban on all taking of fish from the reef for aquariums. let the people who do this take their boats instead for tourists and locals to snorkel and watch the fish	Your comment has been forwarded to the decision makers.
Michael McGuire	See above comments (template format)	Your comment has been forwarded to the decision makers.
Michael McGuire	Save our reefs by saving our reef fish! we need them in Hawaii on our reefs more than in a aquarium.	Your comment has been forwarded to the decision makers.
Peter Meechan	See above comments (template format)	Your comment has been forwarded to the decision makers.
Peter Meechan	We have seen fish stocks and the reef diminished on our local reef Ke'ei and all along the West Coast.	Your comment has been forwarded to the decision makers.
Matt Meier	See above comments (template format)	Your comment has been forwarded to the decision makers.
Justice Meza	See above comments (template format)	Your comment has been forwarded to the decision makers.
Justice Meza	This is a ridiculous and reckless proposition. You would trade the eternal Beauty and betterment of our planet in exchange for a few years of a fish tank. This goes against the very spirit of our ancestors.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Kyle Millar	See above comments (template format)	Your comment has been forwarded to the decision makers.
Nina Monasevitch	See above comments (template format)	Your comment has been forwarded to the decision makers.
Nina Monasevitch	Our oceans are dying before our eyes. The main reason is over extraction. Taking fish for aquariums is 100% wrong. It is unsustainable, cruel, unhealthy, unethical, and goes against Hawaiian cultural values. The ocean is literally our life support system, if the oceans die, we die. Time to realize that protecting our ocean ecosystem is vitally important, much more important than the greed that drives the aquarium trade business.	Your comment has been forwarded to the decision makers.
David Monasevitch	See above comments (template format)	Your comment has been forwarded to the decision makers.
David Monasevitch	The aquarium trade is over! It is not sustainable, by any definition. Grow up. Get a real job. Start contributing to your stewardship agreement as a man being. It's beyond the tipping point. Make haste.	Your comment has been forwarded to the decision makers.
Rebecca Moore	See above comments (template format)	Your comment has been forwarded to the decision makers.
Constance Moore	See above comments (template format)	Your comment has been forwarded to the decision makers.
Constance Moore	I've been to the North & South Kona Reefs. They're stunning, but if we don't protect them, they will not survive for future generations. This needs to be taken seriously. It makes me sick to think that "collectors" would be given the green light to put these beautiful fish in aquariums to live out their lives. Please stop this selfish and deadly behavior!	Your comment has been forwarded to the decision makers.
Mike Moran	See above comments (template format)	Your comment has been forwarded to the decision makers.
Mike Moran	No matter how long & hard the community tries to protect this resource, outside financial forces keep removing it with State government support' Stop it now	Your comment has been forwarded to the decision makers.
Karlene Morrow	See above comments (template format)	Your comment has been forwarded to the decision makers.
Karlene Morrow	As someone who lives in a Hawai'i because of year round access to the beaches and ocean I don't want the natural resources depleted for the profit and enjoyment of only a few.	Your comment has been forwarded to the decision makers.
Nancy Mueller	See above comments (template format)	Your comment has been forwarded to the decision makers.
Nancy Mueller	In order to make our ecosystem whole, we must protect all our species. We don't filly understand all the many interdependencies. Maine Protected Areas are the best way to manage this. There should be a large buffer around all MPAs	Your comment has been forwarded to the decision makers.
Heather Mueller	See above comments (template format)	Your comment has been forwarded to the decision makers.
Heather Mueller	North Kona When they were allowed to take the fish ...seemed like less fish ...when it stopped seemed like more Please leave the fish	Your comment has been forwarded to the decision makers.
Jason Murray	See above comments (template format)	Your comment has been forwarded to the decision makers.
Jason Murray	Please stop allowing collection of our native wildlife. Reef fish very important to keeping our coral healthy and we are already loosing too much to climate issues. Respect it and protect it. Now is the time to stop this trade for good. THE BENEFITS DO NOT OUTWEIGH THE LOSSES. Our reefs need your help now more than ever. Mahalo	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Thomas Nakagawa	See above comments (template format)	Your comment has been forwarded to the decision makers.
Thomas Nakagawa	The tourists would ask me " What happened to all the beautiful fishes "at Ulua Beach, Wailea, Maui. The aquarium trade stole them.	Your comment has been forwarded to the decision makers.
Cynthia Nakamura	See above comments (template format)	Your comment has been forwarded to the decision makers.
Cynthia Nakamura	Hawaii's reefs and fish must continue to be protected to ensure a healthy ocean ecosystem and to avoid the depletion of fish species. The ban on the collection of reef fish for the past three years has brought increases in fish populations, demonstrating that the ban has had a positive impact on the reef ecosystem. Allowing Hawaii's reef fish to be caught for commercial purposes will once again lead to a rapid decline in the fish populations, and additionally can lead to damaging the coral as boats are driven over shallow reefs.	Your comment has been forwarded to the decision makers.
Patricia Nakao	See above comments (template format)	Your comment has been forwarded to the decision makers.
Patricia Nakao	I have been snorkeling all around Maui for 50 years and it is apparent how the reef diversity and abundance have declined where they are not protected. Commercial collection of the fish only diminish our reefs more. Why should Hawaii's precious resources like the indigenous or endemic fish be collected for the profit of a few collectors and hobbyists? Should we allow collectors into our native forests to collect i'iwi so some collector can make a profit and some hobbyist can keep the native bird in a cage? Same thing. Just as the elements of our native forests should be preserved, so should our ocean resources. Furthermore, there is no way to actually monitor fish collectors to insure they abide by limits. Pau, already. Just ban the practice, once and for all, please. Mahalo for considering my comments.	Your comment has been forwarded to the decision makers.
Shannon Kakaya, DVM	See above comments (template format)	Your comment has been forwarded to the decision makers.
Shannon Kakaya, DVM	These are native wild animals, and much any other native wildlife, should be protected from being captured, transported, and kept in artificial environments. The pet trade has a long history of harvesting creatures from their native habitats and selling them for paltry sums as "disposable" pets. As a veterinarian, I can testify that most of the health problems with these animals are the result of inappropriate husbandry. In short, they get sick and die prematurely because they are challenged to survive with the wrong temperature, salination, diets, lighting, aeration, etc. Moreover they are often subject to stresses they would normally avoid such as crowding or sharing space with competitive species or predators. If animals such as these are unable or unwilling to successfully reproduce in captivity (which is not happening), then that captive environment is lacking for the species. Humans who want to observe them up close should put on a mask and snorkel or watch a video.	Your comment has been forwarded to the decision makers.
Keith Neal	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Keith Neal	The very survival of Hawaii's coral reefs is at stake, because without an increase in fish abundance, the impacts of climate change will be far worse. Reef surveys spanning decades have documented significant impacts to species taken by commercial aquarium collectors. The most impacted species including Yellow Tangs, certain butterfly fishes, and other rare native fishes, experienced population declines ranging from 60 – 99% in the areas hardest hit by the trade.	Your comment has been forwarded to the decision makers. The Preferred Alternative limits collection to 8 species which have had stable or increasing populations under historic collection rates.
Keith Neal	DAR must consistently and coherently manage 'resources' ...and actually regulate. Hawaii DLNR management regulations must include species and accurate quantity reporting of takings.	Your comment has been forwarded to the decision makers.
Keith Neal	Perhaps adapting a working model from an other fishery jurisdiction, based on science, based on carrying capacity of specific ecological areas? I suggest looking to the Washington state fisheries. Example: Simply look at how Salmon is manged. Consider level of reporting if applied to Hawaii aquarium collectors as Salmon in the WA fishery? http://www.eregulations.com/wpcontent/uploads/2020/06/Catch-Record.pdf Furthermore, A given geographic area has different impacts, carrying capacity, and regenerative capability. http://www.eregulations.com/washington/fishing/marine-area-rules-definitions/ Each area has it's specific rules: Example See marine area 10; http://www.eregulations.com/washington/fishing/marine-area-10/ Thank you for your consideration	Your comment has been forwarded to the decision makers.
Kaylee Nicholls	See above comments (template format)	Your comment has been forwarded to the decision makers.
Kaylee Nicholls	The ocean provides us with more oxygen than rainforests. We shouldn't be messing with it for a hobby. Hawaii is doing so well because if it's protections of the ocean. Let's no unravel that.	Your comment has been forwarded to the decision makers.
Dorothy Norris	See above comments (template format)	Your comment has been forwarded to the decision makers.
Dorothy Norris	An adequate herbivore population enhances coral growth by reducing the growth of algae on our reefs. If you remove a significant portion of that population, the coral will die and we will have nothing left of our reefs to protect against the eventual sea level rise and storm caused by global warming. In the recent years, we have witnessed the need to protect our shoreline and our island paradise. We have worked hard to address some of the other factors that degrade our reefs (sunscreen, pollution) and we don't need to add to our problems by allowing another nail in our reef's coffin. Please do not accept the DEIS as it stands - It needs to accurately describe the impacts of the reef community.	Your comment has been forwarded to the decision makers.
Lawrence Nunez	See above comments (template format)	Your comment has been forwarded to the decision makers.
Lawrence Nunez	Diving and snorkeling the last five years in Hawaii I have noticed the deterioration of the reefs and wildlife. We need to protect these species at all costs.	Your comment has been forwarded to the decision makers.
Susan Olson	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Susan Olson	Our West Hawaii reefs desperately need more protection as climate change has caused coral bleaching and disruption of habitat. Our reef fish are critical to bringing health back to the reefs. We should continue to have NO FISHING zones and to limit fish taken. Aquarium fishing should be banned in the State of Hawaii.	Your comment has been forwarded to the decision makers. The Preferred Alternative would continue to include FRAs and MPAs, and would also limit the fish collected to 8 species, each with an individual catch quota limiting the annual collection.
Kelly Orourke	See above comments (template format)	Your comment has been forwarded to the decision makers.
Kelly Orourke	The Lower Puna area has had it's share of challenges associated with the volcanic eruptions; please do not add further to the stress this beautiful island is navigating. All species are necessary to contribute to the symbiotic recovery.	Your comment has been forwarded to the decision makers.
Laura Parks	See above comments (template format)	Your comment has been forwarded to the decision makers.
Laura Parks	www.respectbumpersticker.com https://www.facebook.com/oceanrespectcampaign	Your comment has been forwarded to the decision makers.
Darby Partner	See above comments (template format)	Your comment has been forwarded to the decision makers.
Darby Partner	I Swim near south kona and kona town reefs daily. The reefs are a life line of the Hawaiian island and fish are greatly needed to keep them healthy. Please keep fish on the reef!	Your comment has been forwarded to the decision makers.
Zach Patitucci	See above comments (template format)	Your comment has been forwarded to the decision makers.
Zach Patitucci	We need to protect Hawaiian reef more than from a variety of stressors and extraction for aquariums seems like an easy way compared to global climate change	Your comment has been forwarded to the decision makers.
Robert Pecoraro	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Robert Pecoraro	Hawaii's reefs are in trouble due to the affect of climate change. 2014-15 brought a significant coral bleaching event, which killed a lot of coral. Some of the coral started to recover, but a small amount compared to what was lost. 2019 was another very warm year that also stressed many corals. The dead corals encourage algae growth, which could take over the reefs if not controlled by the herbivores, many of which are the target species of aquarium collectors. We don't know what the future will bring, but things are not looking so good for the health of our reefs here in the islands. The added impact of collecting hundreds of thousands of fish each year cannot have anything but a negative affect on an already stressed environment. As an avid diver, I used to visit Hawaii to dive the beautiful reefs. They inspired my wife and I to move here after we retired. They also draw thousand of people from around the world and they support the many dive and snorkel operations. These fish belong here on the reef, not in someone's private aquarium. They help provide for a healthy ecosystem, which support the aforementioned businesses, as well as many ancillary businesses, which benefit from dive tourism. Since the moratorium on collecting fish began, a few years ago, my wife and I, as well as our network of divers, have noticed the abundance of the aquarium trade target species, such as Yellow Tangs and Brown Tangs. We are also seeing an abundance of easily collectable fish, such as frogfish, which were rarely seen, prior to the moratorium. Please consider making Hawaii a no take zone permanently. Let's keep Hawaii's tropical fish in Hawaii, where they belong, for all to enjoy.	Your comment has been forwarded to the decision makers.
Sue Perley	See above comments (template format)	Your comment has been forwarded to the decision makers.
Sue Perley	I am greatly concerned about aquarium collecting for all of Hawaii. The depletion of reef fish on Maui where I snorkel regularly is devastating. The rules are not being enforced. Aquarium collecting should not be allowed anyplace in Hawaii. The cost on every level far outweighs the benefits. Mahalo!	Your comment has been forwarded to the decision makers.
Laura Posson	See above comments (template format)	Your comment has been forwarded to the decision makers.
Laura Posson	In addition to the unmitigated depletion of fish stocks, in my experience, aquarium collectors have no respect for the coral and will destroy large coral heads to get the rare creatures inside. I have seen numerous coral heads destroyed that previously had resident harlequin shrimp, for example.	Your comment has been forwarded to the decision makers.
Louise Priest	See above comments (template format)	Your comment has been forwarded to the decision makers.
Dawn Reed	See above comments (template format)	Your comment has been forwarded to the decision makers.
Tim Reed	See above comments (template format)	Your comment has been forwarded to the decision makers.
Thomas Reppuhn	See above comments (template format)	Your comment has been forwarded to the decision makers.
Thomas Reppuhn	Please stop giving away our natural resources, stop all commercial collection and keep these poachers off our reefs!	Your comment has been forwarded to the decision makers.
Lynn Rinker	See above comments (template format)	Your comment has been forwarded to the decision makers.
Lynn Rinker	Please protect our reefs, the coral and the wildlife. Don't deplete Hawaii waters for personal aquariums.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Anke Roberts	See above comments (template format)	Your comment has been forwarded to the decision makers.
Anke Roberts	I like snorkeling around Oahu, and outside the marine protected areas we see very few herbivores to keep the reefs free of algae. As a result, the coral coverage has been declining, and once healthy coral is smothered by fast growing (and ugly!) brown algae. If not for the people of Hawaii, then protect the reefs and important reef fish for your tourism dollars. Once the world knows that we don't have any tropical reef fish left, the world will stop coming to Hawaii and tourism spending will be in drastic decline. But do it for the children of Hawaii, so they can see in the ocean the wonders their parents and grandparents used to see.	Your comment has been forwarded to the decision makers. As stated in the EIS, Hawaiʻi's tourism industry achieved new records in total visitor spending and visitor arrivals in 2017, marking the sixth consecutive year of record growth in both categories. This occurred while commercial aquarium collection was also occurring. A discussion on post-collection mortality is included in Section 5.4.2 of the EIS.
Eileen Robn	See above comments (template format)	Your comment has been forwarded to the decision makers.
Eileen Robn	I live, snorkel and dive on Maui. I have seen the changes in fish populations over the last decade. The decline in fish populations has been quite obvious. Collectors are interested in only profits and not our sensitive reefs. Collecting is just another added stress to an already fragile ecosystem.	Your comment has been forwarded to the decision makers. The Proposed Action does not inlcude issuance of permits for aquarium collection on Maui. This EIS is limited to the island of Hawai'i, and does not analyze impacts of collection on Maui. Any requested Aqaurium Permits for Maui would need to complete their own HEPA review.
Athena Roesler	See above comments (template format)	Your comment has been forwarded to the decision makers.
Athena Roesler	Two years ago when snorkeling the reefs especially off Puako and at Mauna Kea I could not believe how few fish I saw compared to previous visits. It was truly saddened and amazed at how low the populations were and how little the diversity there was in types of fish.	Your comment has been forwarded to the decision makers.
Kelly Rohlfs	See above comments (template format)	Your comment has been forwarded to the decision makers.
Sam Rohlfs	See above comments (template format)	Your comment has been forwarded to the decision makers.
Sam Rohlfs	Raping the reefs for people's aquariums is absolute lunacy. How can such a practice even gain consideration? Do thr right and obvious thing - stop taking reef fish	Your comment has been forwarded to the decision makers.
Mikhail Rudenko	See above comments (template format)	Your comment has been forwarded to the decision makers.
Mikhail Rudenko	I am a scuba instructor, professional underwater photographer and a owner of a dive business in North Kohala. I have a degree in biology, I've spent 10k+ hours underwater in Hawaii educating divers, guiding tours and photographing marine animals. So yeah, I do have an idea of what I'm talking about. Leave fishes where they belong - in the Ocean!!	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Mikhail Rudenko	The very reason why millions of tourists come to Hawaii is the beauty of the Underwater world. Capturing the most colorful creatures of the reef destroys everything - from the health of ecosystems to the very fabric of tourism-based economy of the island of Hawaii. Not to mention that only about 20% of captured fishes actually make it to aquariums. The practice itself is gruesome and benefits only a handful of individuals. No credible scientific report shows that there is no impact to the reef eco-system from aquarium collecting. One does not need to be a scientist to understand that any action has a reaction. In this case it is algal bloom caused by decreasing the number of herbivorous fishes (every species on the above list). Algal bloom is one of the worst enemies of coral as they both compete for oxygen and nutrients. And therefore when the numbers of herbivorous fishes are decreased the whole reef takes a blow. Sometimes a fatal one. Don't let that happen in one of the very last remaining most pristine coral ecosystem in the state of Hawaii.	Your comment has been forwarded to the decision makers. As stated in the EIS, Hawai'i's tourism industry achieved new records in total visitor spending and visitor arrivals in 2017, marking the sixth consecutive year of record growth in both categories. This occurred while commercial aquarium collection was also occurring. A discussion on post-collection mortality is included in Section 5.4.2 of the EIS.
Shannon Rudolph	See above comments (template format)	Your comment has been forwarded to the decision makers.
Shannon Rudolph	The diving industry is very important to tourism. Private businesses should not be able to steal 'public property and assets'. In this day & age - the aquarium industry is harming all residents of Hawai'i. It must stop.	Your comment has been forwarded to the decision makers. As stated in the EIS, Hawai'i's tourism industry achieved new records in total visitor spending and visitor arrivals in 2017, marking the sixth consecutive year of record growth in both categories. This occurred while commercial aquarium collection was also occurring.
Lupita Ruiz-Jones	See above comments (template format)	Your comment has been forwarded to the decision makers.
Lupita Ruiz-Jones	Future generations deserved to see high biodiversity and abundance of reef fishes in Hawaii.	Your comment has been forwarded to the decision makers.
Garry B. Russell	See above comments (template format)	Your comment has been forwarded to the decision makers.
Garry B. Russell	As an avid scuba diver it has been obvious the changes in the reef from aquarium collectors. There has been plenty of destruction of the coral as well as a depletion of all types of fish population. I have also witnessed aggression from aquarium collectors when confronted with objections from those opposed to this practice.	Your comment has been forwarded to the decision makers.
Kurt Samuelson	See above comments (template format)	Your comment has been forwarded to the decision makers.
Mark Schacht	See above comments (template format)	Your comment has been forwarded to the decision makers.
Mark Schacht	The revised DEIS claims there would be no adverse natural, socioeconomic, or cultural impacts that need addressing despite the fact that, under their plan, they could take all of a particular fish from any reef, bay, or other discrete area. The rapacious greed of the aquarium trade has rarely been more baldly displayed. This DEIS must be rejected.	Your comment has been forwarded to the decision makers.
Henri Etta Schmitz	See above comments (template format)	Your comment has been forwarded to the decision makers.
Henri Etta Schmitz	I believe the comments above are an adequate description of the situation.	Your comment has been forwarded to the decision makers.
Inez Schultz	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Inez Schultz	The quantity of fish have been diminished by pure observation while snorkeling several times a month for over 20+ years . I generally swim mauna lani, puako area. Our ocean fish are also a big tourist attraction. I have had visitors disappointed that they arenot seeing as many fish as previous years. It would be worthy to look at how Palau has managed to keep their fish in abundance so their beauty can be enjoyed.	Your comment has been forwarded to the decision makers.
Julie Shattuck	See above comments (template format)	Your comment has been forwarded to the decision makers.
Julie Shattuck	The very survival of Hawaii's coral reefs is at stake, because without an increase in fish abundance, the impacts of climate change will be far worse. Reef surveys spanning decades have documented significant impacts to species taken by commercial aquarium collectors.	Your comment has been forwarded to the decision makers.
Julie Shattuck	The revised Draft Environmental Impact Study (DEIS) is aimed at reopening West Hawaii reefs to 7 aquarium collectors to take over 246,000 fish every year for the pet trade. This comes nearly a year after their first DEIS was unanimously rejected, for 14 reasons, by the board that oversees Hawaii's Dept. of Land and Natural Resources (DLNR). Unbelievably, the revised DEIS still fails to address a number of those reasons for nonacceptance. For the sake of our populations heavily impacted tropical fish and endangered reefs do not open any reefs for commerical purposes in West Hawaii or anywhere else.	Your comment has been forwarded to the decision makers.
Shannon Shea	See above comments (template format)	Your comment has been forwarded to the decision makers.
Shannon Shea	Since the statewide coral bleaching events of 2015, I have seen corals die and be replaced by algae and other plants. Herbivores help to keep these plants from encroaching further on our already fragile corals. Not to mention how inhumane and exploitative aquarium collection is. We need to care for Hawaii's animals and resources by keeping them here in Hawaii!	Your comment has been forwarded to the decision makers.
Rachel Silverman	See above comments (template format)	Your comment has been forwarded to the decision makers.
Rachel Silverman	I believe Hawaiian reefs need intact ecosystems for our future and aquarium fish collection for export runs contrary to this mindset.	Your comment has been forwarded to the decision makers.
Alexandria Siwecki	See above comments (template format)	Your comment has been forwarded to the decision makers.
Alexandria Siwecki	This is crime against nature and will not be tolerated	Your comment has been forwarded to the decision makers.
Virginia Small	See above comments (template format)	Your comment has been forwarded to the decision makers.
Virginia Small	Far fewer reef fish than when I moved to Kona in 1975. It was great news when the aquarium fish ban was enacted. This should be even stricter. I snorkel most often at Kahaluu Beach and hope it will be protected.	Your comment has been forwarded to the decision makers.
Pamela Small	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Pamela Small	I am a scuba diver who dives the West Hawaii Island coast approximately fives days a week ranging from South Kona to North Kohala. I have directly seen the impacts of the aquarium collection trade on the reefs over the years and have been thrilled to see a very small recovery over the past year since the ban was enacted. While I say "recovery" I mean that I am FINALLY seeing a small number of baby fish again. I have not seen baby Yellow Tang for years. I have NEVER, ever seen a brown tang or a chevron tang. In fact, the white listed fish are so rare that when diving, if they are seen, we photograph them in excitement not knowing when/if we will see them again.	Your comment has been forwarded to the decision makers.
Pamela Small	There are other fish that are collected for the aquarium trade that, although not white listed, are so rare that I can tell you exactly how many times I have seen each one. I make no bones about it. The aquarium trade has devastated our reefs.	Your comment has been forwarded to the decision makers. Collection under the Preferred Alternative would be limited to the 8 species on the Revised White List. No collection of other species would be permitted. The Preferred Alternative included additional enforcement and compliance measures outlined in Section 3.7.2 of the RDEIS, but this section has been revised in response to comments received on the RDEIS.
Pamela Small	Even with the ban, collectors have continued to collect. I, personally, witnessed one of the biggest offenders (who has made the news on multiple occasions) out on his boat collecting and then packing a shipment. He and his wife fled before DOCARE officers arrived.	Your comment has been forwarded to the decision makers. The Preferred Alternative included additional enforcement and compliance measures outlined in Section 3.7.2 of the RDEIS, but this section has been revised in response to comments received on the RDEIS.
Pamela Small	The latest DEIS is a farce. It does not address how communities of reef species are disrupted by aquarium collecting or even address restoring diminished supply. How do the collector's plan to replenish the reefs after they have removed the herbivores? These fish are vital for the conservation of coral reefs. Herbivorous fish feed on the algae that grow on corals and compete with them for light and oxygen. By eating the algae, these fish play a big role in the survival of the entire ecosystem. By removing them, the aquarium collectors are killing off an entire underwater ecological community.	Your comment has been forwarded to the decision makers.
Pamela Small	The DEIS does not address the unacceptably high mortality rate of these fish after collection and during shipment.	Your comment has been forwarded to the decision makers. A discussion on post-collection mortality is included in Section 5.4.2 of the EIS.
Pamela Small	The Hawaiian culture fishes for food. It does NOT collect fish to ship to the mainland for people to keep in aquariums. It is contrary to Hawaiian cultural practices and beliefs.	Your comment has been forwarded to the decision makers. The EIS concludes that, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, all six action alternatives may impact cultural practices.
Pamela Small	I will add that with tourism being the number one industry on Hawaii Island, having fish in our ocean is vital for visitors who snorkel and scuba dive.	Your comment has been forwarded to the decision makers. As stated in the EIS, Hawaiʻi's tourism industry achieved new records in total visitor spending and visitor arrivals in 2017, marking the sixth consecutive year of record growth in both categories. This occurred while commercial aquarium collection was also occurring.

Commentor	Comment	Response
Pamela Small	Our fish need to stay HERE in Hawaii for the benefit of the people in Hawaii. For the benefit of the ocean. For the benefit of the coral reefs and for the beauty of the ocean. Mahalo for your time.	Your comment has been forwarded to the decision makers.
Dan Smith	See above comments (template format)	Your comment has been forwarded to the decision makers.
Rebecca Sonnenberg	See above comments (template format)	Your comment has been forwarded to the decision makers.
Joan Sorbets	See above comments (template format)	Your comment has been forwarded to the decision makers.
Joan Sorbets	Have snorkeled many places over the past 40 or so years with family and friends. Watched the areas near Mauna Lani and Waikoloa decrease in the number and variety of fish especially as I live near there. But have done deep water snorkeling- near Puakol'm not a diver- and noticed a decrease there, also. We need to preserve these sites and water creatures of all kinds for the upcoming generations to enjoy . Please consider very carefully how you vote!	Your comment has been forwarded to the decision makers.
Bill South	See above comments (template format)	Your comment has been forwarded to the decision makers.
Bill South	The bigger issue is that DHHL shows their ignorance of how ocean ecosystems function. Many species of what we may deem as unimportant fish may have a very crucial link in maintaining the structure of the entire ocean ecosystem. It is very possible that if one small link of the chain is severed, the entire coral reef ecosystems could go "tilt." This has occurred and other ocean ecosystems around the world. DNLR does not have the scientific data to back up any of their statements. More independent research needs to be done. I speak is a scientist who has some background in ecosystem management.	Your comment has been forwarded to the decision makers.
Sara Sowers-Collison	See above comments (template format)	Your comment has been forwarded to the decision makers.
Donita Sparks	See above comments (template format)	Your comment has been forwarded to the decision makers.
Donita Sparks	Hmm, I'm still astounded that this is still legal. These fish do not belong in aquariums, they belong in beautiful Hawaiian waters. Simply wrong and depressing. I'm a tourist for many reasons but MAINLY THE SNORKELING. Please keep my tourist dollars coming. No fish, sad reefs, no money or visits from me. Mahalo!	Your comment has been forwarded to the decision makers.
Linda Sparks	See above comments (template format)	Your comment has been forwarded to the decision makers.
Linda Sparks	I am a underwater photographer and a long distance ocean swimmer. I've spent 37 years in the ocean here and I am severely concerned and sadden by the loss of marine life here in Hawaii. The reefs I see on a regular basis have declined drastically. Where I use to see a abundance of fish there are hardly any. The reefs are already way under populated and will die off if the fish are not protected.	Your comment has been forwarded to the decision makers.
Whitney Springer	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Whitney Springer	Last year, I did a study investigating Achilles Tang abundance around Hawai'i Island, particularly in North and South Kona. Part of this study not only included snorkeling along various popular reefs, but a deep dive into the literature of the history of the aquarium trade and it's impacts. While Achilles Tangs themselves do not, for some reason, seem to be recovering since the ban on aquarium trade, most other species have. Most notably is the Yellow Tang, whose populations have, in large part, thrived since the ban on aquarium trade was put in place. It is unquestionable that the aquarium trade has a negative impact on Hawaiian coral reefs, and therefore the entire ecosystem. In a world experience raising ocean temperatures, we need to protect and prepare our reefs for the coming bleaching events now more than ever.	Your comment has been forwarded to the decision makers. Collection of Achilles Tang would not be permitted under the Preferred Alternative. Yellow Tang populations, and described in the EIS, were increasing prior to the ban on commercial aquarium collection.
Whitney Springer	A growing number of coral reefs worldwide are experiencing increased levels of heat stress due to climate change, contributing to record high coral bleaching events (Graham et al. 2020). Previous studies have found coral reef resilience to stress events may be increased by higher biomasses of herbivorous fish (Chung et al. 2019; Graham et al. 2020). Herbivores keep macroalgal cover from dominating a reef, increasing coral rates of settlement and survival and, therefore, biodiversity in this key ecosystem (Chung et al. 2019). Overfishing (including recreational, commercial, and aquarium collection) of herbivorous fish may be detrimental to a coral reef's ability to recover after stress events such as coral bleaching (Chung et al 2019). However, it has been found that aquarium collection takes more reef fish per year than fishing because of the high demand for the Yellow Tang in aquariums (Walsh et al. 2020). Many of the species proposed to be allowed for aquarium collection are herbivores at some point in their life history stage, while others play roles just as critical to healthy coral reef. The Yellow Tang is only abundant in Hawaiian waters, and so we should give them a safe and protected place to continue to thrive and contribute to a healthy and balanced reef ecosystem.	Your comment has been forwarded to the decision makers. Graham et al. (2020) has been added to Section 5.4.3.5 of the RFEIS. The EIS discloses the importance of herbivory to coral reefs in Section 5.4.1.3, including discussions on macroalgae and reef resilience. As disclosed in the EIS, the Yellow Tang is found throughout the Pacific Ocean, including Ryukyu, Mariana, Marshall, Marcus, Wake, and Hawaiian Islands. Furthermore, West Hawai'i had a significantly greater percent change in Yellow Tang density within its planned networked MPAs (and Open Areas) as compared to two non-networked sites on Maui. Since the FRAs were established, the population of Yellow Tang has increased 165% in the FRAs and 101% in the Open Areas (areas fished by commercial aquarium fishers), compared to 74% in the MPAs. Overall Yellow Tang abundance in the 30-60-foot depth range over the entire West Hawai'i coast had increased 150% (over 3.4 million fish) from 1999/2000 to 2017/2018 to a population of approximately 5.7 million fish.
Whitney Springer	There is no doubt that coral reef fishes are critical to maintaining the balance in this complicated ecosystem, and by removing them solely for the economic benefit of aquarium trade, we risk the health and stability of Hawaiian reefs in the coming days (Tissot & Hallacher 2004, Walsh et al. 2019). Please, for the sake of our reefs ability to withstand the heavy impacts of climate change, reconsider allowing the aquarium trade to resume taking key species from our reefs.	Your comment has been forwarded to the decision makers.
Franes Staben	See above comments (template format)	Your comment has been forwarded to the decision makers.
Franes Staben	The reefs off south Maui Kamaole I, II, &III have much fewer fish and coral than when we started coming to Maui 40 years ago. Even if that is not changed because of aquarium collecting, it needs to be protected and bolstered.	Your comment has been forwarded to the decision makers. The Proposed Action does not inlcude issuance of permits for aquarium collection on Maui. This EIS is limited to the island of Hawai'i, and does not analyze impacts of collection on Maui. Any requested Aqaurium Permits for Maui would need to complete their own HEPA review.
Gregory Starmer	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Gregory Starmer	Please Ensure That My Grandchildren Will See The Same Fishes In Hawaii's Beaches As My Parent's Did. I'm 63 And Hawai'I Is My Only Home As Well As My Son's. And Now My Grandchildren Has Taken On The Same Love And Respect For Our Oceans, Shorelines And Beaches Of Hawai'I Islands. Thank You Very Much.	Your comment has been forwarded to the decision makers.
Marianne Starr	See above comments (template format)	Your comment has been forwarded to the decision makers.
Marianne Starr	I moved to Kona in 2009. I swim regularly in Kona at the pier and also swim and paddle regularly at Keauhou Bay. I definitely believe our that our tropical fish population is diminished.	Your comment has been forwarded to the decision makers.
Linda Sue Sue	See above comments (template format)	Your comment has been forwarded to the decision makers.
Linda Sue Sue	Aquarium industry should be set to strict limits and high fines if they fail to stick to the laws.	Your comment has been forwarded to the decision makers. The Preferred Alternative includes limits for all eight species which could be collected, ending collection of the other 32 species previously collected in the WHRFMA. The Preferred Alternative included additional enforcement and compliance measures outlined in Section 3.7.2 of the RDEIS, but this section has been revised in response to comments received on the RDEIS.
Kelly Sundberg	See above comments (template format)	Your comment has been forwarded to the decision makers.
Gabriela Taylor	See above comments (template format)	Your comment has been forwarded to the decision makers.
Gabriela Taylor	Gabriela Taylor I support a total ban in Hawai on catching tropical fish for aquarium trade or any other reason..	Your comment has been forwarded to the decision makers.
Thane Davis	See above comments (template format)	Your comment has been forwarded to the decision makers.
Thane Davis	Nearly all of a Alii drive has changed dramatically throughout my 20 years of life. The coral, the fish who used to dwell in large numbers, and the biodiversity of this strip of reef has been heavily impacted by the aquarium trade, amongst other human altercations. This is just the tip of the iceberg regarding what we must do to protect our coral reef ecosystems	Your comment has been forwarded to the decision makers.
Madison Thiele	See above comments (template format)	Your comment has been forwarded to the decision makers.
Vivian Toellner	See above comments (template format)	Your comment has been forwarded to the decision makers.
Vivian Toellner	Rarely see Puffer fish around Richardson Beach in Hilo. Wasting our important marine life for a deadly hobby thousands of miles away is not environmentally or ethically justifiable. Now that these fish can be aquacultured, there is no excuse to take them from the wild. The only reason the mainland pet trade wants to continue to take Hawaii's fish from the wild is profits: these animals are cheaper to take than they are to aquaculture.	Your comment has been forwarded to the decision makers. Collection of Hawaiian Whitespotted Toby (puffer) would not be permitted under the Preferred Alternative.
Linda Toki	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Linda Toki	Waimanalo and North Shore reefs of Oahu have been devastated over the past 45 years from aquarium catchers, overfishing and human impact. I have been diving in Hawaii since 12 years old with my father and have witnessed the catastrophic loss of large communities of marine life & schools of fishes due to overfishing, human greed, aquarium catchers & other human activity. We desperately need to save and protect our ocean & marine life communities & reefs. We need to do much more as a society and government to designate more marine preserves like Hanauma Bay with protections in place as "safe zones" for marine wildlife & reefs to recuperate and thrive once again.	Your comment has been forwarded to the decision makers.
Linda Toki	Reopening Hawaii's Reefs to the Aquarium Trade is a travesty bringing more devastation to our vulnerable reefs and marine life. We are going the wrong way with this ruling and action. Please stop this. Our government and people need to be wise guardians of our natural resources and the ocean and not be dictated by business needs. Stop all industrialized commercial fishing in Hawaii's waters that are injuring and killing our whales, dolphins, turtles, manta rays, eagle rays, birds and etc., many which are on the federal endangered and protected species list. Our local marine life communities are critical to the health of the oceans and in reversing climate change. Please protect our ocean life. The ocean saves us. We are one earth. Aloha, Linda	Your comment has been forwarded to the decision makers.
Michele Triplett	See above comments (template format)	Your comment has been forwarded to the decision makers.
Michele Triplett	I have watched the decline of the reefs in south Maui particularly Ulua and Makena Landing. Please keep our reef fishes safe.	Your comment has been forwarded to the decision makers.
Cyndy Urry	See above comments (template format)	Your comment has been forwarded to the decision makers.
Cyndy Urry	Aloha. I am a scuba diver and I have lived in Hawaii for almost 25 years. I have traveled all around the world scuba diving and I cannot begin to tell the DEIS how our reefs are hurting . We have fewer fish than any place I have traveled because we cannot replenish . So many are endemic and once they're gone , that's it . I have seen so few Potter's Angelfish lately that it really saddens me. I cannot believe that the DEIS cannot see this. The FBI is finding out that there is so much corruption in Hawaii over several problems such as building permits, etc. I hope they will look into the DEIS because it's our most important resource we have here and I just can't understand how this can be permitted to go on with so many concerned citizens upset about this permitting of taking of our reef fish.	Your comment has been forwarded to the decision makers.
Christy Vail	See above comments (template format)	Your comment has been forwarded to the decision makers.
Christy Vail	Taking our beautiful, essential, rare little reef fish is akin to taking endangered native birds from our forests. Lets simply end the practice of aquarium collection. Thank you for saving our unique ecology.	Your comment has been forwarded to the decision makers.
Diana Varney	See above comments (template format)	Your comment has been forwarded to the decision makers.
Diana Varney	Living in south Kona for 14 years I have seen a decrease in tropical reef fish.	Your comment has been forwarded to the decision makers.
Momi Ventura	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Momi Ventura	All Of The Oceans In And Surrounding Hawai'I Nei Is In Dire Need For Exclusive Protection.!!! Being From A Long Line Of Hawaiian Fishermen And Women We've Always Did Our Best To Protect Reefs And Especially Shorelines For Anyone OverFishing And Not Caring For The Beach Environment. We Need More And More Help Supervising These Area's And Not So Known Area's As Well.!!! Please Do All You Can And We Will Too.. Mahalomai..	Your comment has been forwarded to the decision makers.
Suzanne Villeneuve Villeneuve	See above comments (template format)	Your comment has been forwarded to the decision makers.
John Von Schlegell	See above comments (template format)	Your comment has been forwarded to the decision makers.
John Von Schlegell	The long term benefit to the local citizens of Hawaii of healthy reefs and fishes far outweighs the economic benefits of a few collectors.	Your comment has been forwarded to the decision makers.
Karie Wakat	See above comments (template format)	Your comment has been forwarded to the decision makers.
Karie Wakat	We need to end this barbaric practice of aquarium collecting. These fish can be bred in captivity. It’s common sense to stop wild capture, when you can successfully breed in capability for trade. We are selling these fishies lives, with no guarantee of export survival.	Your comment has been forwarded to the decision makers.
Barbara Wallace	See above comments (template format)	Your comment has been forwarded to the decision makers.
Deborah Wallace	See above comments (template format)	Your comment has been forwarded to the decision makers.
Deborah Wallace	I am 100% opposed to all aquarium trade. A small number of Aquarists make money from these fish which causes depletion of the health of the reefs. It also negatively impacts tourism because we have fewer fish for snorkelers and divers to enjoy, and our reefs are less healthy. It is mind-boggling that this is allowed.	Your comment has been forwarded to the decision makers. As stated in the EIS, Hawai‘i’s tourism industry achieved new records in total visitor spending and visitor arrivals in 2017, marking the sixth consecutive year of record growth in both categories. This occurred while commercial aquarium collection was also occurring.
Mildred Walsh	See above comments (template format)	Your comment has been forwarded to the decision makers.
Mildred Walsh	Been snorkeling Honaunau bay for 38 years and following this issue. There are not a tenth of the fish anymore. It happened when salt water fish tanks became a popular fad an d collectors came out in droves.	Your comment has been forwarded to the decision makers.
Steven Ward	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Steven Ward	I have lived in Kailua-Kona almost four decades. I was certified as a NAUI advanced diver in 1984. I also was Captain of the Captain Cook 7 which was a 399 passenger vessel going to Kealakekua Bay until they sold the vessel and it went to the mainland. I have witnessed the decline in reefs here due to the avarice of fish collectors, and hope that this valuable resource will be protected more effectively. These fish on the reefs are part of an ecosystem that is crucial, and an economic driver for every Scuba shop and every snorkel cruise on the Kona coast, and people come here to enjoy our waters and swim with them and the other attractions of said ecosystem, which is under attack already with global warming. Let's not add to the stress, and not kill this economic driver by allowing the return of fish collecting. I do not believe this EIS is adequate or sufficiently addresses the impact of collecting. This reef ecosystem is fragile enough! Mahalo.	Your comment has been forwarded to the decision makers.
James Ward	See above comments (template format)	Your comment has been forwarded to the decision makers.
James Ward	As a diver who is very familiar with the waters of West Hawaii I want to add my voice to those who want to continue the ban on collecting of reef fish. Since the ban in 2018 I've witnessed an increase in some species that were all but gone from our reefs. The practice of aquarium industry fish collection depleting the reefs of many species is not the only issue. We are just beginning to see tourists return to our island. what's their favorite activity while here? Snorkeling. As a concierge at local resorts from 2014-2019 the constant complaint was " we don't see as many pretty fish as we used to" Why? because the aquarium industry has no regulation of what and how much they collect.No plan to replenish or manage the reef system they profit from. from a moral standpoint, ecological standpoint, and health of future tourism, we must make the ban permanent. Mahalo	Your comment has been forwarded to the decision makers. As stated in the EIS, Hawai‘i’s tourism industry achieved new records in total visitor spending and visitor arrivals in 2017, marking the sixth consecutive year of record growth in both categories. This occurred while commercial aquarium collection was also occurring.
Jennyvie Ward	See above comments (template format)	Your comment has been forwarded to the decision makers.
Nancy Ware	See above comments (template format)	Your comment has been forwarded to the decision makers.
Nancy Ware	I am a Vet Technician and am particularly concerned about the inhumane practices the fishes are subjected to from the point of collection to the rest of their in many cases, shortened lives. Fizzing, finning, denying food and then restrained in small unnatural tanks is inhumane.	Your comment has been forwarded to the decision makers.
Bruce Watkins	See above comments (template format)	Your comment has been forwarded to the decision makers.
Bruce Watkins	Many of these species feed on algae, and are needed to clean therocks, to permit hard corals to grow. With less fish, there will be less coral, and less of everything else. I dive frequently at Honokohau Harbor, and local divers generally do not post to Facebook the location when they photograph rare critters. Seems when they do the collectors grab them.	Your comment has been forwarded to the decision makers.
Sheryl Weinstein	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Sheryl Weinstein	As a local shore scuba diver I have witnessed the tragic decline of ALL undersea life in the last 40 years. Between the El Niño events & Aquarium Fish Collectors, much of the under water landscape is like a watery "desert." All there is left is rocks with algae growing on it. One of my favorite dive sites in Kona used to have this little family of flame angelfish—a highly prized fish for collectors. I haven't seen the flame angels for quite some time—& their sitings becoming even more rare than ever. The entire State of Hawaii should be a fish reserve, banning ALL commercial aquarium fish collections!! Our reefs are hundreds of years away—if ever—from recovering from damage caused by the Human Race!!!	Your comment has been forwarded to the decision makers.
Dan Wellert	See above comments (template format)	Your comment has been forwarded to the decision makers.
Dan Wellert	I am very concerned the thought would even be entertained to take a quarter million reef fish! I come to the big island 2x per year for two weeks to snorkel and dive. Even at that level, I have seen a steady decrease in fish species and reef health decline. This is purely greed entertaining such a reckless amount higher than zero to take from the ocean. It is well documented our reefs, fish and ocean's health are either near or at collapse. By allowing this not only are you risking my many, many thousands spent each year as a tourist- but more importantly ignoring the health of our planet. Shame on anyone supporting this greedy, disgusting thought of continuing the decline of Hawaiian ocean and reef health.	Your comment has been forwarded to the decision makers.
Madolin Wells	See above comments (template format)	Your comment has been forwarded to the decision makers.
Madolin Wells	As a visitor to Hawai'i, Maui, and O'ahu in the 1990's, I was shocked to see the loss of tropical fish 20 years later moving here to Maui to see what's happened to Molokini. I'm concerned about loss of the beautiful exotic fishes like Yellow Tang, Chevron Tang, and Angelfish, but I'm also concerned about the cleaner fishes that groom other fish or the reef itself, providing vital service to the health of many other species.	Your comment has been forwarded to the decision makers.
Madolin Wells	Short-term profits ignore even the medium- and long-term economic health of the Hawai'i and its visitor industry. But above all, it is morally and ethically reprehensible. Fragile, precious eco-systems cannot survive this kind of looting. Please stop aquarium plunder!	Your comment has been forwarded to the decision makers.
Les Welsh	See above comments (template format)	Your comment has been forwarded to the decision makers.
Laurel Whillock	See above comments (template format)	Your comment has been forwarded to the decision makers.
Laurel Whillock	Hawaii's reef and coral populations need every available advantage in order to recover from the current damage they're experiencing and in order to be healthy enough to face future difficulties from rising sea temperatures, higher surf, wind wave erosion and polluted freshwater run-off. A healthy and steadily increasing fish population is integral for this recovery. Taking any reef fish from Hawaiian waters for the tropical fish aquarium trade is detrimental and must be banned.	Your comment has been forwarded to the decision makers.
James Whillock	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
James Whillock	Why would you even entertain opening up collecting for seven people who could/would significantly damage the system? Allowing this does not help our economy in any way. Let the fish populations continue to grow and our reef system will become healthy again.	Your comment has been forwarded to the decision makers.
Toni White	See above comments (template format)	Your comment has been forwarded to the decision makers.
Toni White	Their revised EIS is not much better than the original: It still denies the scientifically proven, significant impacts of aquarium collection in West Hawaii Claims that taking over 246,000 fish each year won't cause population declines Claims there would be no adverse natural, socio-economic, or cultural impacts that need addressing Disregards that the largest surge in Yellow Tang abundance ever documented has nothing to do with the closure of West Hawaii aquarium collection in 2018 Prior to the 2018 West Hawaii ban, the aquarium trade reported taking nearly two times more reef fish than all food fishers, combined. 98% of those animals were herbivores, an important fish group that even DLNR admits should be left on the reef to help build resilience to climate change impacts. Yet, under the proposed revised draft EIS, the number of herbivorous fish taken for aquarium hobbyists outside Hawaii would still amount to more than are taken by food fishers.	Your comment has been forwarded to the decision makers.
Toni White	Further, two of the eight species that would be taken under their new proposal are so fragile in captivity, that they are sold and shipped at retail without any "Arrive Alive" guarantee. Making matters worse, one of those species, Potter's Angelfish, is endemic to Hawaii, found nowhere else on Earth. Of course, this doesn't concern the collectors or the wholesalers who only need to get those fish on a plane and out of Hawaii to make their profit.	Your comment has been forwarded to the decision makers.
Toni White	Wasting our important marine life for a deadly hobby thousands of miles away is not environmentally or ethically justifiable. Now that these fish can be aquacultured, there is no excuse to take them from the wild.	Your comment has been forwarded to the decision makers.
Lisa Whitten	See above comments (template format)	Your comment has been forwarded to the decision makers.
Lisa Whitten	Having grown up snorkeling off of Maui's shores, I have noticed a decline in reef health and in overall fish numbers. I would like to see more relation in the collection of reef fish for aquariums.	Your comment has been forwarded to the decision makers.
Linda Willaby Willaby	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Linda Willaby Willaby	Fragile tropical fish, who were born to dwell in the majestic seas and forage among brilliantly colored coral reefs, suffer miserably when they are forced to spend their lives in glass tanks. Robbed of their natural habitats and denied the ability to travel freely, they must swim around endlessly in the same few cubic inches of water. The popularity of keeping tropical fish has created a virtually unregulated industry that catches and breeds as many fish as possible with little regard for the animals themselves. While many species of coral are protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora, most of the fish who end up in aquariums are not. An estimated 95 percent of saltwater fish sold in pet shops come from the wild, mostly from the waters around Indonesia, the Philippines, Fiji, and Hawaii. Half the affected fish die on the reef, and 40 percent of those who survive the initial poisoning die before they reach an aquarium. I am very familiar with the coral reef off Kehena Beach in lower Puna. In the 12 years that I have lived here I have seen the reef fish populations decline significantly.	Your comment has been forwarded to the decision makers.
Sharon Willeford	See above comments (template format)	Your comment has been forwarded to the decision makers.
Nicole Winegardner	See above comments (template format)	Your comment has been forwarded to the decision makers.
William Wingert	See above comments (template format)	Your comment has been forwarded to the decision makers.
William Wingert	Kahaluu Two Step, Puako. I'm familiar by being in the water at the first two locations many times. I've noticed way less fish at bothe places over these last 11 years. Also coral dying out. Only familiar with the reef fish being taken for off island aquariums since my friend forwarded this to me but I find it appealing that commerce is being allowed to destroy the beauty that is here in Hawaii in this way. I hope it's not foolish to think that Hawaii's legislators will protect the island and the Aina over the destructive and short sighted business interests outlined in these pages.	Your comment has been forwarded to the decision makers.
Anita Wintner	See above comments (template format)	Your comment has been forwarded to the decision makers.
Anita Wintner	No more aquarium fish collecting	Your comment has been forwarded to the decision makers.
Sharin Woloshin	See above comments (template format)	Your comment has been forwarded to the decision makers.
Sharin Woloshin	I have been free diving the Maui area 2-3 times a week for 6 years. This year seems to be one of the worst years for the reef fish. The decline in what I see is startling. I'm not sure if it's because of a bycatch for shore fisherman or not. But this is not a good year to start having an outside collection interest. Number are down all over Maui.	Your comment has been forwarded to the decision makers. The Proposed Action does not inlcude issuance of permits for aquarium collection on Maui. This EIS is limited to the island of Hawai'i, and does not analyze impacts of collection on Maui. Any requested Aqaurium Permits for Maui would need to complete their own HEPA review.
Angela Woolliams	See above comments (template format)	Your comment has been forwarded to the decision makers.
Angela Woolliams	We need to be better stewards of our oceans and do more to protect the fragile ecosystems within it. For too long humans have treated it like a garbage bin and have been blasé about the demise of species due to human activity like shark finning, aquarium collecting, and overfishing. It needs to end.	Your comment has been forwarded to the decision makers.
Jill Wright	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
John Wright	See above comments (template format)	Your comment has been forwarded to the decision makers.
John Wright	I've been a physician resident of Hawaii since 1982, having lived in Honolulu, Maui, Hilo, & most recently Kona. I noticed a severe and drastic decline in coral reef fish over several decades. This is not the Hawaii that my children once knew, nor what I want my grandchildren to experience. HAWAII REEF FISH BELONG IN HAWAIIAN WATERS, not in the exotic fish tanks of the "rich & famous" on the mainland, nor beyond that. I have personally seen, the last couple years, an improvement in reef fish populations, again while snorkeling, in South Kona, since the Hawaii Supreme Court's moratorium on reef fish "harvesting" (I'd call it slaughter by willful neglect, and not "harvesting"). REEF FISH ARE NOT A CROP TO BE HARVESTED. I have personally witnessed, on several occasions, the last 2 years, the continued & illegal "harvesting" of reef fish in South Kona. Unfortunately, Hawaii State DLNR cannot respond fast enough to reported poaching. Making it easier for poaching, or for "harvesting" IS NOT THE ANSWER. Please save our reef fish for future generations. We wouldn't think of "harvesting" Native Hawaiian Birds, would we? Of course not. Hawaii Reef Fish MUST HAVE State protection!. Thank You, John Paul Wright, M.D.	Your comment has been forwarded to the decision makers. The Preferred Alternative included additional enforcement and compliance measures outlined in Section 3.7.2 of the RDEIS, but this section has been revised in response to comments received on the RDEIS.
Linda Wright	See above comments (template format)	Your comment has been forwarded to the decision makers.
Linda Wright	In the thirty years I have been diving in Hawaii the decline of the reef life has been alarmingly noticeable. I am concerned that we are on the threshold of the death of our oceans. As stewards of our planet we owe it to our future generations to begin to mend the destruction of our planet's oceans. It does not take a scientist to see that we are gambling with a our own survival as a species when we see the diminishing returns of our practices. Please pay attention to what we are witnessing in our own lifetime. Make a change and save our reefs.	Your comment has been forwarded to the decision makers.
Jim Wyban	See above comments (template format)	Your comment has been forwarded to the decision makers.
Jim Wyban	I owned a shrimp breeding company based at NELHA in Kona for 20 years. Whenever we would deliver our live, farm-raised shrimp broodstock to Kona airport to ship to Asia, we would be far outnumbered in boxes to ship by the reef fish collectors shipping out. Their catch reports are, for sure, massively underreported. All of these reef fish could be produced by aquaculture but as long as collectors can catch them off the reef, aquacultured-fish can't compete on price. Aquarium fish aquaculture could be a great sustainable industry for Hawaii, we just need to ban ocean collections. In addition, I'm an avid snorkeler on Big Island since early 1990s and have observed a radical decline in reef fishes in both Kona and Hilo. Hawaii's reef fish are far more valuable in their natural habitat than the little money made by off-shore collector brokers. Reef fish collecting is a not sustainable - it is extractive and should be left behind in the 20th century.	Your comment has been forwarded to the decision makers.
Marla Wynn	See above comments (template format)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Marla Wynn	I am a recently certified Scuba Diver. Prior to getting certified, I had only snorkeled in Hawaii, but still felt we need to protect our reefs for the survival of our planet and the humans living on it. Now that I am certified and have had an opportunity to observe ocean wildlife and explore our reefs, I am more convinced than before we need to stop harming our reefs. Allowing the collection of our reef fish for private aquariums seems very selfish and irresponsible. The benefits definitely do not outweigh the costs in my opinion.	Your comment has been forwarded to the decision makers.
Mike Young	See above comments (template format)	Your comment has been forwarded to the decision makers.
Mike Young	I have been snorkeling in Oahu bays regularly for more than 20 years. I had noticed the decline in those species.	Your comment has been forwarded to the decision makers.
Jeffrey Zankel	See above comments (template format)	Your comment has been forwarded to the decision makers.
Jeffrey Zankel	I come to Hawaii to scuba dive. My interest is in seeing healthy reef fish populations. Hawaii's reputation in the scuba diving community has gone down over time because the reefs have been overfished by the aquarium trade. If you can protect these reefs there will be more interest in diving there. This has proven bring far more jobs and revenue than removing the fish can.	Your comment has been forwarded to the decision makers.
Marjorie Awai	My name is Marjorie Awai and I support the Revised Draft Environmental Impact Statement prepared for the West Hawaiʻi Aquarium Fishery.	Your comment has been forwarded to the decision makers.
Marjorie Awai	I have worked as: - Curatorial Assistant to Dr. John Randall at the Bishop Museum; - Aquarium Biologist at the Waikiki Aquarium, - Senior Aquarist at the Georgia Aquarium; - Curator of The Florida Aquarium; - and Manager of reef fish exhibits at Disneyʻs Aulani Resort.	Your comment has been forwarded to the decision makers.
Marjorie Awai	I have worked with aquarium fish collectors in Hawaiʻi for many years and I have an excellent understanding of the techniques and people involved with the aquarium fishery. The conclusions in the RDEIS coincide with my own experience and observations that this fishery is sustainable and poses little to no harm to coral reefs.	Your comment has been forwarded to the decision makers.
Marjorie Awai	I urge you to approve the RDEIS and allow the aquarium fishermen in West Hawaiʻi to resume their livelihoods.	Your comment has been forwarded to the decision makers.
Paula B. Carlson, Chris Coco, Tim Carpenter, and Becky Ellsworth	Please accept this letter in support of the Applicant’s request to allow continued lawful, sustainable commercial aquarium fish collection of 8 aquarium fish species from nearshore habitats of the West Hawai’i Regional Fishery Management Area (WHRFMA).	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Paula B. Carlson, Chris Coco, Tim Carpenter, and Becky Ellsworth	As Marine Biologists and long-time curators of respected public aquariums, we know first-hand the importance of sustainable fisheries and the impact that they have not only on the natural environment, but on the local fishers whose livelihoods depend upon them. We have displayed Hawaiian fishes in our facilities for many years and they not only serve as important ambassadors for the beauty of the Hawaiian Islands, but also reinforce to our visitors the importance of well-managed sustainable fisheries to the coral reef ecosystem.	Your comment has been forwarded to the decision makers.
Paula B. Carlson, Chris Coco, Tim Carpenter, and Becky Ellsworth	We believe that common sense, science based approaches to fisheries management are vital and support the data that the Division of Aquatic Resources (DAR) has gathered in their more than 20 years of monitoring West Hawai'i reef fish populations.	Your comment has been forwarded to the decision makers.
Paula B. Carlson, Chris Coco, Tim Carpenter, and Becky Ellsworth	We support the Applicant's request to revise the previous White List established in 2013 from 40 to 8 species, and to implement individual catch quotas for the 8 species remaining on the proposed Revised White List.	Your comment has been forwarded to the decision makers.
Paula B. Carlson, Chris Coco, Tim Carpenter, and Becky Ellsworth	Allowing for sustainable aquarium collections in the West Hawai'i Regional Fisheries Management Area will ensure that public aquariums can continue to inspire and educate millions of visitors promoting sound science based fisheries and coral reef conservation in one of the world's most beautiful marine ecosystems.	Your comment has been forwarded to the decision makers.
Philip S. Mosher	I am a resident of Hawai`i Island for twenty-seven years and know first- hand on the conditions of the impact of fish collection on my island. When I first vacation here in 1988, I was swimming at the Kailua Pier and the tropical fish were surrounding the coastal shores. The yellow yang fish were so abundant that the water were gold. Kailua Kona "Kona" was known as the Gold Coast of Hawai`i Island. Yes, my history from 1988 to 2021 there is a remarkable difference in the number of tropical fish.	Your comment has been forwarded to the decision makers.
Philip S. Mosher	Allowing the collection of tropical fish in the West Hawaii Regional Fish Management Area would be a mistake. Our nation, our State and our County are advocating sustainability and restoration of the natural resources. The State of Hawai`i entered into the Paris Accord to be a partner in managing its energy and its resources. We can not allow the depletion of our natural resources like tropical fish. Tropical fish and our coral reefs are the living organisms that keep our oceans alive. To deplete the population is wrong. They crucial loss of the coral reefs in 2015 – 2017 with coral bleaching – warming of the oceans were documented.	Your comment has been forwarded to the decision makers.
Philip S. Mosher	Allowing seven (7) permits with licenses to collect eight of the oceans most treasured fish is wrong. The counts for each species can not be allowed. The number of these counts translates to how much income these permits can earn. Our coastal area has already shown depletion of the coral reefs, and the tropical fish in this regional area. No, its time to finalize this issue and reject this Revised EIS.	Your comment has been forwarded to the decision makers. The 8 species on the Revised White List have all had stable or increasing populations under historic collection rates.

Commentor	Comment	Response
Philip S. Mosher	Today, the State of Hawai`i's Natural Energy Lab allows contractors to breed tropical fish for aquarium owners. This is sustainable and will be the best way to acquire tropical fish. The history of those who have caught tropical fish either illegally or legally have demonstrated to the residents and the officials at DNLR that their actions are despicable. The losses from the catches are extremely high and our population of tropical fish are depleted. I can attest to having visitors who come back to Hawai`i each year remind me that the fish count is low during snorkeling.	Your comment has been forwarded to the decision makers.
Philip S. Mosher	Fish collection is disallowed in all Hawaiian Islands at present and most of the third world recreational areas. The DLNR has overwhelming mandate to regulate both land and ocean resources. They cannot regulate the fish collectors as to the numbers caught by each permit, let alone the "rebel fish catchers". The recent arrests of illegal catches indicates the need for larger scale enforcement. The unseen losses from fish collection are a disaster. Scores of fish are lost before shipping and upon arrival at the pet stores. These fish will not be counted on the collector's quotas.	Your comment has been forwarded to the decision makers. The Preferred Alternative included additional enforcement and compliance measures outlined in Section 3.7.2 of the RDEIS, but this section has been revised in response to comments received on the RDEIS.
Philip S. Mosher	Fish Collection benefits the very few at the cost of the rest of Hawai`i 's residents and visitors. The Native Hawaiians were conservators, taking only what they needed. It is our kuleana to do the same. Please reject the EIS and the Fish Collection Practice.	Your comment has been forwarded to the decision makers.
Philip S. Mosher	I appreciate the opportunity to give testimony for the opposing side of this issue. Thank you for reading my comments and recording the receipt of my letter. Please copy my letter and record it as received on April 9, 2021. Mahalo	Your comment has been forwarded to the decision makers.
Pacific Whale Foundation	Pacific Whale Foundation opposes the issuance of commercial aquarium fishing permits for WHRFMA outlined in HRS Chapter 343-5(a) Pacific Whale Foundation (PWF), a 501 (c)(3) nonprofit organization has a mission is to protect the ocean through science and advocacy and to inspire environmental stewardship. The objective of the proposed action is for the Department of Land and Natural Resources (DLNR) to issue 7 Aquarium Permits and 7 corresponding Commercial Marine Licenses (CMLs) for the West Hawai'i Regional Fishery Management Area (WHRFMA), to revise the White List from 40 to 8 species, and to implement individual catch quotas for the 8 species remaining on the proposed Revised White List. PWF opposes the issuance of these aquarium permits and supports a No Action Alternative, where no commercial aquarium collection would occur within the WHRFMA and East Hawai'i.	Your comment has been forwarded to the decision makers.
Pacific Whale Foundation	Hawai'i's DLNR Division of Aquatic Resources has approved the Pet Industry Joint Advisory Council (PIJAC) to apply for the issuance of Commercial Aquarium Permits for the WHRFMA. This project involves review of both the use of state lands and the use of conservation districts that are involved in the proposed permitting areas.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Pacific Whale Foundation	Implementation of the Preferred Alternative, according to this DEIS, would ensure the lawful, responsible, and sustainable commercial collection of 8 fish species deemed "White List Species" from the WHRFMA. While we commend the PIJAC for integrating catch limits for all species, as well as reducing number of species able to be caught, without a complete understanding of a sustainable catch limit, imposing a limit on 8 species leaves room for excessive take of all other species.	Your comment has been forwarded to the decision makers. The Preferred Alternative would not allow for the take of any other species, it would limit collection to the 8 species who have had stable or increasing populations under historic levels of commercial aquarium collection, and furthermore would add individual catch quotas to limit the number of each species which could be collected within any year.
Pacific Whale Foundation	Pacific Whale Foundation acknowledges that the best available science indicates less than significant direct and indirect impact on reef fish populations with the Preferred Alternative outlined in this DEIS. Although the Coral Reef Ecosystem Program (CREP) data are the most comprehensive data publicly available in fish populations estimates, certain limitations of the surveys may lead to an underestimate of some populations. Short period of survey effort, exclusive survey zone and the misidentification of fish disallow this survey from collecting accurate fish population numbers. Determining actions based on these numbers can lead to an overestimation of population numbers and misidentifying take limits.	Your comment has been forwarded to the decision makers. Population estimates from both CREP (now PIFSC-ESD) and the DAR are included in the EIS.
Pacific Whale Foundation	The draft EIS states that the research suggests collection between 5%-25% is sustainable to reef species similar to those on the White List. We believe this is too large a range to use as a guide and without a verification system to ensure accuracy of self-reported data, there is no way to know what the sustainable catch limit is. In addition, these data come from fish exclusive from the target fish of these permits, further reducing their accuracy in application. Using the precautionary approach, the maximum take should be the lowest estimated percentage of sustainable take (5%) for all species, in all areas open to collection.	Your comment has been forwarded to the decision makers. The Preferred Alternative is limited to species which have shown increasing or stable population trends, thereby using population trend data as the measure of sustainability, rather than the 5-25% range. Nonetheless, collection under the Preferred Alternative would be less than 5% of the island-wide populations for all 8 species.
Pacific Whale Foundation	This DEIS outlines calculated economic benefits based on a 17-year time frame between 2000 and 2017 and creates a 5-year analysis period, inflation-adjusted, to these permits which under the Preferred Alternative, work out to be approximately 0.06% of Hawai'i's ocean economy, and an even smaller percentage of the overall economy in the State. With such a minute economic benefit, the purpose of this permit issuance is unclear.	Your comment has been forwarded to the decision makers. The purpose and need are described in Section 2.0 of the EIS.
Pacific Whale Foundation	PIJAC serves as the legislative voice for retailers, animal suppliers, manufacturers, wholesale distributors, pet hobbyists, and other trade organizations. Given the educational value of aquariums, PWF supports the display of fish, coral, and invertebrates for educational purposes under the following conditions: The aquarium has (1) collected fish under appropriate permits and management plans; (2) a goal of promoting ocean literacy; (3) active conservation efforts to engage the public. We cannot verify that the fish collected under these permits will be used for such purposes, and therefore cannot support the issuance.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Pacific Whale Foundation	There are a number of impacts outside of aquarium fisheries that are affecting coral reefs, including recreational aquarium fish collection, non-aquarium fishing, tourism and climate change. Under the climate change umbrella there includes additional stressors such as coral bleaching and ocean acidification, which lead to coral death. We believe that these cumulative impacts outweigh a single stressor. Using the precautionary principle, without a complete understanding of the environmental stressors on reefs in relation to climate change and other impacts, there should be no introduction of additional stressors to the reef ecosystem.	Your comment has been forwarded to the decision makers.
Pacific Whale Foundation	Due to the near negligible economic benefit and the introduction of a new stressor on a currently stressed ecosystem, we suggest a precautionary approach and oppose the issuance of the 7 aquarium permits and & corresponding CMLs and support a No Action Alternative, where no commercial aquarium collection would occur within the WHRFMA or East Hawai'i.	Your comment has been forwarded to the decision makers.
Sierra Club	These comments are prepared by the Conservation Committee of Sierra Club, Hawaii Island Group, on behalf of the 27,000 members and supporters of the Sierra Club that reside in the Hawaiian Islands. Sierra Club strongly believes that the No Action Alternative regarding open-ocean aquarium collecting is the best and only acceptable alternative, and we support research to develop and sustain captive breeding for species used in the aquarium trade. Under the No Action Alternative, the court order would remain in place, and no Aquarium Permits would be issued for the entire island of Hawai'i and the taking of aquarium fish or other aquatic life in the WHRFMA for commercial aquarium purposes would be prohibited. In addition, the changes to CMLs would remain in place, and CMLs could not be used to collect aquarium fish for commercial purposes in East Hawai'i. Therefore, no commercial aquarium collection would occur on the island of Hawai'i under this Alternative. The No Action Alternative meets the DLNR's objectives to ensure an applicant's actions do not lead to degradation of fish populations and the habitats in which they occur in the context of commercial aquarium collection alone.	Your comment has been forwarded to the decision makers.
Sierra Club	The objective of the proposed action is for the Department of Land and Natural Resources (DLNR) to issue 7 Aquarium Permits and 7 corresponding Commercial Marine Licenses for the WHRFMA, revise the White List from 40 to 8 species, and implement individual catch quotas for the 8 species remaining on the proposed Revised White List.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Sierra Club	HRS §343-5 Trigger: Trigger 1 (use of state lands) and Trigger 2 (use of conservation districts). Review of an Environmental Assessment (EA) prepared in 2018 determined an EIS was required based on Significance Criteria #1, #2, #3, #4, and #8. Review of a previous EIS prepared in 2020 resulted in non-acceptance by the Board of Land and Natural Resources (BLNR), and the Environmental Council concurred with decision. (Environmental Council's Amended Findings of Fact, Conclusions of Law, and Decision and Order Nunc Pro Tunc to August 13, 2020)	Your comment has been forwarded to the decision makers.
Sierra Club	Regarding biological resources, this Revised DEIS focuses primarily on the effects of aquarium fishing on wild populations of White List Species, as it is at the population level that DAR measures changes in White List Species and makes management decisions.	Your comment has been forwarded to the decision makers.
Sierra Club	Species of Greatest Conservation Need (SGCN) are identified in Hawai'i's State Wildlife Action Plan (SWAP) but are not threatened, endangered, or otherwise legislatively protected species. However, recognizing the need to take action to protect endemic species, the DLNR identified Hawaiʻi's indigenous SGCN in Exhibit 1 of Hawaiʻi Administrative Rules Chapter 124. The SWAP (2015) addresses these species and identifies the following actions to ensure the species conservation and sustainability: 1)Conservation Actions: The goals of conservation actions are to not only protect current populations, but to also establish further populations to reduce the risk of extinction. … In addition to common statewide and island conservation actions, specific actions include: Restoration of habitat; and, Maintaining healthy populations with appropriate fishing regulations and education. 2) Monitoring: Continue to survey for populations and distribution in known and likely habitats. 3) Research Priorities: Improve understanding of factors affecting the species population size and distribution; and, Support aquaculture research to develop captive breeding for species used in the aquarium trade.	Your comment has been forwarded to the decision makers.
Sierra Club	We concur and uphold DLNR's mission to 'Enhance, protect, conserve and manage Hawai'i's unique and limited natural, cultural, and historic resources held in public trust for current and future generations of the people of Hawai'i nei, and its visitors, in partnership with others from the public and private sectors.'	Your comment has been forwarded to the decision makers.
Sierra Club	The legislature has decreed it the "policy of the State" that DNLR and other agencies must "[c]onserve natural resources . . . by preserving or augmenting natural resources, and by safeguarding the State's unique natural environmental characteristics . . . ." The Agency must also "[e]ncourage management practices which conserve . . . all natural resources," and encourage all individuals "to fulfill the responsibility as trustees of the environment for the present and succeeding generations." In enacting HEPA, the State legislature found "that the quality of humanity's environment is critical to humanity's well-being, [and] that humanity's activities have broad and profound effects upon the interrelations of all components of the environment . .	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Sierra Club	We have reviewed the revisions to the EIS prepared in 2020, however, we find that this RDEIS still fails to provide adequate baseline data from which to analyze the risks posed by cumulative factors, such as unregulated collecting, under-reporting of catch, non-reporting of dead and disposed fish, failure to monitor and take enforcement actions when violations occur, changes to habitat from natural and human perturbations historically, and the effect proposed alternative(s) would have on traditional fishing practice and diminishment of our clean and healthful environment. The RDEIS fails to offer appropriate mitigation for anticipated impacts, regulation and reporting of all collection, sales records and export data, and it fails to address the cruelty to which the collected animals are exposed.	Your comment has been forwarded to the decision makers. Current population estimates are used to evaluate impacts, as those are the populations that would be impacted. Underreporting and poaching are addressed in Section 5.4.3.6 of the EIS. Post-collection mortality is discussed in Section 5.4.2 of the EIS. The Preferred Alternative included additional enforcement and compliance measures outlined in Section 3.7.2 of the RDEIS, but this section has been revised in response to comments received on the RDEIS. Past cumulative impacts, including changes in reef habitat, were disclosed in Section 5.4.3 of the EIS. As stated in the EIS, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, all six action alternatives may impact cultural practices. As stated in the EIS: Measures included in the Preferred Alternative (e.g., limited permit issuance, Revised White List, and implementation of individual catch quotas) will mitigate potential impacts to cultural resources by halting collection of 32 species in the WHRFMA, and by limiting the number of the remaining 8 species which can be collected by any fisher in a given year.
Sierra Club	The complier of this RDEIS failed to adequately consult with citizen groups and communities who are affected, and dismissed the significant input provided by those with whom it did consult. The RDEIS did not sufficiently address our specific issues and concerns raised in the earlier environmental assessments, nor did it appropriately disclose adverse effects to the biological and cultural resources that are part of the public trust the State of Hawaii has the responsibility to protect.	Your comment has been forwarded to the decision makers. Consulted parties are listed in Section 6.1 of the EIS, and responses to those comments are provided in Appendix B of the DEIS and incorporated into the EIS as appropriate. In addition, the public has had the opportunity to comment on previous HEPA documents related to this, and those comments and responses are provided in those documents available on the Hawaii Office of Environmental Control website. As can be seen by changes that have been made between the original Draft EA, Final EA, original Draft and Final EISs, and this revised DEIS and FEIS, numerous changes have been incroprated into the the alternatives and analysis in response to public comments, the most significant of which is the inclusion of hard upper limits on the catch which was suggested by many previous commentors inlcuding the Sierra Club.

Commentor	Comment	Response
Sierra Club	Future serious cumulative impacts to the coastal near-shore habitat due to climate change, ocean acidification, coral bleaching, run-off and pollution are largely ignored in this document, and the proposed action alternatives do not address mitigation for the anticipated loss of coastal habitat. A recent DAR announcement appealed to subsistence and recreational reef fishers to refrain from taking herbivorous fish off the reefs. This tacit recognition of the vital symbiotic service they perform in this delicate coral reef ecosystem is overdue and yet completely absent in the RDEIS. The 'preferred alternative' in the document would allow takes by unidentified permittees of many of these same important organisms. Any declines whether driven by, or contributed to, by the trade are simply not justified by the logic and necessity of sustainability.	Your comment has been forwarded to the decision makers. The following language has been added to the FEIS: The seven permittees covered by this Revised FEIS have verified that they are each legally qualified to apply for, and hold, an Aquarium Fishing Permit, Commercial Marine License, and West Hawai'i Aquarium Permit. The seven permittees covered by this Revised FEIS will file individual permit applications with Department of Land and Natural Resources (DLNR) in parallel with the submission of this Revised FEIS to Office of Environmental Quality Control (OEQC) and DLNR. DLNR will review such applications and take action upon them after further consideration of the Revised FEIS. Collection under the Preferred Alternative would be limited to 8 species which have been shown to have stable or increasing populations.
Sierra Club	The RDEIS preferred alternative proposes to exploit a public resource for the economic benefit of a few, (some of whom have been non-compliant with past rules and regulations), at the expense of the subsistence communities, the resident public, the visitors, and the health of the state as a whole. Absent the documentation needed for a complete and accurate analysis, we ask that at the very least, a No Action Alternative be implemented.	Your comment has been forwarded to the decision makers.
Sierra Club	Significance Criteria #3 - Does the take of aquarium fish conflict with the state's long-term environmental goals? Comment: The current RDEIS now under consideration sets out a history of 'user conflicts' associated with this 'trade' from over half a century. To some degree it documents the evolution of commercially driven practices that are acknowledged to have become reviled in society as its attention, ecological awareness, and concerns over diminished resources have taken on larger dimensions in the political affairs of our modern state. Credible recent polling indicates that 84% of residents are opposed to aquarium collecting from the ocean. (Anthology Research, 2017: Hawaii Resident Study)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Sierra Club	'Soft costs' associated with the subversion of public trust, poaching, legal and enforcement administration, are difficult to calculate and therefore scarcely reasoned with in the study. (And most if not all of the 'soft cost' factors weigh in on the negative side of the industry balance sheet.) 'Hard' socio-economic impacts are somewhat easier to derive and should be weighed in as part of this process. Not cited in the RDEIS is new research from our own University of Hawaii, in a breakthrough paper made public within the last six months titled: Managing Near-shore Fisheries in Hawaiʻi: A Policy Analysis of the State's Marine Aquarium Fishery (Siena Schaar May 2020). This study is a cost-benefit analysis of four different policies regarding collection of marine aquarium fish from the West Hawaiʻi Regional Fishery Management Area. The policy scenarios included the status quo, a permit system, a complete ban, and a limited permit system for stakeholders equipped with captive breeding facilities. Management costs, impacts on tourist appeal, and environmental and social costs were all included. Benefits included income to collectors and permit fees to the state. The complete ban resulted in the greatest net benefits. Under any permitting system, the benefits flow primarily to the collectors, while costs are borne primarily by the local community and the environment. The author uses 'cost benefit analysis' to conclude: "The results of this CBA indicate that the closed trade policy scenario, which was described in this report as a statewide aquarium collection ban, is the most equitable and efficient option. It also was the only option that yielded a net positive NPV, and negatively impacted the fewest overall stakeholders." The analysis further states: "Only a small number of stakeholders directly involved in the fishery, including collectors, divers, wholesalers, and dealers, receive the market benefits of this fishery while the other stakeholder groups pay the indirect and non-market costs." The Schaar report with its implications, as direct and substantive as it is, was not included or similarly addressed in the RDEIS. Instead, a more simplified one-sided extrapolation of economic benefits, profits to the trade generally, were given, implying a net positive impact. Nothing could be farther from the truth.	Your comment has been forwarded to the decision makers. The paper referenced here (Schaar and Cox 2021) did not analyze the current Preferred Alternative, which limits collection to 8 species, limits collection to the WHRFMA, and includes individual catch quotas providing a hard upper limit on the number that can be collected. Additionally, the Applicant questions the validy of the CBA referenced by the commenter because the study assumes a complete loss of the tourism industry under any alternative which includes collection. As stated in the EIS, Hawaiʻiʻs tourism industry achieved new records in total visitor spending and visitor arrivals in 2017, marking the sixth consecutive year of record growth in both categories. This occurred while commercial aquarium collection was permitted. Therefore, the loss of the entire tourism industry, for the entire state, based on issuance of permits for 8 species limited to the WHRFMA on the island of Hawai'i, does not seem reasonably foreseeable.
Sierra Club	RDEIS : The graphic representation of the various management choices offered in a table on page 167-168 of the RDEIS claims that the Preferred Alternative would remove 1.2 million fish over a five year period while under the 'NO ACTION' option, a likely benefit to recreational users would be 'greater viewing opportunities (fish and wildlife) of 32 species (removed from 'White List') for visitors and residents.'	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Sierra Club	Elsewhere in their analysis is juxtaposed the outsized dimensions of what's at stake economically speaking: "Much of the state's economy is based on the island's coastal and marine resources. Tourism accounts for the majority of the state's economy, with a significant portion of the tourist activities associated with beaches and marine wildlife (DLNR 2015). Coastal development and land values have both increased with the growth in tourism. In 2002, the Hawai'i Coral Reef Initiative funded a study regarding the economic valuation of the coral reefs of Hawai'i, where the value of coral reefs to the Hawai'i economy was estimated to be about $380 million dollars per year (DLNR 2015). In 2001, Cesar et al. documented the annual recreational value of the coral reefs of the Hawaiian reefs for snorkelers and divers was estimated to be $281 million and $44 million, respectively. (page 34)	Your comment has been forwarded to the decision makers.
Sierra Club	Meanwhile, "The Preferred Alternative would add an estimated $2.5 to $10 million over the 5-year analysis period (range of $499,416 to $2,022,686 per year), and another five times this value in indirect economic benefits. Loss of the fishery would result in the loss of income, tax revenue, and jobs." Comment: The information not specifically identified in the RDEIS includes the amount of income the Preferred Alternative would provide the proposed collectors, the criteria proposed for selection of the permittees, the tax revenues anticipated and previously reported by each of the 10 reported permitted collectors (Table 5.2). Based on the analysis in this document, the balance of economic costs appears to weigh heavily against the residents including cultural practitioners and visitor industry in contrast to the benefits for a select few collectors.	Your comment has been forwarded to the decision makers.
Sierra Club	Since, on Page 97 of the RDEIS, it states .. "Additionally, the 10 fishers who would receive Aquarium Permits under the Limited Permit Issuance Alternative, including the 7 fishers who would receive permits under the Proposed Action, waived their right to confidentiality, so all data from these 10 fishers were released for analysis in the EIS for the WHRFMA and East Hawai'i from 2000 through 2017. " …the statistics should be readily available and transparently presented.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Sierra Club	The economic valuation of the recreational value of coral reef reported by the Hawaii Coral Reef Initiative (above) in 2001 at $325 million (unadjusted for 2020), compared to the total ex-vessel value for the ten fishers reported in 2001 (page 99) of $14,000, calls into question accuracy of the data reported. On page 37, the RDEIS reports: "Since 2000, the commercial aquarium fishery within the WHRFMA on the island of Hawai'i has averaged annual landings valued at approximately $1.5 million, with a low of approximately $738,568 (inflation- adjusted 2020 dollars) in 2001 and a high of $1,965,381 (inflation-adjusted 2020 dollars) in 2014 (Table 4- 2; DAR 2018a). " In either case, the reported economic value of aquarium collection is less than one percent of the recreational value reported.	Your comment has been forwarded to the decision makers.
Sierra Club	Significance Criteria #1: does not involve an irrevocable commitment or loss or destruction of any natural, historic, or cultural resource. Significance Criteria #4 - To what extent does the take of aquarium fish impact cultural practices in the state? "Why should people take our fish just for pleasure?" – Chuck Leslie, cultural practitioner RDEIS, Applicant Publication Form, Project Purpose: "The purpose of the Applicant's action is to ensure that commercial aquarium fish collection allows for the lawful, responsible, and sustainable commercial collection of 8 aquarium fish species from nearshore habitats of the West Hawai'i Regional Fishery Management Area (WHRFMA), where collection is currently limited to 40 "White List" species of fish." Comment: If permitted, it is state approvals that will "allow for" the action and "ensure that commercial aquarium fish collection is lawful, responsible, and sustainable. The purpose of the action should be to perform the lawful, responsible, and sustainable commercial collection of aquarium fish, if the Board of Land and Natural Resources ("BLNR") finds the proposed action is in fact lawful, responsible, and sustainable. However, with respect to cultural resources and traditional and customary practices, we believe the only lawful, responsible, and sustainable alternative is only the No Action Alternative.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Sierra Club	RDEIS, page ii, Executive Summary: "The Preferred Alternative does not involve an irrevocable commitment or loss or destruction of any natural or cultural resource." The Cultural Impact Assessment (Appendix 1) on page 135 states, "No matter how or why these fish are extracted, their removal constitutes an irrevocable loss of bio-cultural resources that could potentially have an adverse effect on the overall health and sustainability of the fishery." Irrevocable loss = irreparable harm. Irreparable harm is harm or loss that would not be adequately compensated by monetary damages. Deprivation of constitutional rights is an example of irreparable harm.	Your comment has been forwarded to the decision makers. As stated in the EIS, the Applicant acknowledges that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices. As such, all six action alternatives may impact cultural practices. No cultural impacts would occur under the No Action Alternative.
Sierra Club	The Hawai'i Supreme Court has ruled that traditional and customary Hawaiian rights are a part of the public trust. It along with the state legislature have taken the position that, pursuant to the precautionary principle, where there are present or potential threats of serious damage to natural resources, the lack of full scientific certainty should not be a basis for postponing effective measures to prevent environmental degradation. In addition, where uncertainty exists, the State's duty to perform as a public trustee requires a presumption in favor of public resource protection. The precautionary principle should also be applied when there are present or potential threats of serious damage to cultural resources, which include traditional and customary Hawaiian rights and practices. The state Supreme Court has also ruled the applicant bears the burden of proof that their proposed activity does not result in harm or loss to the public trust. By rejecting the applicant's Final Environmental Impact Statement, the BLNR has exercised its affirmative duty to act as a trustee of the public trust and applied the precautionary principle.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Sierra Club	RDEIS, page iiii, Executive Summary: "The Cultural Impact Assessment (CIA; Appendix A) concluded that cultural impacts would occur if issuance of Aquarium Permits under an alternative would cause a significant decline in the population of a White List Species considered to be a cultural resource, either directly through the collection of fish or indirectly through habitat impacts. It is noted, however, that some believe that collection for aquarium purposes, regardless of impact or sustainability, is a violation of traditional beliefs. While seven of the eight species on the proposed Revised White List have a known cultural use for food, medicinal, religious or ceremonial purposes, it is assumed a cultural impact could occur if populations of any of the eight species were impacted. As detailed in Section 5.4, populations of the eight species on the proposed Revised White List are not anticipated to substantially decline under the Preferred Alternative. However, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, the Preferred Alternative may impact cultural practices, but the extent of the impact is unknown. Under the Preferred Alternative, cultural impacts in the WHRFMA would be less than the other action alternatives which include commercial aquarium collection in the WHRFMA due to implementation of the proposed Revised White List (32 species would not be collected at all in the WHRFMA) and individual catch quotas for the remaining 8 species. No cultural impacts would occur under the No Action Alternative, and cultural impacts under the CML-only Alternative would be limited to East Hawai'i." Comment: In general, as in the Executive Summary, the RDEIS studiously avoids using the word "negative". For instance, the sentence should be, "The CIA concluded that [negative] cultural impacts would occur…". The paragraph acknowledges "that collection for aquarium purposes, regardless of impact or sustainability, is a violation of traditional beliefs" and "is contrary to cultural practices". This wording avoids using the legal phrase "traditional and customary practices" contained within Article XII, Section 7 and within state Supreme Court precedent rulings. A more appropriate and relevant statement would be "the collection for aquarium purposes is a violation of traditional and customary practices. " The paragraph states, "the Preferred Alternative may impact cultural practices, but the extent of the impact is unknown". This statement is incorrect. The consultations contained within the CIA make it clear the Preferred Alternative will impact cultural practices and the extent of the impact is in fact known. It is a known violation of traditional and customary practices. The only acceptable remedy for this violation is the No Action Alternative and denial of aquarium fish collecting permits. These permits should become kapu, especially given the increasing systemic stresses being caused by climate change.	Your comment has been forwarded to the decision makers. The word "negative" has been added to Section 5.3.1of the Revised FEIS for clarification, and "traditional and customary practices" has been added to this section as well.

Commentor	Comment	Response
Sierra Club	RDEIS, page 9, Introduction, BLNR Fact and Reason 13: "The FEIS failed to sufficiently consider cultural impacts. The FEIS improperly concluded that the impacts to cultural resources under any of the proposed alternatives would be less than significant based on the flawed premise that cultural impacts would only occur if the proposed action would cause a significant decline in the population of a White List Species considered to be a cultural resource. A number of testimonies expressed misgivings from a cultural standpoint with the proposed activity itself, regardless of impact on resources, and this was not adequately considered in concluding no significant impact. • This concern has been addressed through edits to Section 5.3." Comment: We have reviewed the edited text of RDEIS Section 5.3 and we do not think it adequately addresses our concerns for the following reasons:. Paragraph 136 of the Environmental Council's Amended Findings of Fact, Conclusions of Law, and Decision and Order Nunc Pro Tunc to August 13, 2020 states, in part, "Accordingly, the [original] EIS does not propose or even discuss mitigation measures specific to reducing cultural impacts that are not ecological in nature." The RDEIS does not propose mitigation measures specific to reducing cultural impacts that are not ecological in nature, other than to admit the No Action Alternative is the only alternative with no cultural impact. We disagree, and believe 1) the No Action Alternative has an intrinsic positive cultural impact, and 2) all other alternatives have inherently negative cultural impacts. Rather than referring to specific statements made by cultural practitioners consulted in the CIA, RDEIS Section 5.3.1 refers to studies by research scientists. These studies are indirect sources of information by authors who are not cultural practitioners. They should not be used as references in determining the intrinsically negative cultural impact of aquarium fish collecting. It is important to note the CIA lists consultations with individuals who are not cultural practitioners, including aquarium collectors, commercial fishers, charter boat operators, and researchers, who do not have expert working knowledge and understanding of traditional and customary practices.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Sierra Club	The only references to the impact of the proposed activity in Section 5.3.1 are the statements: 1)"However, some interviewees expressed the belief that collection for aquarium purposes, regardless of impact or sustainability, is a violation of traditional beliefs (see Appendix A)", and 2)"However, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, all six action alternatives may impact cultural practices. No cultural impacts would occur under the No Action Alternative." The expert testimonies given by the cultural practitioners in the CIA make it clear all action alternatives, except the No Action Alternative, will impact traditional and customary practices and that impact will be negative.	Your comment has been forwarded to the decision makers.
Sierra Club	In section 5.4.2.1, the consequence of the No Action Alternative does not even mention the benefit to cultural practitioners of reduced extraction of reef fishes and habitat health on the native Hawaiian communities that depend on the reef. The RDEIS does not otherwise propose or discuss mitigation measures specific to reducing cultural impacts that are not ecological in nature. Section 5.3.2 contains the statement, "However, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, any aquarium collection could have a cumulative impact, though that impact cannot be quantified at this time." Again, aquarium collection has had and will have a cumulative impact and that impact will be negative. Traditional and customary practices occur within a belief system in which ecology, environment, and culture are inseparable. This is the most serious flaw in the good intentions behind the requirement for Environmental Impact Statements and Cultural Impact Assessments. Biological, Socio-economic, Physical, and Cultural Resources and traditional and customary practices are inseparable, which is why the impact on resources and traditional and customary practices cannot be "quantified" and any harm or loss is therefore considered irreparable.	Your comment has been forwarded to the decision makers. Section 5.4.2.1 is the indirect effects on biological resources, and is not a cultural resource section. The word "negative" has been added to Section 5.3.1 of the FEIS for clarification, and "traditional and customary practices" has been added to this section as well.
Sierra Club	Final Comments on Cultural Resources: We would like to highlight the following excerpts from consultation interviews contained with the applicant's Cultural Impact Assessment (Appendix A):	Your comment has been forwarded to the decision makers.
Sierra Club	Bimo Akiona: When asked if the proposed project could result in any potential cultural impacts, Bimo did mention that aquarium collecting methods can have a damaging effect on the reef, which in itself, is considered a valued cultural resource.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Sierra Club	Pelika Andrade: Pelika believes that the proposed project would lend to adverse impacts to the community and is not aligned with traditional fishing practices. She went on to explain that with aquarium collection, "there's no tending process, only lawe iʻa." She argued that modern aquarium collection practices negatively impact fisheries and disrupts traditional knowledge systems, because there is no input or contribution to maintaining the very resource that the industry is dependent upon.	Your comment has been forwarded to the decision makers.
Sierra Club	Kehau Springer: Kehau shared from her experience and observation that the influx of ocean activities, including aquarium fishing, has caused a major disruption to fish behavior. With the increase in boat traffic and people, she has seen a change in fish aggregation patterns and thus has seen the differences in the natural patterns of ocean wildlife.	Your comment has been forwarded to the decision makers.
Sierra Club	Nohealani Kaʻawa: She described aquarium collectors as just another group that comes to K aʻū to take its resources and lamented that "it's hard to watch." Nohea added that many people come to Kaʻū just to take its resources and that these people do nothing to give back to these resources. She expressed that seeing these kinds of extractive practices have significantly altered her family's fishing practices to the point that today, she and her family "rarely go holoholo at the kai because there's just too much taking and the balance is not in place anymore."	Your comment has been forwarded to the decision makers.
Sierra Club	Mike Nakachi: With respect to the aquarium industry, Mike disclosed that in the past, he has been approached by several individuals to participate in this industry, but affirmed that he has never participated in it because it never felt right in his naʻau (guts, moral nature). He expressed that the feelings that come with taking fish to be sold outside of Hawaiʻi to be placed in someone's tank never felt appropriate to him nor does it contribute to the health of the ocean. He acknowledged knowing several Native Hawaiians that have participated in this industry but stated that many of them have left after learning about the workings of the industry. Mike lamented that in some smaller Hawaiian communities, especially in South Kona where traditional methods of harvesting fish are still practiced, the aquarium industry has created serious discord and tension amongst its members, which he feels is very sad and unfortunate.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Sierra Club	Wilford Kaupiko, Ka'imi Kaupiko, and Greg Asner: Kaʻimi added that Miloliʻi was always known for its abundance and is one of the last places to maintain traditional Hawaiian fishing practices, which is why Kaʻimi and his father have played a key role in developing educational programs for the ʻohana and youth of Miloliʻi. When asked about the types of educational programs they offer, Kaʻimi stated that they focus on teaching the keiki about traditional ʻōpelu feeding, net making, developing fluency in traditional Hawaiian fishing related terminology, seasonal changes, Hawaiian moon calendar, and other pono ways of fishing. Uncle Willy and Kaʻimi expressed that many of the kupuna and fishing practitioners have passed away but there are "plenty kamaliʻi" in the village. They described a pressing need to teach the next generation about the cultural traditions unique to Miloliʻi so that they can makaʻala (remain watchful) and mālama (care for) these traditions, place, and resources into the future. Kaʻimi stated that today, the Miloliʻi community and its ocean resources are in a "vulnerable state" and expressed that the seasonal patterns are off, which creates challenges for their subsistence lifestyle.	Your comment has been forwarded to the decision makers.
Sierra Club	While all four interview participants were aware of the Miloliʻi FRA, which prohibits that taking of reef fish for the aquarium industry, they noted that in the adjacent Pāpā Bay, aquarium collection is allowed. Uncle Willy stated that while growing up, he learned that Pāpā Bay is where the fish are born. Greg Asner, who has been diving and conducting coral and fish surveys at Pāpā Bay for the past twenty-three years highlighted some of his research findings.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Sierra Club	Greg explained that the science he has been conducting puts numbers to what people like Uncle Willy grew up learning and knowing. Greg described a phenomenon known as "bio slicks" which are visible from land as glass-like, meandering streaks that appear on the ocean surface. Greg explained that these drifting slicks contain larvae fish and invertebrates, algae, and debris and serve as an important habitat during the early growth stages of these organisms. Greg stated that these slicks are common in and near Pāpā Bay but are not generated within Miloliʻi Bay. He emphasized that coastal areas share important biological connections and from his research, he has learned that fish migrate to different areas to live out their life cycle. He went on to explain that Pāpā Bay and Miloliʻi share important biological connections because some of the larvae fish that are carried on these slicks are deposited into adjacent bays. Greg stressed that what happens at Pāpā Bay impacts Miloliʻi and other areas. Both Greg and Gail confirmed fish population crashes at Pāpā Bay and have recorded collectors walking on and damaging coral, which they expressed is key to maintaining a healthy marine ecosystem. The group stated that they have seen aquarium collectors day after day collecting fish from the same areas and feels that this intensive harvesting does not give the fish and the ecosystem a chance to recuperate from previous biological removals. Greg believes that the destructive methods used by certain aquarium collectors are dismantling this integrated system. Additionally, Kaʻimi and Greg described other events, one of which included the 2015 mass coral bleaching which devastated the corals in West Hawaiʻi. Uncle Willy recalled that after this bleaching event, the ʻōpelu were missing.	Your comment has been forwarded to the decision makers.
Sierra Club	Comment: When comparing the Western Management System to the Traditional Hawaiian Management System, as offered in Table 1 below, the differences between Western culture and Hawaiian culture are profound. The harvesting of fish for aquariums for pleasure and the manner in which the activity is performed is absolutely contrary to traditional and customary practices. The only positive cultural impact is the No Action Alternative with all other alternatives having negative impacts with irreparable harm to native Hawaiian rights. [Table 1 - Sierra Club Comments pg. 12]	Your comment has been forwarded to the decision makers.
Sierra Club	Significance Criteria #2 - To what extent does the take of aquarium fish curtail the use of the environment, including: Aquatic invasive algae control, Tourism industry, Integrity of diverse aquatic ecosystems Member Bill Coney is a co-founder of Legacy Reef Foundation, and the group runs a coral restoration lab at the NELHA marine facility in Kona, Hawaii. The mission is the restoration and conservation of coral reefs in Hawaii and around the world and to ensure critical food security for future generations. He provided the following:	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Sierra Club	Comment: Our evaluations of West Hawaii coral health and comments on AQ DREIS Our opinion is that both the state and AQ DREIS only look at limited and selective data. Our scientist, staff and the local diving community all agree that what has been stated by the state and AQ industry does not tell the complete story. We have people in the water almost every day and what has been reported to us over the last ten years or more, up until the AQ fishing ban, has indicated a steady decline with our reef fish, particularly the herbivories that are critical to coral health. In some areas we have seen an almost complete depletion of the key reef fish.	Your comment has been forwarded to the decision makers.
Sierra Club	It is important to understand the relationship between reef fish and coral health. In the natural balance of coral reefs, the herbivores feed on the algae that is constantly growing on our reefs. Without the reef fish the algae take over and smothers the coral reefs. This balance is critical to coral health. In every case we see in areas that have been heavily fished, the coral is greatly diminished or has completely died off. Coral cannot survive without a proper balance of herbivores.	Your comment has been forwarded to the decision makers.
Sierra Club	Our coral reefs have a number of stressors they have to deal with, both manmade and natural stressors have reduced living coral in many areas to near extinction levels. If the trend continues, we will see large areas of coral reefs die off completely. We are limited on what we can do to reduce global warming, run off and sewage outfall to an impactful level that will keep the coral healthy, but we can reduce or eliminate the removal of our coral marine life that the coral depends on. This alone may be the only thing between our coral dying off completely or surviving.	Your comment has been forwarded to the decision makers.
Sierra Club	The most telling fact is that within months of the AQ ban we saw, in areas the poachers were not still frequenting, the coral began to grow and now is on its way to pre AQ fishing level. Although this may take decades to return to healthy levels it is proof the trade has a negative impact on coral health in Hawaii. Today we see our reefs and the marine life regaining a foothold and giving us hope they may return. Certainly, allowing the AQ trade to return will put all of our reefs in Hawaii in jeopardy.	Your comment has been forwarded to the decision makers.
Sierra Club	Further, the success or failure any coral restoration work done in Hawaii will be dramatically impacted by the outcome of this issue. Any future restoration work done will be at risk if the AQ industry is allowed to remove the essential herbivores that keep the algae in check. In our case we are already looking at moving our restorative efforts to more favorable locations in Florida and the Caribbean. For Legacy Reef Foundation the cost / benefit / risk is just not favorable in Hawaii at this time.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Sierra Club	Conclusion and recommendations – It is the opinion of our scientist, staff and the local water community that the ban on aquarium collecting should remain in place indefinitely. History has shown that the state can't police the trade effectively, so a ban seems the only effective option. We believe the answer to this issue is to support land-based aquaculture to raise the fish desired for the aquarium trade. This option protects our reefs and marine life and allows the aquarium collector to make living without harming Hawaii's coral reefs.	Your comment has been forwarded to the decision makers.
Sierra Club	Revised DEIS comments on data analyses and results Dr. Asner and colleagues provided very thorough and sound analyses of the Draft EIS-Nov 2019 and of the Final EIS-Apr 2020. They appropriately pointed out several scientific inadequacies in their first analysis of the DEIS that were not corrected or adequately addressed in the FEIS. In their analysis of the FEIS, Dr. Asner and colleagues emphasized the areas that required correction and were not addressed, particularly in the areas of inaccurate calculation of fish species population estimates, inadequate statistical analyses, and insufficient presentation of the impacts of herbivorous fish harvest on ecosystem function and coral community health.	Your comment has been forwarded to the decision makers. Responses to comments from Greg Asner et al., including information on edits made in response to those comments, are provided in the Final EIS (April 2020), and additional edits were made in this document in response to his comments on the FEIS.
Sierra Club	Although several important scientific topics, including species population and catch estimates, have not been adequately addressed in the Revised DEIS, a large criticism is that EIS population and catch estimates were provided at the entire island scale. Reef fishes have very high site fidelity, and most reef fish species have very small home ranges. Several factors influence the local site abundance of reef fishes, including wave exposure, habitat complexity, larval recruitment, among numerous others, so local removal of numerous fishes can have long-term negative effects on local fish abundance. Population and catch estimates should be calculated at the smallest scale and statistically analyzed and compared among sites, in order to derive best management practices from local (site) to larger (coast, island) scales. Human population density has been shown to negatively correlate with fish abundance (e.g., Williams et al. 2008), so management agencies must consider socio-economic factors when establishing harvest management strategies for reef fishes in Hawai 'i. Obviously, local depletion of resources around tourist and population centers can negatively influence tourism and local resident recreation.	Your comment has been forwarded to the decision makers. The RDEIS disclosed impacts at three populations scales: island-wide, WHRFMA, and Open Areas within the WHRFMA.

Commentor	Comment	Response
Sierra Club	A few additional points should be emphasized. As presented by Dr. Asner and colleagues, the DAR and NOAA data were incorrectly analyzed and presented for the purposes used in the RDEIS. Both data sets should have been analyzed using more robust statistical methods in order to provide proper trends and developing the population estimates. As stated by Dr. Asner and colleagues, fish abundance and biomass data collected using the DAR and NOAA sampling methods have large variance. Trend analysis of these type of monitoring data require data for several years with at least annual sampling frequency to conduct defensible analyses of population trends. Statistical comparisons between two years (or short periods) at the same site are not statistically appropriate in most cases because of variance and autocorrelation in the data. Another large inaccuracy stated was the population estimates made from non-random data.	Your comment has been forwarded to the decision makers. Population estimates from the DAR and NOAA were provided to the Applicant, and not calculated by the Applicant. Likewise, the Applicant did not determine the study design for either study.
Sierra Club	Our scientific advisors and Sierra Club Executive Committee members have reviewed the DEIS, FEIS, and the analyses of Dr. Asner and colleagues, and we support the criticisms and conclusions of Dr. Asner and colleagues.	Your comment has been forwarded to the decision makers.
Sierra Club	Recommendations for revision of the Revised Draft EIS: -Re-analysis of data for population size, catch, and total allowable catch estimates for each species on the White List should be conducted. Ideally, this would be conducted using all available data and various statistical models, such as generalized linear mixed models, as suggested by Asner and colleagues, and spatially explicit population models for each species (for those species with sufficient data). Other datasets, such as the NPS I&M program data for Kaloko-Honokohau NHP, would provide addition data for trend analysis for species in a protected management area.	Your comment has been forwarded to the decision makers. The Applicant used the data and analyses which were publicly available or provided by the DAR. The DAR used the most applicable data, and used analyses which have been widely accepted by the scientific community both in Hawaii and elsewhere for over 20 years. Applying more complicated statistics or models to relatively simple data such as catch numbers or population density data would make the results unnecessarily difficult to understand and therefore not add value to decision makers.
Sierra Club	-Improved analysis on herbivorous fishes by species, feeding guild, and as a functional group should be conducted to provide results addressing the impacts of herbivore removal and potential impact on ecosystem function.	Your comment has been forwarded to the decision makers.
Sierra Club	-Provide unbiased results and conclusions from relevant literature suggested by Asner and colleagues and other commenters. This should include literature on the effects of commercial fishing on reef fishes, which is important regardless of the estimated proportion of harvest conducted by aquarium trade collectors.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Sierra Club	-Any commercial collection alternative should provide a list of species that should have no allowable catch, including species that have a statistically significant negative trend and those species that are uncommon in commercial catches. The latter could be a proposed simple rule of exclusion of species that are uncommon in fisheries dependent and independent datasets (based on frequency of occurrence analysis). There are numerous 'fish watchers', similar to 'bird watchers', who spend hundreds of hours to complete their 'life list' or 'annual counts' and believe that the harvest of uncommon species abhorrent.	Your comment has been forwarded to the decision makers. All alternatives in the EIS for which commercial aquarium collection would occur in the WHRFMA have a "White List" of species specific to that alternative which can be collected. The Revised White List for the preferred alternative includes only 8 species. If a species does not appear on a White List it cannot be collected. The purpose of a White List is to specifically list those species that can be collected. As such, a list of species that cannot be collected is unncessary as it would inlcude everything that is not on the White List. The applicant assumes the DNLR would address this by simply stating in a permit condition that only those species on the White List can be collected.
Sierra Club	Significance Criteria #3 - Does the take of aquarium fish conflict with the state's long-term environmental goals? Significance Criteria #4 - To what extent does the take of aquarium fish impact cultural practices in the state? Comment: This environmental review concerns a resource extraction industry that involves many consequences beyond the removal of fishes from their natural habitat. It involves the holding and transportation of fragile wildlife requiring scientific, ecological and humane practices to maintain the health and welfare of the animals extracted from their reef ecosystem. It is well known that many of these creatures succumb to deleterious practices from the point of capture on the reef to the well-intentioned (though often ignorant) hobbyist's tank thousands of miles from Hawai'i. Many captured fishes are unnecessarily lost on this torturous journey to destinations as far away as Russia leading to over-collection of our precious fishes. Concerns about the over-collection of many fish species arise from the fact that the aquarium trade is largely untraceable. No centralized global database exists for tracking how many fish are scooped from reefs—or even how they're captured. We ask that the applicant address the practices of the trade during all phases of capture, transporting and warehousing of our reef fishes. We find that the RDEIS does not adequately address the animal welfare issues and unacceptable high mortality rates which can be considered cumulative effects of the actions proposed.	Your comment has been forwarded to the decision makers. The Preferred Alternative included additional enforcement and compliance measures outlined in Section 3.7.2 of the RDEIS, but this section has been revised in response to comments received on the RDEIS.

Commentor	Comment	Response
Sierra Club	The RDEIS states: "The purpose of the Applicant's action is to ensure that commercial aquarium fish collection allows for the lawful, responsible, and sustainable commercial collection of 8 aquarium fish species from nearshore habitats of the West Hawai'i Regional Fishery Management Area (WHRFMA)". The applicant asserts "Permittees would abide by all rules and regulations set forth in HRS 189-2,3 (Commercial Marine Permit; Section 1.2.2), and HRS-188-31 (Section 1.2.1), governing aquarium permit use". One of these rules provided in the RDEIS is from HRS 188-31 1.2.2 —"Except as prohibited by law, the permits shall be issued only to persons who can satisfy the department that they possess facilities to and can maintain fish and other aquatic life alive and in reasonable health." Comment: A number of practices of the trade from the point of collection are subject to Hawai'i Misdemeanor Cruelty to Animals statute HRS 711-1109. These documented practices of the trade include puncturing of gas bladders of fishes to prevent barotrauma during ascent from the reef. The procedure involves puncturing the gas bladder through the musculature of the fish using a sharp object such as a hypodermic needle. Later, during warehousing of the fishes prior to shipping, trimming their fins and withholding of food are common practices. The fishes are shipped in small plastic bags that are easily punctured. Food is withheld to lessen ammonia contamination from defecation during the shipping process. All of these practices are in violation of HRS 711-1109, and we ask that they be addressed. The animal cruelty statute specifically includes violations for: (b) Deprives a pet animal of necessary sustenance or causes such deprivation (c) Mutilates, poisons, or kills without need any animal. The effects on individual fish removed from the population matter. The manner of capture and care should be included in the analysis. These fishes are not used for subsistence, they are used for ornamentation and fleeting pleasure. The impacts of trapping, finning, starving, enclosure in confined packaging, transporting and eventual placement of remaining live "specimens" in artificial conditions must be documented and mortality data disclosed in the RDEIS analysis. Comment: What measures are taken to ensure fish are treated humanely? Are fishes that do not survive the harvest/storage and transport reported? How is the report documented for public review? What agency is charged with regulating the care of fish?	Your comment has been forwarded to the decision makers. The 7 fishers who would receive permits under the preferred alternative would comply withall laws, regulations, and permit conditions regarding harvest, storage, transport, and reporting of catch.

Commentor	Comment	Response
Sierra Club	Comment: In the CIA section cultural concerns are raised by numerous cultural practitioners who view the trade as “wasteful “ and therefore contrary to their traditional cultural values. The interview of respected community member John Replogle states “John also raised concern for the mortality rate of the fish and noted that there have been several instances when bags of dead aquarium fish were dumped and ‘thrown out like garbage.’ He described that culturally when something of value needs to be disposed of, it is done so properly and cited the example of a lei, where once it is no longer needed, it is returned to the land. John contends that although only a few cases of dumped aquarium fish have made public headlines, he believes that such cases may be more common. In describing some of his concern about the proposed action, John exclaimed that in fifty years from now, what will those people think of the culture that would allow this type of activity to happen. He stated that these marine resources are a part of a living culture and are a part of a living ecosystem that is intimately connected to the land.”	Your comment has been forwarded to the decision makers.
Sierra Club	Significance Criteria #8 - What is the cumulative impact of the take of aquarium fish when combined with: Commercial take of aquarium fish using other legal methods Recreational take of aquarium fish Commercial and non-commercial take of aquarium fish for consumption (particularly the Achilles Tang and Kole)	Your comment has been forwarded to the decision makers. Cumulative impacts are discussed in Section 5.4.3 of the EIS.
Sierra Club	The RDEIS (page 157) states “Between 2008 and 2018, total fish biomass decreased by 45% in the WHRFMA, with a variety of drivers potentially causing these declines (Foo at al. 2020). “ Comment: The State of Hawaii has a constitutional duty to protect the natural and cultural resources for future generations. Unless the No Action alternative is chosen, the state would fail to meet its public trust obligations if it were to allow continued aquarium collecting, knowing full well that historic degradation would continue to occur. The public trust doctrine has been adopted in Hawaiʻi as a "fundamental principle of constitutional law." In re Water Use Permit Applications, 94 Haw. 97, 132, 9 P.3d 409, 444 (2000).	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Sierra Club	The Hawai'i Supreme Court also adopted the precautionary principle as a corollary to the public trust, ruling that "the lack of full scientific certainty should not be a basis for postponing effective measures to prevent environmental degradation" and that "where [scientific] uncertainty exists, a trustee's duty to protect the resource mitigates in favor of choosing presumptions that also protect the resource." Id. at 154, 9 P.3d at 466 (quoting the Water Commission's decision). The court determined that "at minimum, the absence of firm scientific proof should not tie the [agency's] hands in adopting reasonable measures designed to further the public interest." Id. at 155, 9 P.3d at 467. Most recently in Ching v. Case, the Hawai'i Supreme Court reaffirmed that "[u]nder the Hawai'i Constitution, all public natural resources are held in trust by the State for the common benefit of Hawai'i's people and the generations to come." 145 Hawai'i 148, 152, 449 P.3d 1146, 1150 (2019) (emphasis added). The State of Hawaii has a public trust obligation to mitigate and/or reverse cumulative impact on public trust resources.	Your comment has been forwarded to the decision makers.
Sierra Club	The RDEIS states: "As of April 2018, all recreational permits for collection of aquarium species with fine mesh nets were voided, and no collection with fine mesh nets is currently legally allowed, pending environmental review (DAR 2019a). " Comment: Nevertheless, fine-mesh nets were and continue to be used, with limited enforcement. On and off-shore resident monitors regularly report violators of the ban, but few are caught by enforcement officers. Two that that were caught were documented to have hundreds of fish; Jason Beevers' boat was spotted within the West Hawai'i Regional Fishery Management Area by DLNR enforcement officers last August 2020 with illegal collecting gear and more than 300 fish, mostly yellow tang, found when an officer inspected the boat after it landed. Stephen Howard and Yukako Toriyama were apprehended by Division of Aquatic Resources (DAR) recovered and released 235 fish of ten different species. Most of them were yellow tangs and their total retail value was estimated at $24,730. The two were accused of committing several violations, including possessing aquarium collecting gear, an unregistered, fine-meshed lay net, and illegally collecting aquarium fish species. We understand that six of the formerly permitted collectors were cited for poaching in 2020.	Your comment has been forwarded to the decision makers. Poaching is addressed in Section 5.4.3.6 of the EIS. The Preferred Alternative included additional enforcement and compliance measures outlined in Section 3.7.2 of the RDEIS, but this section has been revised in response to comments received on the RDEIS. None of the fishers listed by the commenter would be issued permits under the Preferred Alternative (i.e., they are not included in the 7 fishers who would receive permits).
Sierra Club	Our members who monitor the collecting activity report that collectors are spotted 4-5 times a week, and if they are collecting 300-500 fish per day, they could reasonably be expected to collect/poach at least 500,000 near-shore reef fish annually.	Your comment has been forwarded to the decision makers. Poaching is addressed in Section 5.4.3.6 of the EIS. The Preferred Alternative included additional enforcement and compliance measures outlined in Section 3.7.2 of the RDEIS, but this section has been revised in response to comments received on the RDEIS.

Commentor	Comment	Response
Sierra Club	Comment: HAR 13-60.4 identified West Hawai'i Aquarium Permit Terms and Conditions by implementing the following provisions: Aquarium collectors must submit each month's daily aquarium fishing trip reports before every 10th day of the following month. According to table 4.1, barely 47 percent of permittees provided required reports, so it begs the question: how meaningful is the data if those with permits are historically non-compliant?	Your comment has been forwarded to the decision makers. As stated in the EIS, In the past, some collectors participated in a dive team. To avoid duplicate fish catch reporting, only a principal diver was required to report the catch and effort for the dive team (DAR, pers. comm., 2018). This process ensures that reported catch data are not duplicated in the State's system. However, this reporting mechanism can lead to confusion by outside observers, as the total number of permit holders is higher than the number of permit holders reporting data, giving the appearance of under reporting. Analysis by the DAR (2014a) has shown that actual underreporting of catch is small, with a 3.5% difference between the number of animals reported caught and sold in 2010 and a 0.4% difference in 2014, which likely represent live releases and mortality.
Sierra Club	Comment: The procedures outlined in Section 3.7.2 Additional Enforcement and Compliance Measures could address some of these issues. If any alternative other than the No Action alternative were selected, we would support the applicant's efforts in the RDEIS to use a triplicate certificate of origin system monitored by the DOA that traces the dealers buying the fishes and addresses the issue of poaching and possible violations of the Lacey Act.	Your comment has been forwarded to the decision makers.
Sierra Club	In spite of commenting on every aquarium collecting document offered in the past several years, Sierra Club was not a consulted party. Many of the consulted parties pointed out that the lack of support and funding have hampered DNLR- DAR's ability to fulfill its fiduciary responsibility, namely to enhance, protect, conserve, and manage Hawai'i's unique and limited resources, which are supposed to be held in public trust for the current and future generations of the people of Hawai'i nei, and visitors alike.	Your comment has been forwarded to the decision makers. Although not a designated consulted party, as the commentor points out the Sierra Club has had, and has taken, the opportunity to provide comments on the DEA, DEIS, FEIS, and RDEIS in addition to providing testimony at the May 22, 2020 BLNR hearing on the FEIS. The Sierra Club's comments have been recieved and fully considered at each stage.
Sierra Club	We contend that collectors can pursue alternate livelihoods raising aquarium fish in captivity, working in commercial aquariums, fishing for food fish, and running boat and dive tours.	Your comment has been forwarded to the decision makers.
Sierra Club	In order to protect and ensure the sustained health of the reef, traditional and customary practices, and subsistence fishing practices, Sierra Club members support the No Action Alternative.	Your comment has been forwarded to the decision makers.
Bruce Carlson, Richard Pyle, and Randall Kosaki	The West Hawai'i Aquarium Fishery RDEIS has been exhaustively researched and updated and based on the best available science, we support its findings and conclusions.	Your comment has been forwarded to the decision makers.
Bruce Carlson, Richard Pyle, and Randall Kosaki	Your decision on this EIS will be a judgement on the efficacy of the FRA management system. No amount of hyperbole, anecdotes, or obfuscation can erase a simple truth that the FRA system has resulted in a 20-year upward trend in the populations of the most-collected species of aquarium fishes. This is a "fact" and keeping this foremost in mind will place all other arguments in proper perspective.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Bruce Carlson, Richard Pyle, and Randall Kosaki	No inshore reef fishery in Hawai'i has been subjected to the level of scrutiny, research, management and debate as the West Hawai'i Aquarium Fishery. This fishery has been required to meet higher standards than all other commerical or recreational fisheries. Thousands of hours and hundreds of thousands of dollars have been spent monitoring and reporting on the fishery and in drafting this RDEIS. Ultimately, it is the comprehensive data sets gathered by DLNR/DAR, UH and NOAA biologists over the past two decades, that provide clear evidence of the sustainability of this fishery. As a result, we continue to support this fishery as sustainable in the long-term, and reject anedotal evidence, and the mis-characterization of the available data.	Your comment has been forwarded to the decision makers.
Bruce Carlson, Richard Pyle, and Randall Kosaki	We especially urge you to carefully evaluate the DAR-West Hawai'i Aquarium Project (WHAP) data, and especially to critically review the negative critique offered by Dr. Gregory Asner and his colleagues. In our opinion, their reasoning, analyses and conclusions would not withstand peer review if submitted for publication. We hasten to add that they are not able to provide any of their own publications or original field data to support their conclusions and opinions. Significantly, they fail to mention other peer-reviewed publications that reference the WHAP data and associated conclusions that the West Hawai'i Aquarium fishery is, in fact, sustainable by any standard metric. In particular, they should have noted the 2019 Report to the Legislature submitted by DLNR, with extensive data that support the fishery. Additionally, they ignore the conclusions published by Gove et al. (2019) in a NOAA publication, which states: "The total abundance of nearshore fishes has shown a positive trend in all management areas – MPAs, FRAs, and open areas – across West Hawai'i since 2003....Total abundance has increased by 28.9%, 36.0% and 34.9% in MPAs, FRAs and open areas, respectively...." Additionally, "Species richness, or the total number of species present per survey, has not changed within each management area over the last 15 years..."	Your comment has been forwarded to the decision makers.
Bruce Carlson, Richard Pyle, and Randall Kosaki	We will highlight a few of the overstatements, or erroneous conclusions reached by Asner et al. These examples should warrant a critical and skeptical review of his entire testimony:	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Bruce Carlson, Richard Pyle, and Randall Kosaki	1. Pg. 2 "For WHAP data, aquarium fish show extremely variable decreases and increases across survey years, indicating they are not necessarily stable...." a. Every fisherman and every diver who has spent any time on the ocean knows that fish populations can vary dramatically over time. For example, Hawai'i reefs in the summer of 2014 had such high levels of recruitment of many reef fish species, that scientists termed it "biblical", but in other years, recuitment can be minimal. This recruitment variability is one prime factor affecting population swings, and it is not necessarily indicative of "non-stable populations", unless viewed on an inappropriate brief time scale. What is more important are the long-term population trends, which for the most critical species in the fishery, have trended upwards over the past twenty years. This is particularly true for the two most important species: Yellow Tang and Kole which comprise over 90% of the total aquarium fish catch.	Your comment has been forwarded to the decision makers.
Bruce Carlson, Richard Pyle, and Randall Kosaki	b. By analogy, In the same way that emphasizing short-term fluctuations in carbon dioxide (CO2) levels in the atmosphere misrepresent the long-term trends of rising atmospheric CO2 and its globally important implications, framing these short-term fluctuations in reef-fish populations as indicative of undesirable consequences of the aquarium fish collecting activity misrepresent the important story told by 20 years of data, which show that the most important fish populations are increasing.	Your comment has been forwarded to the decision makers.
Bruce Carlson, Richard Pyle, and Randall Kosaki	2. Pg. 2 "...PIFSC-ESD (data), not all....species show a trajectory of increasing abundance. Of note, the two top aquarium fish species, Yellow Tang and Kole, both show decreases...between 2016 and 2019 in open collection areas...." a. Again, the 2016 to 2019 declines in some species from PIFSC-ESD (CRED) data probably represent the expected response to the massive recruitment event in 2014; a temporary boost in 2015 that was still there in 2016 but largely gone by 2019. Why was this significant biological event not mentioned as a possible or probable explanation?	Your comment has been forwarded to the decision makers.
Bruce Carlson, Richard Pyle, and Randall Kosaki	b. The WHAP data set is much more extensive spatially and temporally and offers a more robust view of population trends over two decades to evaluate population trends. The WHAP surveys are repeated several times each year (presently quarterly). Over 8,700 fish surveys have been conducted at more than two dozen sites along the coast over 20 years. By comparison, CRED data are collected only once every three years, thus obscuring seasonal and annual variability in larval recruitment and adult densities.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Bruce Carlson, Richard Pyle, and Randall Kosaki	3. Pg. 6 For five species, the proposed catch is higher than the annual catch data previously reported in the majority of the last 20 years. a. Asner et al. calculate that the potential future catch for all 7 fishers for Yellow Tang could be 200,000 and for Kole 30,000. In FY 2017, the Yellow Tang catch was somewhat higher: 265,000 but that year there were 51 licensed collectors In West Hawai'i of which 33 were very active (collecting a total of more than 10,000 fish that year). It is effectively impossible for 7 collectors to collect at close to the same rate as 33 collectors. Live fish cannot be over-collected or kept on ice. There are physical limits to how many fish one fisherman can catch, properly care for, maintain in holding tanks, and sell. In this context, we submit that the Asner calculations and conclusions are invalid.	Your comment has been forwarded to the decision makers.
Bruce Carlson, Richard Pyle, and Randall Kosaki	4. Pg. 8 Herbivores are critically important for resisting coral to algae regime shifts (Graham et al. 2015).... a. Herbivores do indeed have an important ecological role on coral reefs. But a thorough reading of Graham et al. (2015) reveals a more nuanced conclusion: "Interestingly, a relatively low biomass of herbivores (177 kg/ha) - below average values for the Indian Ocean - reduced the risk of a regime shift occurring....Our results suggest that although both (herbivory or nutrients) related to ecosystem trajectory, they are weaker and less certain predicators than structural complexity, depth, and the density of juvenile corals".	Your comment has been forwarded to the decision makers.
Bruce Carlson, Richard Pyle, and Randall Kosaki	b. Data available from the WHAP surveys indicate that Hawai'i reefs have a biomass of herbivores in excess of 250 kg/ha.	Your comment has been forwarded to the decision makers.
Bruce Carlson, Richard Pyle, and Randall Kosaki	c. NOAA IEA data indicate that herbivore biomass has not decreased since 2003 in the FRAs and open areas on West Hawai'i reefs and has significantly increased in the more heavily protected MPAs (+30.8%).	Your comment has been forwarded to the decision makers.
Bruce Carlson, Richard Pyle, and Randall Kosaki	d. Tissot and Hallacher (2003) specifically studied Hawai'i reefs where intensive fish collecting had occurred and found neither any significant increase in macro-algae nor any significant coral damage (as reported in the RDEIS).	Your comment has been forwarded to the decision makers.
Bruce Carlson, Richard Pyle, and Randall Kosaki	e. The take of herbivorous species by aquarium collectors is only a fraction of the total herbivorous fish populations on these reefs, which are dominated (in terms of herbivorous activity) by many other species of acanthurids (surgeonfishes) not taken for the aquarium trade, as well as scarids (parrotfishes) pomacentrids (damselfishes), and herbivorous invertebrates. Indeed the impact of nearshore food fisheries on the herbivory of these reefs (and potential consequences for corals) most likely dwarfs that of the aquarium collectors.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Bruce Carlson, Richard Pyle, and Randall Kosaki	5. Pg. 9 ...targeting mostly immature fish has huge implications for sustainable useage of the resource. Protecting immature fish is key to keeping any fishery sustainable in the long term where catching juvenile fish removes them and future offspring a. This statement is fundamentally incorrect. Protecting the adult brood stock is the key to keeping the fishery sustainable. Unlike most terrestrial vertebrates, fishes such as the Yellow Tang can produce up to a million eggs per female per year. Fish fecundity increases exponentially with size, thus a fishery that explicitly avoids large reproductively mature individuals maintains its unfished reproductive output. For example, a population with millions of adult Yellow Tang will produce millions2 of eggs, larvae and eventually new recruits. With 35% of the coast protected, and with the adult brood-stock of no interest to collectors, the population can renew itself despite the typical loss most of the offspring due to predation and other natural causes. The population trends presented in the DLNR 2019 report clearly show that this model is working in practice.	Your comment has been forwarded to the decision makers.
Bruce Carlson, Richard Pyle, and Randall Kosaki	6. Pg. 9 ...the RDEIS fails to acknowledge the primary finding of Tissot and Hallacher (2003): that seven of the ten aquarium fish species surveyed were significantly reduced by collecting. a. This statement is misleading. Tissot and Hallacher conducted their research BEFORE the FRA management plan was instituted. They did in fact report a “significant difference” in populations where fishing occurs versus protected areas. However, “significant” in this context means “statistically significant” and is not a statement that the populations were in significant peril. Since then an extensive network of no-aquarium-collecting areas comprising 35% of the coast has been established and the fish populations have been closely monitored by DAR biologists and associated research divers (over 80 of them) . The long-term trends for the most heavily collected species show increasing populations, even in areas where collecting is permitted. The RDEIS is not reporting only partial information, as claimed by Asner; data collected prior to the implementation of the management plan have historical value but are largely irrelevant to the current discussion.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Bruce Carlson, Richard Pyle, and Randall Kosaki	Our motivation to provide this testimony is to defend the use of robust, data-driven science in determining policy. Science within the U.S. has often been neglected, mis-represented, or distorted to defend political agendas. In our criticisms, we want to be clear that we do not accuse Asner et al. of intentionally promulgating distortions; we are providing a professional review of his comments and disagree with his conclusions. We want to make sure that the science and the data are interpreted appropriately and accurately. Each of us has multiple decades of experience studying reef fishes in Hawaiʻi in general, and the impacts of the aquarium fishery on populations of those reef fishes in particular. We hope that our insights gained over these decades is taken into account when you make policy and management decisions based on the best and most robust data and scientific interpretations.	Your comment has been forwarded to the decision makers.
Bruce Carlson, Richard Pyle, and Randall Kosaki	In a perfect world, many of us would prefer to leave all the fishes in the ocean. This is especially true for the larger and demonstrably overfished populations consumed for food. But not everyone can enjoy the ocean and enjoy viewing marine life underwater. Aquariums do have an important and often inspirational purpose both for public facilities, and for hobbyists. Many researchers and conservationists (ourselves included) started our interest in marine biology with a home aquarium. The arguments against this fishery are emotional, anecdotal but misleadingly powerful. If it weren't for the DLNR-WHAP data, probably none of us could support the fishery because we would not know any better. But the DLNR-WHAP data do exist, and they constitute one of the best data sets for any inshore coral reef fishery in the world. As a consequence, the aquarium fishery in Hawaiʻi is widely regarded as one of the best-managed coral reef fisheries in the world. If BLNR dismisses these robust and important data based on misleading arguments and anecdotal comments, why would any researcher ever want to devote years of hard work gathering data on any other fishery in Hawaiʻi?	Your comment has been forwarded to the decision makers.
Bruce Carlson, Richard Pyle, and Randall Kosaki	The West Hawaiʻi Aquarium Fishery comprehensive management plan is recognized as a model to emulate for sustainable management of coral reef fisheries. Rejecting this RDEIS and permanently shutting down the West Hawaiʻi Aquarium Fishery would set a terrible precedent by effectively announcing that fishery management areas (FRAs) are a failure, when in fact, they have been a remarkable success story.	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	Aloha. I am submitting the following comments in strong support of the Applicant's action to allow continued commercial aquarium collection in the West Hawai'i Regional FMA (WHRFMA). The following points are from the DLNR/DAR Nov. 2019 Report to the Thirtieth Legislature 2020 Regular Session - Findings and Recommendations of Effectiveness of the West Hawai'i Regional Fishery Management Area (WHRFMA).	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	In 1998, The West Hawaiʻi Regional Fishery Management Area (WHRFMA), which spans the entire coastline of West Hawaiʻi, was created by Legislative Act 306 (1998) largely in response to long-standing and widespread conflict surrounding commercial aquarium collecting.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
William J. Walsh PhD.	To accomplish the mandates of Act 306, a community advisory group, the West Hawai'i Fishery Council (WHFC) was convened by the Division of Aquatic Resources (DAR) in 1998. The first accomplishment of the WHFC was the designation of a network of nine Fish Replenishment Areas (FRAs), in which aquarium collecting was prohibited. The FRAs, along with other existing aquarium protected areas, comprise 35% of the coastline.	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	The Hawai'i marine aquarium fishery has been the most economically valuable commercial inshore fishery in the State with Fiscal Year 2017 average reported landings greater than $2.2 million.	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	In West Hawai'i, the aquarium fishery has undergone substantial and sustained expansion over the years. Total catch and market value increased by 29% and 143% respectively since FY 2000. Approximately 26% of both the total number of aquarium fish caught in the State and value of the catch was from West Hawai'i in FY 2017.	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	Concerns over continued expansion of the West Hawai'i aquarium fishery and over-harvesting in the open areas prompted DAR in 2013 to establish a 'White List' of 40 species which can be taken by aquarium fishers. All other species of fish and invertebrates have been off-limits to aquarium collectors in West Hawai'i since that time.	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	Of the 40 collected aquarium species taken prior to the closure of the fishery, Yellow Tang comprise 82% and Kole 9% of the total catch (FY 2017).	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	DAR has been monitoring West Hawai'i reefs and populations of reef fishes for over 20 years. Over this period, 82 survey divers have conducted over 8,700 underwater transects at more than two dozen sites along the coast.	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	The FRA network has successfully driven an increase in the population of Yellow Tang. In the 20 years after the closure, the population of Yellow Tang has increased 165% in the FRAs, 74% in existing Marine Protected Areas (MPAs) and 101% in the Open Areas.	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	Overall Yellow Tang abundance in the 30'-60' depth range over the entire West Hawai'i coast has increased by over 3.4 million fish (150%) from 1999/2000 to 2017/2018 to an estimated population of 5.7 million fish.	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	A 2009 study of adult Yellow Tang in their shallow water habitats (10'-20' depths) found no significant differences in the abundance of adult Yellow Tang in open vs. closed areas.	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	Yellow Tang populations at two of three long-term monitoring sites in South Kohala (Puakō) and South Kona (Ke'ei) have recovered to levels found over three decades ago, prior to the expansion of commercial aquarium collecting in West Hawai'i.	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	Comparative surveys utilizing DAR and NOAA data subsequent to FRA establishment, indicate Yellow Tang are substantially more abundant in West Hawai'i over most size ranges than in any of the other islands in the Main Hawaiian Islands and the Northwestern Hawaiian Islands.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
William J. Walsh PhD.	The FRAs have also been very successful in increasing Kole populations. In the 20 years after FRA closures, Kole populations have increased 85% in the FRAs, 120% in the MPAs and 97% in the Open Areas.	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	Overall Kole abundance in the 30'-60' depth range over the entire West Hawai'i coast increased by almost 5.2 million fish (118%) since FRA establishment on 31 December 1999, with a current estimated population of about 9.6 million fish.	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	As with Yellow Tang, DAR and NOAA data indicate Kole are substantially more abundant in West Hawai'i over most size ranges than in any of the other islands in the Main Hawaiian Islands or the Northwestern Hawaiian Islands	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	Six of seven of the top 3-10 collected species had long-term population increases in one or more of themanagement areas since FRA establishment (1999/2000). The notable exception was Achilles Tang (Acanthurus achilles) which declined in all areas, significantly so in Open Areas and FRAs.	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	Achilles Tang is the fourth most collected species in the West Hawai'i aquarium fishery although relative to Yellow Tang and Kole, the numbers collected are low, representing only 1.7% of the total FY 2017 catch.	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	Commercial aquarium landings of Achilles Tang have been declining in West Hawai'i over the past two decades. This has occurred in association with a 192% increase in the ex-vessel value of the fish since 2008, suggestive of declining availability (i.e. abundance).	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	DAR Shallow Water Resource Fish (SWRF) surveys indicate a significant (90%) decrease in Achilles Tang biomass in their primary adult habitat since 2008 when the surveys were first conducted. Achilles Tang were observed on 73% of transects in 2008 but only on 38% in 2018.	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	Given the overall evidence for a marked decline in the population of Achilles Tang in West Hawai'i, a reduction in the aquarium bag limit or a moratorium on aquarium collecting for this species, in conjunction with a conservative bag limit for other fishers should be considered and implemented.	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	For most of the species on the White List, collecting impact, in terms of the estimated percentage of the Open Area population being removed annually by aquarium collectors, is relatively low with nine species having single digit percent catch and 21 species having catch values of <1% of the total estimated population in the Open Areas (30'-60' depth range).	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	Benthic monitoring at West Hawai'i sites indicates that commercial aquarium collecting is not having a measurable negative impact on percent coral cover or change in coral cover over time.	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	In West Hawai'i, the aquarium fishery took 1.8X the number of total reef fishes taken by recreational and other commercial fishers combined. However, if Yellow Tang, which is primarily harvested at small sizes and not targeted by other fishers, is excluded, the recreational and commercial fisheries took 3X the total number of reef fishes caught by aquarium collectors.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
William J. Walsh PhD.	The effectiveness of the West Hawai'i FRAs for aquarium fish suggests it would be prudent to establish MPAs for other resource species throughout Hawai'i as a precautionary measure against overfishing and for restoration of marine resources. Currently, less than 1% of nearshore areas in the Main Hawaiian Islands are fully protected by MPAs.	Your comment has been forwarded to the decision makers.
William J. Walsh PhD.	The scientific findings of over 20 years of coral reef monitoring clearly show that the existing network of Fish Replenishment Areas (FRAs) has led to the sustainable management of the West Hawai'i aquarium fishery and resulted in substantial population increases of most of the most heavily collected species. The Revised Draft EIS proposes substantial reductions in overall catch both in terms of numbers of fish and the species which can be collected. Thus, there is strong scientific support for continuance of the proposed scaled down WHRMA aquarium fishery.	Your comment has been forwarded to the decision makers.
Marie Aguilar	I am a long-time resident of Hawai`i Island and know first-hand the conditions of the impact of fish collection on my island. First, the seriousness of the loss of our coral on the Hawai`i coasts is listed as severe and may not recover anytime soon. The State of Hawai`i has a responsibility to protect Hawai`i's natural resources. The tropical fish of Hawai`i are declining year after year. and I have seen the decline from 1988 through 2021. Yellow tang swam along the Kailua Pier and their visual presences created the name "Gold Coast" of the Big Island. The effects of environmental conditions have to be taken into consideration for the future of maintaining the population of our tropical fish populations. The recent Revised Draft Environmental Impact Statement from Pet Industry Join Advisory Council continues to be flawed. First, there is an impact of a collection of tropical fish collecting on the population. The population of reef fish is declining due to serious ocean warming waters which affect coral life. The damage is severe to our coral from the warm waters several summers and needs to replenish or recover if it is possible. Our coral reefs live symbiotically with tropical fish to flourish and nurture.	Your comment has been forwarded to the decision makers. Collection under the Preferred Alternative would be limited to the 8 species on the Revised White List, all of which have had stable or increasing populations in the WHRFMA under historic aquarium collection.
Marie Aguilar	The Supreme Court in 2017 held that collection without environment review violates the Act, and DLNR later ordered to cease issuing further aquarium collection permits until the environmental effects of aquarium collection are fully and publicly vetted through the HEPA process. Previously the heaviest impact to our fish collection is the lack of holding the permit holders with a limit to their taking aquarium fish. Now the new revised EIS states the eight species collected per month. The eight species being requested for collection are extremely high.	Your comment has been forwarded to the decision makers. Collection under the Preferred Alternative would be limited to the 8 species on the Revised White List, all of which have had stable or increasing populations in the WHRFMA under historic aquarium collection. All 8 species on the Revised White List would have individual catch quotas, placing an upper limit on the number which could be collected within any given year. Existing size and bag limits would also remain in effect, as would existing MPAs and FRAs.

Commentor	Comment	Response
Marie Aguilar	The collection of 200,000 yellow tangs can not be allowed through seven permittees, it does not access those that died in transport. If each of these operators owns two boats and has staff using that license, they could collect in South Kau and North Kohala each day. The fish population could not possibly be restored monthly while being collected each day, weekends included. There is no expiration on these permits and could run collectively year after year.	Your comment has been forwarded to the decision makers. Aquarium permits are valid for a period of 1 year. The DNLR has the responsibility to review each permit each year before renewing the permit and can choose to not issue a permit or change the conditions of a permit at that time. In addition, post-collection mortality is addressed in Section 5.4.2 of the EIS.
Marie Aguilar	Today, the same permit holders want to be able to take aquarium fish with limits, this is not acceptable for our ecosystem. State of Hawai`i, DLNR does not have the staff to monitor these seven permits and get actual limits accounted for each day and monthly. This most definitely will not support what the Supreme Court ruled. There is no management of the fish collection limits demonstrated in this summited EIS. Self-monitoring is not acceptable.	Your comment has been forwarded to the decision makers. The Preferred Alternative included additional enforcement and compliance measures outlined in Section 3.7.2 of the RDEIS, but this section has been revised in response to comments received on the RDEIS.
Marie Aguilar	The most startling outcome of this Revised Draft Environment Impact Statement written by the Pet Industry Joint Advisory Council is this Council has a conflict of interest in presenting a proposal for the whole benefit for the retailing of our reef fish. They support aquarium fish pet stores throughout the mainland. Their impact statement is false, their statements do not provide the actual outcomes. of the fish population from fish collecting. They have deleted facts. The collection of Hawai`i's natural resources cannot be open for sale to the mainland aquarium trade. The going prices for these fish start at $60.00 for a yellow tang. What gain is Hawai`i's residents gaining for allowing the collection of their natural resources? No revenue can replace our ocean ecology. Do not accept this bargain hunter's profitable business for mainland commerce. PIJAC's study does not support factual counts of tropical fish in WHRFD.	Your comment has been forwarded to the decision makers. Population estimates from the DAR and NOAA were provided to the Applicant, and not calculated by the Applicant.
Marie Aguilar	In their Revised EIS, there is no mention of who the seven (7) permit holders are and who they represent. Are these permit holders, actual residents of Hawai`i? Can we seriously trust the permittees who have access to our reef fish for three hundred sixty- five days? There are weekends that DLNR would have issues with patrolling all of the west coasts of Hawai`i Island. Is DLNR requiring bonds for each of the permit holders? Our fish population will not recover. Recently, the County of Hawai`i and Mayor Roth presented a Sustainability Summit. The Summit successfully showed community leaders what sustainability means in the scope of all of our resources. Among our resources, the County of Hawai`i presented Waste Management, Sustainable Tourism, Technology, Preserving the Environment, Energy, Health Care, Education, Affordable Housing, Economy, Transportation, Food Security, Aloha + Challenge.	Your comment has been forwarded to the decision makers. The following language has been added to the revised FEIS: The seven permittees covered by this Revised FEIS have verified that they are each legally qualified to apply for, and hold, an Aquarium Fishing Permit, Commercial Marine License, and West Hawai'i Aquarium Permit. The seven permittees covered by this Revised FEIS will file individual permit applications with Department of Land and Natural Resources (DLNR) in parallel with the submission of this Revised FEIS to Office of Environmental Quality Control (OEQC) and DLNR. DLNR will review such applications and take action upon them after further consideration of the Revised FEIS. The Preferred Alternative included additional enforcement and compliance measures outlined in Section 3.7.2 of the RDEIS, but this section has been revised in response to comments received on the RDEIS.

Commentor	Comment	Response
Marie Aguilar	Greg Asner, scientist of Global Institute of Sustainability Airborne Observatory (University of Arizona State) understands conservationism through his scientific approach to mapping the coral reefs of the Hawaiian Islands. Through Asner Labs, using Global Airborne Observatory technology to generate a mapping of the coral health, beginning in mid- 2019. This technology and its mapping will save our coral reefs in the future. The Hawaiian Islands are globally important case-in-point. In less than fifty years, Hawai`i's unique and highly endemic coral reefs have undergone alarming losses in coral extent and health as well as in fish populations. The Hawaiian Islands are now in a state of extremely variable reef conditions driven by a complex mosaic of coastal development, overfishing, and ocean warming. In response to these alarming losses, Hawai`i Governor David Ige announced a new effort in 2016 to manage and conserve at least 30% of Hawaii's reefs by 2030, known as the Marine 30x30 Initiative. Currently, Hawaii's reefs remain unmanaged. He is based here in Hawai`i, and showed maps of depletion of the tropical fish using his satellite imagery showing ten years of depleted sea life on the west coast of the Island of Hawai`i. Those images do not lie, they show the loss of our natural resources – tropical fish and the ocean coral reefs. Sustainability does not include fish collection. The State of Hawai`i through the direction of Governor David Ige has granted the Marine 30x30 Initiative in 2016, and it is the responsibility of DLNR to follow the protocol of this important mapping and study for our coral reefs and its tropical fish population. Hawai`i is sustaining its resources and must continue the protection of its marine life.	Your comment has been forwarded to the decision makers.
Marie Aguilar	Each member of our County government knows the importance of Sustainability in each area of government. Our island and our ocean must be protected by the State of Hawai`i and the County of Hawai`i. Please reject this EIS for Pet Industry Joint Advisory Council. Their trade is not needed. Tropical fish are now being raised at the State of Hawai`i -Natural Energy Labs for that purpose. Their breeding system is working, so please leave our natural resources alone. It is your responsibility.	Your comment has been forwarded to the decision makers.
Marie Aguilar	I oppose any fish collections on the Island of Hawai`i, specifically the West Hawai`i Regional Fish Management (west coast) especially as the Revised EIS Draft indicates from Ka`u to Kohala. Our island depends on economically sustainable tourism where tour operators bring visitors to snorkel, dive and swim and view our pristine waters. We cannot have seven permit holders taking our natural resources for their economic benefit. It is true, third world countries protect the collection of their reef fish, and Hawai`i must continue the restriction on any fish collection for years to come.	Your comment has been forwarded to the decision makers. As stated in the EIS, Hawai'i's tourism industry achieved new records in total visitor spending and visitor arrivals in 2017, marking the sixth consecutive year of record growth in both categories. This occurred while commercial aquarium collection was also occurring.

Commentor	Comment	Response
Marie Aguilar	The Board of Land and Natural Resources voted anonymously for the dis-allowance of the previous Draft EIS, and if they voted again, they would vote the same. Not much has changed, illegal collectors have been caught red-handed in collecting our tropical fish and tried in the courts. Penalties were severe in some cases, however, were they ever collected and paid to the State of Hawai`i? The fish collector applicants can find another form of economic standing, not at the cost of our resources that are currently being protected by our Governor. Hawai`i residents, its sea life tour boat owners, and operators depend on these natural resources. They protect our environment and are invested in our community. Most of our businesses on Hawai`i Island flourish with tourism.	Your comment has been forwarded to the decision makers.
Marie Aguilar	Our economy is semi-dependent on eco-tourism, sustainability tourism, and agri-tourism. We have learned a hard lesson with the COVID 19 Pandemic. Our islands flourish with visitors who support our state. These visitors support our economy, enjoying our environmental friendliness, and expect us to care for our resources. Hawai`i's economy does depend on tourism. Aloha + challenge remains a part of our Hawaiian lifestyle.	Your comment has been forwarded to the decision makers. As stated in the EIS, Hawaiʻi's tourism industry achieved new records in total visitor spending and visitor arrivals in 2017, marking the sixth consecutive year of record growth in both categories. This occurred while commercial aquarium collection was also occurring.
Marie Aguilar	Additionally, presenting the Native Hawaiian culture in fishing, fish netting, and its marine tools was educational to the reader, however, there is no similar correlation to the Revised EIS to those collecting tropical fish. Native Hawaiians were fishing, fish netting fish for human consumption for their families. They are living sustainably, providing for their families. Mahalo	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Department of Land & Natural Resources, Division of Aquatic Resources	The Department of Land & Natural Resources (DLNR), Division of Aquatic Resources (DAR) submits the following comments on the Revised Draft Environmental Impact Statement (RDEIS) on the Issuance of Commercial Aquarium Permits and Commercial Marine Licenses for the West Hawaiʻi Regional Fishery Management Area. DAR has critically examined the RDEIS submitted by Pet Industry Joint Advisory Council (PIJAC). Our goal was to assess whether or not it adequately discloses impacts associated with the proposed issuance of 7 aquarium fishing permits for the West Hawaiʻi Regional Fishery Management Area (WHRFMA). For this effort, we began with the points raised by the Board of Land and Natural Resources (BLNR) in their Findings and Reasons for Non Acceptance of Final Environmental Impact Statement (FEIS) Regarding Proposed Issuance of Commercial Aquarium Permits, Commercial Marine Licenses, and West Hawaiʻi Aquarium Permits for the WHRFMA, issued May 30, 2020. We evaluate whether the RDEIS adequately addresses these concerns. Many of the issues brought up by the BLNR have been addressed in the RDEIS by the addition of a new preferred alternative that incorporates individual catch quotas and a reduced white list. These two conditions were designed to clarify questions surrounding estimated future take and mitigate concerns regarding collection of species in decline or those with little data. Here, we provide comments on how the RDEIS addresses each of the points raised by the BLNR.	Your comment has been forwarded to the decision makers.
Department of Land & Natural Resources, Division of Aquatic Resources	1. In order to properly assess the likely impact of the proposed take of the aquarium fish, the FEIS should contain a reasonably reliable estimate of the amount of future take. • This point has been addressed via the suggestion of catch quotas for each species. The applicant now discusses impacts in relation to the maximum allowable catch under this quota system.	Your comment has been forwarded to the decision makers.
Department of Land & Natural Resources, Division of Aquatic Resources	2. Except for the pākuʻikuʻi, or Achilles tang, the FEIS does not contain any daily bag limits on any of the "White List" species which the fishers are allowed to take, and there are no annual limits on the take of any species except that the total take of pākuʻikuʻi would be limited by the fact that only ten permits with a daily limit of five each would be allowed under the proposed action. In addition, there is no scientific basis provided for reducing daily take of pākuʻikuʻi from ten to five per permit, nor any analysis of the impact of that level of take on the population of pākuʻikuʻi. • This point is also addressed by the creation of species-specific catch quotas. There are now annual limits for each species on a per-fisher basis. The issue regarding pākuʻikuʻi is addressed via the reduced white list of 8 species. Under this proposed alternative, no take of pākuʻikuʻi would be allowed.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Department of Land & Natural Resources, Division of Aquatic Resources	3. The existing regulations of the WHRFMA do not contain any daily or annual bag limits other than for the pāku'iku'i, a "slot limit" for yellow tang, and a limit on kole over 4" long. To project how many fish are likely to be taken, the FEIS relies completely on the historical catch records of these ten fishers for the forty "White List" species. See Tables 5-2 and 5-11. The FEIS concludes that 160,832 fish would be taken annually, based on the maximum number taken by the ten permittees in any year, during the 2000-2017 period. See §5.4.1.5. • The new preferred alternative that includes catch quotas addresses this by setting a cap on allowable take in a given year.	Your comment has been forwarded to the decision makers.
Department of Land & Natural Resources, Division of Aquatic Resources	4. It appears that no more than 8 of the 10 fishers were active in any previous year. See Table 4-2. It seems likely that all ten fishers will be active, given they had sufficient interest in the permits to fund the EIS, and that they will have a monopoly on the use of fine-mesh nets to collect fish in the WHRFMA. • This point was determined to be arbitrary and capricious by the Office of Environmental Quality Control.	Your comment has been forwarded to the decision makers.
Department of Land & Natural Resources, Division of Aquatic Resources	5. The FEIS has no information about the level of effort of these 10 fishers in prior years, i.e. whether they collected 100, 200, or 300 days a year, for example, and the amount of time spent collecting. It is possible that they could significantly increase their collection efforts and total take. • This point is addressed via the creation of individual catch quotas. Under this alternative, fishers would be limited to their yearly quota for each species regardless of their level of effort.	Your comment has been forwarded to the decision makers.
Department of Land & Natural Resources, Division of Aquatic Resources	6. The fishers could also or alternatively change what species they target for collection and increase the impact on some species. • The yearly quota system proposed sets a per-fisher limit on each species. Under this system, a fisher changing which species they target would not alter the impact disclosed in section 5.4.1.7 of the RDEIS.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Department of Land & Natural Resources, Division of Aquatic Resources	7. The data in the FEIS show that these ten fishers take some species at a very different rate than the fishery as a whole. For example, although the percentage taken of all species by the ten in the WHRFMA varies from a low of 7.0% in FY2000 (when only two were active) to 46.4% in FY2017 (Table 5-2), their percentage of take of individual species, at least in certain years, has been much higher. Table 5-11 gives the maximum catch in any one year for each of the "White List" species, and the maximum catch in any one year by the ten. The ten fishers took 83.7% of the lei triggerfish (252/301), 95.5% of the milletseed butterfly fish (402/421), and 89.2% of the Fisher's angelfish (257/288), and 54.6% of the kole (23,014/42,122.) On the other hand, they took only 9.1% of the ornate wrasse (1130/12,445). This demonstrates that collectors can, and do, selectively target some species more than others. (It is not clear whether the maximum year given for all collectors is the same year as that given for the maximum by the ten fishers. The basic point made here is valid in either case, however.) • The yearly quota system proposed sets a per-fisher limit on each species. Under this system, a fisher changing which species they target would not alter the impact disclosed in section 5.4.1.7 of the RDEIS.	Your comment has been forwarded to the decision makers.
Department of Land & Natural Resources, Division of Aquatic Resources	8. In order to assess the likely impact of the take, the FEIS should adequately analyze the sustainable level of take. The FEIS relies on Ochavillo and Hodgson (2006) for the proposition that 5-25% of a population is a sustainable level for annual take. The FEIS has an inadequate justification for the reliance on this publication as the best available science. The FEIS does not provide data for nor statistically analyze the sustainability of that level of take for each type of fish, given each fish species' life span, population size, reproductivity rates and age at first reproduction. • In comparison to the 2020 FEIS, the RDEIS relies more heavily on population trend data to determine sustainability of take, particularly in their criteria for species inclusion in the revised white list. There remains, however, a heavy emphasis on the Ochavillo and Hodgson (2006) paper to justify the proposed level of take. There are several issues with the use of this document in the RDEIS including the lack of peer review, unclear sampling and analysis protocols, and the study location (Philippines). Further, this document is specifically looking at total allowable catch, rather than catch from a single fishery. Therefore, even if take by the aquarium fishery is below the "sustainable level", a species could still be in decline due to the combined effect of all types of fishing. A better approach for this RDEIS would be to assess sustainability by utilizing trend data and simply report the proposed take as a percentage of population estimates without suggesting that this percentage is sustainable based on Ochavillo and Hodgson (2006).	Your comment has been forwarded to the decision makers. The Preferred Alternative is limited to species which have shown increasing or stable population trends, thereby using population trend data as the measure of sustainability, rather than the 5-25% range; therefore, the concern over the use of Ochavillo and Hodgson (2006) is moot as the RFEIS does not rely on that. Language has been added to the FEIS to explain that the population trend data are now the primary factor used to determine sustainability for the Preferred Alternative; the Ochavillo and Hodgson paper is still cited, but caveats have been added to the text.

Commentor	Comment	Response
Department of Land & Natural Resources, Division of Aquatic Resources	9. In §5.4.1.5, the FEIS uses Table 5-11 to compare the take of various species to the CREP population estimates, to show that they are well below the claimed 5-25% sustainable level. In Table 4-5, however, the harvest/population ratios of four or five species (depending on the year) in the West Hawai'i open areas at 30'-60' depth exceeded 5% for several species, and are as high as 39.67% for the paku'iku'i in 2017-2018. The West Hawai'i open area population estimates may be more relevant than the island-wide CREP data. • The RDEIS utilizes the PIFSC-ESD (formerly CREP) dataset to give a population estimate limited to the WHRFMA, which is more applicable than the previous island-wide estimates given in the 2020 FEIS. The applicant also includes estimates from DAR Kona's West Hawai'i Aquarium Project data for open areas as well as throughout the WHRFMA. • The revised white list in the preferred alternative no longer includes paku'iku'i.	Your comment has been forwarded to the decision makers.
Department of Land & Natural Resources, Division of Aquatic Resources	10. The FEIS has an inadequate discussion of the role of herbivores. Many of the "White List" species are herbivores. • The applicant has revised their section on impacts to biological resources to include a discussion on the role of herbivory. While this section does state the importance of herbivores to coral reef systems, the authors conflate ideas of resilience and recovery, indicating that there is "conflicting data on the role of herbivores on reef resiliency". While there is less evidence for the role of herbivores in allowing a reef to fully recover to its precise original state, there is ample support for their role in creating a reef system that is resilient to perturbation.	Your comment has been forwarded to the decision makers. The text has been edited to clarify that the data are conflicting on recovery, not resilience.
Department of Land & Natural Resources, Division of Aquatic Resources	11. The FEIS does not adequately discuss relevant negative findings, for example, the reduced numbers of aquarium fish at collection sites found by Tissot and Hallacher (2003). The FEIS need not agree or disprove the negative findings, but it should discuss them. • This point was determined to be arbitrary and capricious by the Office of Environmental Quality Control.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Department of Land & Natural Resources, Division of Aquatic Resources	12. The extreme threat of climate change on our reefs warrants extreme caution in reviewing activities that may affect them. The FEIS should further discuss potential effects of present and future levels of climate change including ocean warming, ocean acidification, coral bleaching, extreme storms, and resulting reef destruction and algae growth, and the potential for mitigating harm (i.e. further regulation) if the proposed fishery has unanticipated or greater negative effects with climate change. • The RDEIS includes a more in-depth discussion on the effects of climate change on coral reefs as well as an overview of the Coral Bleaching Recovery Plan developed by DAR in 2017. Similar to the discussion on herbivores, the applicant suggests that "protection of herbivores is unlikely to improve coral reef resilience to climate change" and that "current fishing pressure only slightly affects herbivorous fish communities". These statements are based on a study in New Caledonia (Carassou et al., 2013) and are not representative of West Hawai'i's ecosystem, fisheries, and management regime. While the section does briefly discuss unanticipated or greater negative effects in the light of climate change, there is no mention of options for mitigating harm via additional regulations in this section, as requested by the BLNR. We suggest including language found elsewhere in the RDEIS that states that, as aquarium permits come up for renewal each year, DLNR can evaluate whether there are significant new circumstances or information relevant to environmental concerns and bearing on the commercial aquarium fishery or its impacts requiring further mitigation measures or supplemental HEPA review.	Your comment has been forwarded to the decision makers. As suggested, language has been added to Section 5.4.3.7 stating "As Aquarium Permits for the 7 fishers who would be issued Aquarium Permits under the Proposed Action come up for renewal each year, DLNR should evaluate whether there are significant new circumstances or information relevant to environmental concerns and bearing on the commercial aquarium fishery or its impacts requiring a supplemental HEPA review (e.g., changing climate)."
Department of Land & Natural Resources, Division of Aquatic Resources	13. The FEIS failed to sufficiently consider cultural impacts. The FEIS improperly concluded that the impacts to cultural resources under any of the proposed alternatives would be less than significant based on the flawed premise that cultural impacts would only occur if the proposed action would cause a significant decline in the population of a White List Species considered to be a cultural resource. A number of testimonies expressed misgivings from a cultural standpoint with the proposed activity itself, regardless of impact on resources, and this was not adequately considered in concluding no significant impact. • This point is primarily addressed by the removal of statements of significance regarding cultural impacts. The applicant also notes that some interviewees stated that they view any collection for aquarium purposes as contrary to their cultural practices. The RDEIS then concludes that all six action alternatives may impact cultural practices.	Your comment has been forwarded to the decision makers.
Department of Land & Natural Resources, Division of Aquatic Resources	14. The FEIS does not adequately discuss the effect of illegal aquarium fishing on the numbers of projected sustainable take of fish species. • This point was determined to be arbitrary and capricious by the Office of Environmental Quality Control.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	For the Fishes, Center for Biological Diversity, The Humane Society of the United States, and the other undersigned individuals and organizations (collectively, "Commenters"), are conservation and animal protection organizations and individuals with strong interests in preserving the State of Hawaiʻi's natural resources and protecting its delicate coral reefs. Commenters submit these comments on the Pet Industry Joint Advisory Council's (PIJAC's, or "Applicant's") Revised Draft Environmental Impact Statement (RDEIS) purporting to analyze the environmental impacts of commercial aquarium fish collection by 7 permittees in the West Hawaiʻi Regional Fishery Management Area (WHRFMA).1	Your comment has been forwarded to the decision makers.
For the Fishes	Under the Hawaiʻi Environmental Policy Act (HEPA, Haw. Rev. Chapter 343) and its implementing regulations, the RDEIS was required to fully analyze the environmental impacts of commercial aquarium collection in the WHRFMA and specifically address the significance criteria in HAR § 11-200-12, including, but not limited to: • Involving an irrevocable commitment to loss or destruction of any natural or cultural resource; • Curtailing the range of beneficial uses of the environment; • Conflicting with the state's long-term environmental policies or goals and guidelines as expressed in Chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders; • Substantially affecting the economic or social welfare of the community or State; • Involving a substantial degradation of environmental quality; • Cumulatively has considerable effect upon the environment or involves a commitment for larger actions; • Substantially affects a rare, threatened, or endangered species, or its habitat; • Affects or is likely to suffer damage by the activity/activities being located in an environmentally sensitive area such as a beach, erosion-prone area or coastal waters.	Your comment has been forwarded to the decision makers.
For the Fishes	To this end, we expected the Applicant to comply with the requirement "to develop a fully acceptable draft EIS prior to the time the draft EIS is filed with the office, through a full and complete consultation process, and shall not rely solely upon the review process to expose environmental concerns."2 However, as with the prior iterations of this document, this RDEIS is fully unacceptable because it remains legally inadequate, despite the Applicant having taken steps toward a valid EIS by proposing limits on take.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	As we wrote in our consultation letter, our primary expectation was that the Applicant would stop using the erroneous methods and false characterizations which have dominated the previous process and which led to an entirely inaccurate impact analyses and conclusions. That expectation was based on the requirement for the RDEIS to accurately and adequately evaluate the HEPA significance criteria, to disclose any and all effects (beneficial and adverse) to biological, socioeconomic, and cultural resources and traditional cultural practices, stemming from the proposed alternatives, and, to propose mitigation measures to eliminate, reduce, and rectify those impacts, as set forth in HAR § 11-200-17.	Your comment has been forwarded to the decision makers.
For the Fishes	The inaccurate and inadequate impact analyses contained within this RDEIS render it fatally flawed because they lead to patently false conclusions that the Applicant's actions will not result in substantial declines in fish abundance, and that their actions do not involve an irrevocable commitment, loss, or destruction of natural or cultural resources.3 Not surprisingly, by minimizing the effects of the Applicant's actions on impacted fish species and assemblages, these inaccurate analyses skew toward a favorable outcome for the industry.	Your comment has been forwarded to the decision makers. The Preferred Alternative is limited to species which have shown increasing or stable population trends, thereby using population trend data collected and analyzed by the DAR as the measure of sustainability.
For the Fishes	DLNR has the authority to issue permits for the taking of fish and other aquatic life for aquarium purposes.4 While these permits are limited in duration to one year, neither the aquarium collection statute nor DLNR places any limits on the number of animals that can be captured per commercial permit, nor on the number of permits the Agency issues.5 In fact, prior to court mandated compliance with HEPA, DLNR automatically granted every commercial aquarium permit application and every commercial marine license, and allowed the collection of unlimited numbers of animals under those permits.6 DLNR also automatically granted every recreational permit application, which effectively allowed for unlimited recreational collection of nearly 2,000 fish per year per collector.7 Furthermore, while commercial collectors are required to report their collections (but in practice, do so inaccurately), there is no similar requirement for recreational permits.8 Therefore, there are no definitive data on how many of each type of fish or other aquatic animal have been taken from the State's delicate coral reef ecosystem each year, nor on what level of take would be sustainable.	Your comment has been forwarded to the decision makers. The Preferred Alternative limits the number of permits to 7, reduces the White List to 8 species, and includes annual catch limits for those 8 species. It is assumed that the DLNR would implement this as a permit condition, which the DLNR has the authority to do. Additional enforcement and compliance measures were included in the Preferred Alternative and outlined in Section 3.7.2. The Action analyzed in the EIS does not include recreational permits. However, recreational permits are discussed as a cumulative impact in Section 5.4.3.1. As noted in the EIS, as of April 2018, all recreational permits for collection of aquarium species with fine mesh nets were voided, and no collection with fine mesh nets is currently legally allowed, pending environmental review. Nonetheless, the EIS analyzed the potential cumulative impacts of recreational aquarium collection.

Commentor	Comment	Response
For the Fishes	The RDEIS is still entirely inadequate under HEPA and its implementing regulations despite the permit, species, and total allowable catch limits proposed in the Preferred Alternative. The RDEIS failed to address these and other notable flaws that we outlined in our prior Environmental Assessment and DEIS comments: • The RDEIS failed to analyze the impacts of collection over time (i.e. the 5-year scope of the analysis, beyond one year, is inadequate); • The RDEIS failed to accurately analyze the environmental consequences (i.e. direct, indirect, and cumulative impacts) of the proposed collection of aquatic life to biological, cultural, and socioeconomic resources at the sites in the WHRFMA where the activity would occur, focusing instead on the WHRFMA generally, as a whole; • The RDEIS failed to accurately analyze the environmental consequences (i.e. direct, indirect, and cumulative impacts) of unlimited collection of aquatic life to biological, cultural, and socioeconomic resources in East Hawai‘i and other parts of the State that may be connected via larval dispersal patterns; • The RDEIS failed to accurately analyze the cumulative impacts of commercial collection along with the take of aquatic resources as food in subsistence, recreational, and commercial fisheries; • The RDEIS failed to accurately analyze impacts on cultural resources; • The RDEIS failed to accurately analyze the alternatives presented; • The RDEIS failed to accurately analyze the impacts of collection practices harmful to corals; • The RDEIS relied on inaccurate, misleading, and incomplete data; • The RDEIS failed to propose and analyze mitigation measures; and • The RDEIS failed to adequately incorporate input of Native Hawaiian groups, experts, affected citizens, and consulted parties.	Your comment has been forwarded to the decision makers.
For the Fishes	The Applicant’s Preferred Alternative does not ensure that commercial aquarium fish collection is lawful, responsible, and sustainable for any of the White List fish species from nearshore habitats in the WHRFMA. Nor for any species taken elsewhere in the state where collection is allowed under the current geographic scope of the aquarium permits. The RDEIS’s continued conclusion that the aquarium fishery in the WHRFMA is not anticipated to impact targeted reef fish species, coral reefs, and the human communities that rely on them is unsupportable. The RDEIS failed to accurately evaluate the primary, secondary, cumulative, short-term and long-term effects of the Preferred Alternative and failed to propose any proper mitigation.	Your comment has been forwarded to the decision makers. As stated in the EIS, the Applicant assumes a permit condition would be added limiting the permit to the WHRFMA, thereby not permitting collection elsewhere in the state.
For the Fishes	The fundamental errors occurring in the impact analyses include, but are not limited to, 1) the use of an incorrect baseline and 2) an exaggerated spatial scale against which impacts are measured. These errors serve to minimize, rather than accurately assess the impacts. These failures serve to obscure the irrefutable evidence of impacts and contribute to erroneous conclusions and improper evaluations of HEPA significance criteria.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	A critical component in any DEIS is the establishment of proper baseline against which to compare the impacts of the proposed action. Any analysis stemming from an improper baseline cannot be considered accurate or relevant. The RDEIS assumes that current targeted fish population estimates are healthy and not impacted and this represents a shifting in baselines. Population abundance of most of these fish species has declined over the past decades due to overexploitation and habitat degradation and thus they cannot be considered baselines. Strong scientific evidence shows that coral reefs of the main Hawaiian Islands, especially near higher human population densities (where exploitation pressure is the highest), have significantly less abundance and biomass of reef fish species than more isolated islands due to overfishing.9	Your comment has been forwarded to the decision makers. The EIS does not claim that current populations are healthy, rather, it states that continued collection of the 8 species that have shown stable or increasing population trends would not lead to any further population declines as a result of aquarium collection which is supported by the fact that these 8 species have had stable or increasing population trends under higher levels of aquarium collection. Current population estimates and trends are used to evaluate impacts, as those are the populations that would be impacted.
For the Fishes	A proper baseline reflects pre-project environmental conditions, and is spatially relevant. Here, a proper baseline is found in the conservation districts and managed areas, collectively referred to as Marine Protected Areas (MPAs), within the WHRFMA where aquarium collecting has been prohibited for over 30 years. MPAs have been used as the pre-aquarium collection baseline, for example, in the West Hawai'i Aquarium Project (WHAP) which was designed to gauge changes in FRAs and Open Areas by comparing them to MPAs.	Your comment has been forwarded to the decision makers. Current population estimates and trends are used to evaluate impacts, as those are the populations that would be impacted.
For the Fishes	The WHAP utilized a powerful experimental design that is often used in environmental impact studies, called the BACI (before-after-control-impact) method and which "is considered optimal to help isolate the effect of the proposed action from natural variability."10 Using the MPAs as the controls in the BACI method, the WHAP design has been able to separate out any changes due to natural occurrences that would be expected to impact fish abundance in all 3 WHRFMA management areas from those that are human caused and thus allows the impacts of aquarium collecting in the Open Areas to be accurately estimated.11 The importance of the WHAP BACI design for exposing natural vs. human caused changes in aquarium targeted species can be understood through these examples (see Figure 15): • 2003: Yellow tang abundance soared in the FRAs 3.5 years after collection was halted in those areas. o MPA and Open Area abundance increased by less than half as much. • 2014: An anomalous recruitment pulse (aka "juvenile fish bloom") occurred across the state and caused an unprecedented increase in yellow tang abundance in FRAs and MPAs. o Collection pressure kept populations in the Open Areas suppressed. • 2018: Yellow tang abundance soared in the Open Areas in an unprecedented single year increase that resulted after aquarium collecting was halted in late 2017. o MPA abundance was unchanged and FRAs decreased.	Your comment has been forwarded to the decision makers.
For the Fishes	The WHAP isn't the only study to separate out natural variances and measure impacts through comparisons between control and impacted areas:	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	• Two MPAs were used in 1997-1998 to document the magnitude of the effect of aquarium collecting on natural populations in West Hawai'i: o "The magnitude of the effect was estimated by comparing fish abundance at collection sites where aquarium fish collecting was known to occur and control sites where collecting was prohibited. Because the study was initiated after collection had begun, we assumed there were no differences between control and collection sites in the abundance of aquarium fishes prior to the onset of aquarium harvesting (i.e. their natural abundances were similar." (emphasis added).12 o Using this method, the authors concluded "that aquarium collectors have a significant effect on the abundance of targeted aquarium fishes." • A 2019 National Oceanic and Atmospheric Administration (NOAA) coral reef ecosystem status report used comparisons between WHRFMA management areas to describe the impacts of activities such as aquarium collecting.13 o They found that, for aquarium collecting, in particular, "In 2017, MPAs and FRAs had 66.2% and 90.2% more juvenile yellow tang than in open areas;" and, o For all reef fish indicators, "Total abundance and biomass, adult fish length, species richness, herbivore biomass, juvenile yellow tang were 1.1–2.0 times higher in MPAs over open areas in 2017." • The WHAP included six MPAs among the 25 study sites in their BACI design to measure the effects of aquarium collecting and/or its removal in the WHRFMA. The MPAs were key, because at the time (1999), they had been closed to aquarium collecting for at least 9 years (31 years as of 2021) and were presumed to have close to "natural" levels of aquarium fish abundances and, thus, "serve[d] as a reference or 'control' to compare with the FRAs and open areas."14 They further noted, "changes in FRAs and open areas can best be estimated by comparing them to other areas which have been protected for relatively long periods of time. These areas (MPAs) serve as control areas. . ."15	Your comment has been forwarded to the decision makers. 1997-1998 was before the current WHRFMA regulations were in place. The 2019 NOAA report is included in the EIS (Gove et al. 2019). While the commenter is correct that in 2017 there were 66.2% and 90.2% more juvenile yellow tang in MPAs and FRAs than Open Areas, the study also concluded that juvenile yellow tang numbers increased in all three areas between 2003 and 2017, including a 60.8% increase within open areas. MPAs are an important part of the WHRFMA, but as noted in the NOAA report, they restrict all fishing, not just commercial aquarium collection. Therefore, the difference between MPAs and Open Areas reflect additional fishing pressures beyond the impacts of commercial aquarium collection.
For the Fishes	It is noteworthy that although the NOAA report (Gove et al. 2019) was cited over a dozen times in the RDEIS, nowhere did it disclose these effects of aquarium collecting in the WHRFMA. The Applicant avoided disclosing the inconvenient truths found in the NOAA and the WHAP data described above by claiming that aquarium collecting is part of the baseline.	Your comment has been forwarded to the decision makers. The FEIS has been revised to include additional data from the Gove et al. (2019) report.
For the Fishes	Table 1, adapted from WHAP data, shows the impacts of aquarium collectors on the 8 species (see Figure 1) the Applicant has proposed in the Preferred Alternative. In 2017/2018 the effect of aquarium collecting on five of the species was significant. Reduced abundance in the Open Areas ranged from 14.3% to 59.5% lower than the MPAs. Note that populations in the 2012/2013 columns reflect abundances prior to the 2014 anomaly and that the 2017/2018 column encompasses the period following the Oct.2017 closure of legal aquarium collecting. [Table 1 - For the Fishes Comments pg. 6]	Your comment has been forwarded to the decision makers. As noted, MPAs restrict all fishing, not just commercial aquarium collection. All 8 species on the Revised White List have had stable or increasing population trends based on DAR data.

Commentor	Comment	Response
For the Fishes	Rather than using the WHAP data to describe the impacts of aquarium collecting, as it was designed, in part, to do, the Applicant has chosen, again and again, to use a baseline that incorporates decades of aquarium collecting that occurred without environmental review and in violation of HEPA. The Applicant asserts that this extractive industry is a part of the natural environment, attempting to justify this absurd claim as follows: "the evaluation includes past use and potential impacts by the commercial aquarium fishery because it has been a part of the baseline condition of these resources since the late 1940s," and "permitted commercial aquarium fishing has been a part of the socioeconomic, cultural, physical, and biological resources for decades and is considered a part of the baseline condition of the affected environment."16 Commenters reiterate that in all of those decades the industry has been allowed to operate, the impacts to the environment have—still—never been openly addressed by the industry itself, despite the data being widely available.	Your comment has been forwarded to the decision makers. Current population estimates and trends are used to evaluate impacts, as those are the populations that would be impacted. A discussion comparing FRAs and Open Areas has been added to Section 5.4.3.3.
For the Fishes	The Applicant refused to substantively respond to our comments on this critically important issue.17 Instead, PIJAC merely repeated its refrain that trade exploitation is the baseline condition, and neglected to explain how or why the MPAs are not the proper baseline.18 Frankly, we believe such an explanation does not exist: MPAs are the only logical control group for assessing the trade's impacts. In the related context of protecting habitat for endangered salmon, federal courts require that trade degradation of baseline conditions be incorporated into the analysis of potential future jeopardy.19 In other words, the trade's past degradation of fish populations cannot be "rolled into" the status quo as PIJAC insists; that defeats HEPA's purpose by obfuscating the true impacts of the permits requested.	Your comment has been forwarded to the decision makers. MPAs are not the most appropriate control group to compare with Open Areas since MPAs also prohibit a range of other, nonaquarium related activities. Comparing Open Areas and FRAs are the appropriate comparison, and language has been added to Section 5.4.3.3 of the FEIS to explain this.
For the Fishes	It appears that the Applicant's reluctance to properly use the WHAP data stems from the fact that to do so illuminates the significant effects aquarium collectors have on the abundance of targeted aquarium fishes, and that, for a number of species, those effects have only grown worse over time, despite the 2014 recruitment pulse (see Table 1). Ignoring the data and pretending aquarium trade impacts are anything other than highly significant renders the RDEIS functionally useless and runs counter to HEPA's core requirement to consider the proposed action's environmental effects, including cumulative impacts "which result[] from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions."20	Your comment has been forwarded to the decision makers. The Preferred Alternative is limited to species which have shown increasing or stable population trends, thereby using population trend data collected and analyzed by the DAR as the measure of sustainability.

Commentor	Comment	Response
For the Fishes	The Applicant subsequently used a before-after method to reframe the impacts of aquarium collecting by comparing the abundances of aquarium targeted fishes in 1999/2000 before the establishment of the FRAs, to sometime after. This method is useful and part of the WHAP BACI design to determine the effectiveness of the FRAs themselves, however, it fails for the purpose of an EIS because it doesn't in any way illuminate the impacts of aquarium collection itself, as the RDEIS must.	Your comment has been forwarded to the decision makers. The DAR report included this comparison of the 1999/2000 and 2017/2018 population estimates, which is disclosed in the EIS, but was not calculated by the Applicant. A discussion comparing FRAs and Open Areas has been added to Section 5.4.3.3. The population trend data from Open Areas included in the EIS (provided by the DAR) includes the impact of commercial aquarium collection.
For the Fishes	The years 1999/2000 do not represent the time before aquarium collecting began in West Hawai'i. Aquarium collecting had been occurring along that coastline, without environmental review and in violation of HEPA, for decades prior. In fact, it was "observed declines in reef fishes due to the aquarium trade [that] triggered the establishment of FRAs and associated monitoring surveys in West Hawai'i in 1999."21	Your comment has been forwarded to the decision makers. As stated in the EIS, 1999/2000 represents the timeframe when FRAs were established. The EIS does not claim that this represents a time before aquarium collection occurs.
For the Fishes	Furthermore, while 1999/2000 was the beginning of reduced impacts in the newly protected FRAs, it also signaled the beginning of increased impacts in Open Areas, as increased levels of collection were focused in fewer legal places to collect.	Your comment has been forwarded to the decision makers. While impacts within Open Areas may have increased after establishment of the FRAs, as stated in Section 3.7.1, the 8 species on the Revised White List have densities of at least 0.5 fish/100 square meters and have had stable or increasing population trends within Open Areas between 1999/2000 and 2017/2018. This includes the timeframe during which increased impacts may have been seen within the Open Areas.
For the Fishes	Additionally, the Applicant appeared to use the increased abundance in targeted species stemming from the anomalous recruitment pulse and the cessation of aquarium collection in late 2017 as a smoke screen to avoid disclosing the Open Area decreases in fish abundance that aquarium collecting has caused for decades under illegally issued permits and licenses, likely by some of the 7 collectors now seeking these permits. It is evident that any increased fish populations have nothing to do with "sustainable aquarium collecting," but that did not stop the Applicant from implying that it does, through dozens of references in the RDEIS to significant increases in abundance since 2000.	Your comment has been forwarded to the decision makers.
For the Fishes	Under this RDEIS, the impacts of the Applicant's actions would continue to be undisclosed, and unmitigated.	Your comment has been forwarded to the decision makers. The EIS discloses the impacts. The Preferred Alternative includes a hard upper limit on collection as requested by many commenters, including For the Fishes. This eliminates any uncertainty regarding the number of fish which could potentially be collected.

Commentor	Comment	Response
For the Fishes	In determining the level of impact to the 8 targeted (i.e. White List) species that would occur under the Preferred Alternative, the RDEIS employs 3 hypothetical scenarios to compare the annual total potential catch of those species, by 7 aquarium collectors, to their estimated populations, with the following results: • Using WHAP Open Area population estimates (30-60-foot depth, Open Areas only), the annual collection would be no more than 7.0% of any of the 8 species • Using WHAP WHRFMA population estimates (30-60-foot depth, and including areas open and closed to collection), the annual collection would be no more than 3.5% of any of the 8 species • Using PIFSC-ESD WHRFMA population estimates (0-98-foot depth, and including areas open and closed to collection), the annual collection would be no more than 3.3% of any of the 8 species Used properly, this basic analysis using harvest/population ratios can be useful in describing impacts of past actions and in setting future management goals.22, 23 However, when used to describe hypothetical scenarios and applied to exaggerated spatial scales, as is done in the RDEIS, the results will fail to accurately assess current impacts or properly mitigate them.	Your comment has been forwarded to the decision makers.
For the Fishes	1. Affected Environment/Directly Affected Area We appreciate that the RDEIS no longer used island-wide fish populations to assess aquarium collection impacts. However, for the reasons below, impacts can only be accurately assessed at a scale that is much smaller than is used in this RDEIS, the WHRFMA Open Areas as a whole, and/or WHRFMA in its entirety.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	Across the WHRFMA, the main factors in determining aquarium collecting impacts—fish abundance/assemblages and aquarium collection pressure—are far from uniform. It is well established that population abundances of reef fish species in Hawaiʻi, especially relatively small-size species that are targeted by the aquarium industry, are highly variable in space depending on reef complexity, depth and wave exposure, and in time (within and among years) depending on the season, mortality, recruitment to the population, and environmental factors.24 In addition, scientific evidence shows that collecting activities substantially affect targeted species in Hawaiʻi and fishing intensity remains high even when stocks are depleted or recruitment is weak. The RDEIS determines impacts by comparing proposed total allowable take to Open Area populations, as a whole, or to the WHRFMA, as a whole. This analysis is deeply flawed both because these areas vary widely in fish populations and other ecological characteristics, and because it fails to accurately capture the industry's impacts at the scale on which they actually occur. Attempting to assess impacts using this overly broad and generalized spatial scale minimizes, obscures, or omits the harsh impacts that are occurring—in reality—in a much more geographically targeted fashion. The WHRFMA is not one uniform whole and treating it as such results in an impact analyses that is far too generalized to be meaningful.	Your comment has been forwarded to the decision makers. The DAR provided the population estimates, which are pooled across geographic areas. The DAR does not have population estimates by zone available. The DAR will receive the collection data by zone, and can review any necessary changes when they issue the permits on an annual basis. In the unlikely event that all collection occured within a single AQ reporting zone, the DAR would be able to evaluate this information; however, this would effectively leave the rest of the coast completely free of collecting, and essentially create an FRA everywhere else. Given that on the island of Hawaii there is connectivity between adjacent reefs (up to 184 kilometers), with fish from protected FRAs being documented to seed unprotected areas (Christie et al. 2010), it is assumed that the population growth occuring in other non-fished areas would seed the collection zone where fishing occurred, and therefore the total allowable catch limits should be based upon the entire population, not subpopulations along the WHRFMA coast. This text has been added to Section 3.7.1 of the RFEIS for clarification.

Commentor	Comment	Response
For the Fishes	Additionally, the RDEIS failed to properly assess what would be allowed under the Applicant's Preferred Alternative whereby: "DLNR would issue Aquarium Permits and CMLs to seven aquarium fishers in the WHRFMA, thereby allowing these seven individuals to resume commercial aquarium fish collection in the WHRFMA, including the use of fine mesh nets. No Aquarium Permits or CMLs for aquarium collection would be issued for areas outside of the WHRMA, and therefore no commercial aquarium collection would be allowed in East Hawai'i. In addition, the 40 White List Species would be reduced to 8 species and each fisher would be allocated an individual catch quota for each species. It is assumed that, upon issuance of an Aquarium Permit, permit conditions would be included in each permit limiting the geographic area covered by the permit to the WHRFMA, limiting collection to the eight species on the proposed Revised White List, and implementing individual catch quotas for each of those eight species. Permittees would abide by all rules and regulations set forth in HRS 189-2,3 (Commercial Marine Permit; Section 1.2.2), HRS-188-31 (Section 1.2.1), governing Aquarium Permit use, and would obtain a West Hawai'i Aquarium Permit as required under HAR 13-60.4 (Section 1.2.4.2). Existing slot limits for Yellow Tang and Kole would remain in effect in addition to the individual catch quotas for all 8 Revised White List Species. Collection of Achilles Tang would not be permitted under this Alternative."25 The Applicant's Preferred Alternative includes assumptions, stated, as above, and also unstated. A key unstated assumption appears to be that, under this scenario, take of the total allotment of 246,560 fish would occur in equal amounts across the Open Areas within the WHRFMA. This is evident by the RDEISs consideration of just one scenario, the WHRFMA as a whole, without any discussion of collection occurring in any other fashion.	Your comment has been forwarded to the decision makers. See previous response regarding this issue.
For the Fishes	Additionally, as the Applicant is well aware, for resource management purposes, the WHRFMA is divided by DLNR into 8 aquarium collection trip report zones (AQ zone), that aquarium collectors are required to use when reporting aquarium catch.26 Despite that knowledge, the RDEIS omits any discussion of where the proposed total allowable take would be distributed: would it be among the 8 AQ zones, evenly, perhaps just a few, or just one? Instead, it focused on the individuals, giving them quotas, but ignored the environment which would be impacted entirely differently should all 246,560 fish be taken from just one AQ zone.	Your comment has been forwarded to the decision makers. See previous response regarding this issue.

Commentor	Comment	Response
For the Fishes	The importance of the 8 AQ zones is explained in a 2011 letter from DLNR to commercial aquarium collectors outlining the need to increase focus and gather more data by aquarium trip zone, to better monitor and analyze management of the fishery due to what was, at the time, a growing interest in the aquarium fishery (See Figure 2).27 As further emphasis of the importance of gathering information by zone, the updated Aquarium Trip Fish Report included the instructions, "DO NOT COMBINE ZONES" and noting that a separate report is required for each zone, even for catch taken on the same day (see Figure 3.).28 We agree with DLNR that more data yields a better analysis and that for proper management, the level of catch must be understood at the spatial scale represented in the AQ zones. If aquarium collectors cannot combine zones for reporting purposes, the RDEIS should not combine and conflate the zones when analyzing impacts. The importance of analyzing impacts and setting limits for each zone are revealed in DLNR catch report data which show large variances in overall collection pressure between the 8 zones. For example, during one 5-year time frame (2013-2017) average annual take ranged from fewer than 10,000 to 85,000 within the various zones (see Figure 4). These large variances, together with the potential for all 246,560 fish to be taken from one zone must be addressed.	Your comment has been forwarded to the decision makers. See previous response regarding this issue.
For the Fishes	The data also reveal that it's not uncommon for large volumes of a single species, such as yellow tangs, to be taken from a single zone. For example: • 84,313 yellow tangs from zone 103a in 2017 (7 collectors reporting) • 74,445 yellow tangs from zone 102a in 2012 (14 collectors reporting) • 66,456 yellow tangs from zone 100a in 2012 (13 collectors reporting)	Your comment has been forwarded to the decision makers. Collection under the Preferred Alternative will include both annual limits as well as the existing bag and size limits. Collection under the Preferred Alternative would be limited to species who have had stable or increasing population estimates under historic aquarium collection, including the Yellow Tang.

Commentor	Comment	Response
For the Fishes	Under the Preferred Alternative, the amounts above, taken from single zones, represent 33% - 42% of the proposed total allowable take of 200,000 yellow tangs within the entire WHRFMA. More importantly, nothing in the Applicant's proposal would prevent 100% of allowable yellow tang catch to come from a single zone. Further, the impacts that such collection pressure would have on yellow tangs in those zones would depend, in large part, on their abundance. For example, intense collection where abundance is 10 yellow tangs per 100m2 would result in a significantly different impact than where abundance is 20 per 100m2. The absence of these fundamental analyses in the RDEIS must be addressed. Under the Preferred Alternative, nothing prevents the 7 aquarium collectors from focusing all of their collection effort in a single zone in response to impacts in other zones such as habitat destruction from storms and climate change, or changes in abundance of the target species (under a "get it while you can" rationale).33 As we explain below, this is not mere speculation, as it has already happened on O'ahu (see Figures 5 and 6). Taking all fish from one zone would allow impacts greater than occurred under the prior scenario with unlimited permits and unlimited fish taken. Any such level of concentrated take could very likely lead to degradation of fish populations and habitats, contrary to the assertions made in the RDEIS that no degradation would occur.36	Your comment has been forwarded to the decision makers. See previous response regarding this issue.

Commentor	Comment	Response
For the Fishes	Further, HEPA requires that an EIS assess the potential cumulative impacts of what State regulations allow, not just what some permittees may claim they intend to do, or have historically done, with their permits. As the Hawai'i Supreme Court clearly stated, "the properly defined activity for the purposes of the HEPA analysis must encompass the outer limits of what the permits allow and not only the most restrictive hypothetical manner in which the permits may be used."37 The RDEIS failed to address this. The real potential exists for as much as 100% of the total allowable catch (246,560 fish) to be taken from a single zone. Similarly, the potential exists for take of 100% of the populations of any, or all, of the 8 species within a single zone. Each of these scenarios would result in impacts substantially greater than collection pressure distributed among the 8 AQ zones, according to the unique fish assemblages, reef zones, and other characteristics found within each zone. Neither of the above scenarios have been addressed in the RDEIS, but require analysis and mitigation to prevent the significant impacts that would result from each. The RDEIS, does, however analyze the impacts of take under hypothetical distributions of harvest and fish abundance whereby both are spread equally across the entire WHRMFA. A subsequent determination of harvest/population ratios flows from those distributions. Although such equal distributions are unfounded and highly improbable, the RDEIS provides no justification for their use.	Your comment has been forwarded to the decision makers. See previous response regarding this issue.
For the Fishes	Below, we hypothesize an equally improbable distribution of fish populations—8 equal parts, representing 8 AQ zones—to provide additional examples of potential impacts under the outer limits of the permits would allow in the Preferred Alternative: we apply the harvest to one AQ zone containing a hypothetical 1/8th of the WHAP Open Area population (see Table 2.).	Your comment has been forwarded to the decision makers.
For the Fishes	The Applicant should not dismiss these points as mere speculation as they have done in the past. It is predicted and foreseeable that natural disasters such as coral bleaching and hurricanes will kill corals and destroy habitat for reef fishes in the coming years, with increasing frequency and intensity. Following hurricanes Iwa and Iniki and the resulting habitat destruction, Hawai'i aquarium collectors have already shown the propensity to over-harvest yellow tangs to the point of collapse along an entire Hawai'i coastline, and safeguards must be put in place to ensure that never happens again.38	Your comment has been forwarded to the decision makers. The data do not support the commentors assertion that aquarium collectors over-harvest Yellow Tang to the point of collapse along an entire Hawai'i coastline. As stated in Section 5.4.1.3 of the EIS, since the FRAs were established, the population of Yellow Tang has increased 165% in the FRAs and 101% in the Open Areas (areas fished by commercial aquarium fishers), compared to 74% in the MPAs. Overall Yellow Tang abundance in the 30-60-foot depth range over the entire West Hawai'i coast had increased 150% (over 3.4 million fish) from 1999/2000 to 2017/2018 to a population of approximately 5.7 million fish. The Preferred Alternative includes the safeguard of placing limits on the number of Yellow Tang that could be collected each year (as previously requested by the commentor), as well as the existing size and bag limits already in place and the existing MPA and FRA network.

Commentor	Comment	Response
For the Fishes	An adequate environmental statement requires much more than the hasty review of potential impacts found in PIJAC's oversimplified harvest/population ratios. Each AQ zone is comprised of unique reefs with equally unique fish assemblages, populations of the 8 White List species, population ratios, and communities. Thus, the impacts of collection in the different AQ zones will also be unique. Moreover, because DLNR insists—and rightly so—on zone-specific reporting, zone-specific data was readily available to the Applicant, and the RDEIS provides no justification for neglecting to address impacts with the same specificity by which the WHRFMA is regulated. The level of detail required in an EIS "depends upon the nature and scope of the proposed action," and "if it is reasonably possible to analyze the environmental consequences of a particular type at a particular stage," the party seeking environmental review "is required to perform that analysis."39	Your comment has been forwarded to the decision makers.
For the Fishes	Here, PIJAC (1) knew that DLNR mandates zone-specific reporting, (2) had access to a plethora of zone-specific data, and (3) is preparing the RDEIS on behalf of long-operating individual West Hawai'i collectors who could easily have conveyed their collection practices and patterns to the consultants preparing the RDEIS. The Applicant has no excuse for wielding such a broad brush when the agency prioritizes and mandates site-specific reporting and the AQ zone take reports are so readily available.	Your comment has been forwarded to the decision makers.
For the Fishes	2. Additional Considerations for Determining Sustainable Take Beyond harvest/population ratios, by zone, allowable levels of take for each species should be determined for each zone by factoring the following: • The current level of depletion within each zone and for each White List species, determined by a comparison between the MPAs and Open Areas within said zone (see Table 1.). • The DLNR management goal and related sustainable level of take, determined by the maximum allowable reduction in natural (i.e. unfished) abundance, per metric (e.g. herbivorous surgeonfish biomass, species abundance, female/male ratio, etc..). • Species life span, population size, reproductivity rates, and age at first reproduction. • What the larval connectivity and dispersal patterns are for the White List species within the zone (i.e. is it primarily a source or sink area?) and what are the implications for each? • What any continued reduction in herbivore biomass and structure means for any future necessary reduction of same for food fishers. • The strong preferences of Hawai'i residents and visitors who desire that fish populations are restored to their natural abundance on the majority of Hawai'i reefs. • The cultural importance of those species for native Hawaiians dwelling in or with ties to ahupua'a that are potentially affected by take of fish in or adjacent to the AQ zones.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	Quotas for the White List species must be set for each of the 8 AQ zones and should be based upon the above factors. The RDEIS erred by setting arbitrary take quotas for the 7 fishers while disregarding the primary purpose of the EIS. Assessing and describing the differences between the AQ zones, and the proposed impacts to each of those zones is essential for an adequate and informative RDEIS. There is no excuse for this information to continue to be omitted from the EIS. DLNR can provide the necessary WHAP data at the scale needed as evidenced by their ability to pool the data at an even smaller scale, the individual FRAs. The PIFSC-ESD may also be pooled at smaller scales for comparisons.	Your comment has been forwarded to the decision makers. See previous response regarding this issue.
For the Fishes	The Preferred Alternative applies the take limits to the entire WHRFMA and the RDEIS provides (flawed) impact analyses for that broad area, alone. However, the RDEIS failed to provide impact analyses for other scenarios that would be allowed under the permits, such as take that is focused in much smaller areas.	Your comment has been forwarded to the decision makers.
For the Fishes	Without an additional condition in the Preferred Alternative defining relevant take limits for each AQ zone, the impacts of taking 246,560 fish from each of the 8 zones must be analyzed, since it is what the permits would allow.	Your comment has been forwarded to the decision makers. See previous response regarding this issue.
For the Fishes	Moreover, PIJAC appears to be relying on an escape hatch to increase its proposed quotas at will in stating: “the individual catch quotas may be revised (i.e., increased or decreased) over time during the annual permit renewal period based on re-evaluation by the DLNR of each proposed Revised White List species’ population status (e.g., new population estimates, new population trend data, etc.).”40 This view is legally inaccurate; HEPA’s implementing regulations specifically require supplemental environmental review “[i]f there is a change in any of these characteristics which may have a significant effect,” in which case, “the original EIS . . . shall no longer be valid.”41	Your comment has been forwarded to the decision makers. As stated in the EIS, as Aquarium Permits for the seven fishers who would receive permits under the Preferred Alternative come up for renewal each year, DLNR will presumably evaluate whether there are significant new circumstances or information relevant to environmental concerns and bearing on the commercial aquarium fishery or its impacts requiring a supplemental or additional HEPA review. Language has been added to Section 3.7.1 stating that changes to the individual catch quotas may require additional HEPA review.
For the Fishes	The PIFSC-ESD data set includes fish abundance collected from 257 stationary point count locations around Hawai‘i between depths of 0-98 feet, representing 176 surveys since 2010 in West Hawai‘i . In contrast, the WHAP data set collected data from 25 transect survey sites within the three WHRFMA management areas between depths of 30-60 feet, representing 8,712 surveys since 1999. Neither data set encompassing the entire WHRFMA are representative of regional population abundance that occurs within each of the 8 AQ zones, and should not be used to assess the impacts of aquarium collecting, via harvest/population ratios, in this RDEIS.	Your comment has been forwarded to the decision makers.
For the Fishes	The use of unrepresentative data expands the affected environment in the impact analysis to include the fish populations in the protected MPAs and FRAs. While this may be appropriate for assessing indirect and cumulative impacts, it fails to accurately capture the direct effects, because the action would not occur throughout the entire WHRFMA, including the protected areas, but, only on reefs in the WHRFMA Open Areas.	Your comment has been forwarded to the decision makers. Section 5.5.1.2 summarizes impacts on the WHRFMA Open Areas, and does not include population data from within the FRAs and MPAs.

Commentor	Comment	Response
For the Fishes	The Open Areas are where the direct (and greatest) impacts occur. The FRAs and MPAs likely experience indirect impacts as does East Hawai'i (i.e. Hawai'i Island as a whole), but those impacts would be eclipsed by the direct impacts occurring in the actual areas where the activity would take place.	Your comment has been forwarded to the decision makers. Section 5.5.1.2 summarizes impacts on the WHRFMA Open Areas, and does not include population data from within the FRAs and MPAs.
For the Fishes	While the PIFSC-ESD data are useful for comparisons, they are problematic for a number of reasons, including the apparent inability to be pooled by management status, and therefore the inability to separate out natural variability from the human-induced characteristics such as reduced abundance from decades of heavy aquarium trade pressure on targeted species.	Your comment has been forwarded to the decision makers.
For the Fishes	The WHAP data is most relevant and representative because, as noted in the RDEIS, WHAP was designed to "gauge the effects of the aquarium fishing industry" in the WHRFMA.42 To do so, WHAP surveys are conducted within the 30-60 foot depth range because it represents the depths from which the fish are taken (i.e. the directly affected area).43 Additionally, WHAP data can be pooled by AQ zone, and in doing so, the most detailed view of aquarium collecting impacts are made visible in a direct comparison with reported catch from those zones. Note that for the 2017/2018 WHAP data, PIJAC cites to "Dr. Bill Walsh, personal communication" as a reference. Such data should come from publicly available sources, not personal communications, or, at minimum, these personal communications should be fully disclosed in the RDEIS.	Your comment has been forwarded to the decision makers. Section 5.5.1.2 summarizes impacts on the WHRFMA Open Areas, and does not include population data from within the FRAs and MPAs. A citation related to the personal communication has been added to the FEIS.
For the Fishes	The Agency must conduct stock assessments of species before it is able to determine a sustainable rate of take. Clearly the Agency has not done so, as DLNR personnel have stated that to do so would take over a decade for just 40 fish species targeted by the trade.44 Without such data, the Agency cannot meaningfully assess the environmental impacts of commercial aquarium collection. Such assessments must be completed prior to the issuance of the EIS, and in the face of any uncertainty, the EIS's analyses must err on the side of caution to protect these vulnerable species.	Your comment has been forwarded to the decision makers. The Preferred Alternative is limited to just 8 species species which have shown increasing or stable population trends, thereby using population trend data collected and analyzed by the DAR as the measure of sustainability.
For the Fishes	The RDEIS ignores the largest single year surge in fish abundance that has ever been recorded in the WHRFMA which has occurred in the Open Areas in 2018 after aquarium collecting was prohibited in the area (Figure 15). Note that the increase occurred solely in the areas recently closed to aquarium collecting: a similar increase did not occur in the areas long closed to the trade. This significant increase, once collection pressure is removed, is further indisputable evidence of major aquarium collecting impact on heavily targeted species.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	At the foundation of every assessment made in the RDEIS are flaws stemming from the use of an incorrect baseline, extreme hypothetical scenarios and an exaggerated spatial scale. Each of these flaws lead to unfounded and plainly biased conclusions regarding the trade's impacts. Additionally, the RDEIS failed to consider cumulative impacts, both short- and long-term. HEPA requires that "agencies shall consider the sum of effects on the quality of the environment and shall evaluate the overall and cumulative effects of an action."45 Furthermore, the Agency must consider "both primary and secondary [consequences] and the cumulative as well as short-term and long-term effects of an action."46 Notably, "cumulative impact" is defined as the impact resulting from "the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions," and "[c]umulative impacts can result from individually minor but collectively significant actions taking place over a period of time."47	Your comment has been forwarded to the decision makers. The cumulative impact of commercial aquarium collection is addressed in Section 5.4.3.3.
For the Fishes	The Applicant unlawfully limited its analyses to the time period of five years.48 The Applicant's reasoning for this 5-year temporal scope is that it corresponds with DLNRs 5-year review of its WHRFMA management plan while noting that each permit lasts only one year, and therefore, as they "come up for renewal each year, DLNR will presumably evaluate whether there significant new circumstances or information relevant to environmental concerns and bearing on the commercial aquarium fishery or its impacts requiring a supplemental HEPA review." 49, 50	Your comment has been forwarded to the decision makers. Fishing permits are one year in duration. As noted in the EIS, if new information becomes available that was not previously considered in this EIS, such new information can be taken in to consideration at the time of permit renewal.
For the Fishes	While Commenters agree that it is critical for the Agency to continue to monitor the impacts that aquarium collection is having over time, the one-year duration of the requested permits does not nullify HEPA's clear requirement for considering the long-term effects of that activity.51 For example, a large excavation project could destroy habitat in an area of an island that takes decades to regrow—and even if the excavation itself was only for a year, HEPA would clearly require consideration of the impacts to the environment during the decades of regrowth. Similarly, the use of a pesticide could have known impacts on a species where serious or lethal effects are felt far beyond the time frame of the actual application of the pesticides—yet HEPA would clearly require consideration of those expected impacts. Thus, the Applicant's claim that a five-year projection is sufficient to disclose the cumulative impacts of a year of substantial collection simply does not hold up, particularly considering that, under the Applicant's assumption of yearly renewal, the impact of each permit itself would be compounded annually.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	Further, the Applicant asserts that "supplemental HEPA review would be triggered if WHAP monitoring data indicate a substantial decline (as determined by DAR) in the population of one or more of the proposed Revised White List species. If this happened, then a temporary moratorium could be instituted until the species rebounds. Under this approach, any changes in resource data (e.g., increase or decrease in population estimates, unforeseen circumstances, etc.) would be addressed, as necessary, by supplemental HEPA documents, allowing for the HEPA process to quickly recognize and address any potential issues."52 Stating that the Agency can simply reevaluate the consequences of a year-long permit after that year is up entirely contradicts HEPA's mandate to evaluate the potential consequences of an action before the Agency authorizes the action. The purpose of an EIS is to anticipate an event such as the substantial decline of a target species, and propose a plan for it. Something unforeseen and beyond what has been anticipated should trigger full, not supplemental, HEPA review.	Your comment has been forwarded to the decision makers. The FEIS has been revised to reflect that this could also include additional HEPA review.
For the Fishes	Additionally, the Applicant's suggested approach is an example of an unresolved issue that HEPA requires must be addressed.53 The Applicant's suggested approach contains numerous faulty assumptions, and does not appear to be a workable solution based on the following: • Analysis of potential permit outcomes such as a "substantial decline" in one of the 8 permitted species should be included in the Preferred Alternative and accompanied by proposed mitigation measures to be incorporated into permit terms and conditions. Even though DLNR has the authority to refuse to renew permits, and to adopt emergency rule(s) for no longer than 120 days if the agency finds imminent peril to natural resources, this process is rarely used by DLNR/BLNR and is considered an option of last resort: the Applicant should have provided for such foreseeable outcomes in its RDEIS. • The RDEIS does not define "substantial decline." We propose the following: 'Substantial decline' means Open Area abundance that is less than 95% of natural abundance (i.e. MPA abundance); or natural abundance that has declined by more than 10% since the start of the current calendar year. An example of a workable solution based on the above would be a mitigation measure that is automatically triggered when any "substantial decline" threshold is crossed, as follows: using our proposed definition for "substantial decline," if real-time WHAP monitoring indicated such a decline at any point in time within a permitting period, collection of that species would immediately cease within that AQ zone.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	Additionally, a 5-year timeframe that analyzes impacts is inadequate because the impact of fish removal will accumulate over time. For example, though collection pressure has been removed from the White List species in the FRAs, populations of once heavily targeted species in those areas, such as yellow tangs, have yet to return to natural levels of abundance, as reflected in the baseline MPAs, even after 20 years of protections. For very long-lived species such as the yellow tang and other surgeonfishes heavily targeted by aquarium collection, which have lifespans measuring decades, and which may not reproduce until they are at least 5 years old, a 5-year analysis period is far too short.	Your comment has been forwarded to the decision makers.
For the Fishes	Furthermore, the RDEIS is for 7 collectors, however, nothing prevents more collectors from seeking permits through additional HEPA reviews. The relationship between the number of participants in a fishery and impacts to fish populations is well-established in the literature. The importance of restricting access to fisheries has been acknowledged and used for thousands of years to conserve and help sustain fish populations.54	Your comment has been forwarded to the decision makers. Any subsequent permits issued would need to conduct their own HEPA review, and include potential impacts from any previously-issued permits.
For the Fishes	Further, the RDEIS also failed to acknowledge the beneficial impact that would continue to occur in the WHRFMA under the No Action Alternative as is evident by the Open Area increases in White List species that have occurred since Oct. 2017 when all legal aquarium collecting was prohibited within the WHRFMA. Further evidence is found in the 2018 surge in yellow tang abundance which was the largest ever recorded in the WHRFMA. That significant increase occurred only in the Open Areas: FRA and MPA populations changed very little between 2017 and 2018, proving that the increase was due solely to the removal of collection pressure, and was unrelated to any natural variance.	Your comment has been forwarded to the decision makers. Text has been edited in Section 5.4.2.1 to discuss potential increases in populations under the No Action Alternative.
For the Fishes	The failure of the RDEIS to conduct proper analyses, as described throughout this document, is not only a legal flaw but also the main reason that the RDEIS inaccurately anticipated no impacts to targeted populations and their habitat. In addition, by limiting the timeframe of their analysis to five years, the RDEIS failed to accurately consider the impacts of one-year collection permits cumulatively with other “past, present, and reasonably foreseeable actions” “over a period of time.”	Your comment has been forwarded to the decision makers.
For the Fishes	Coral reefs are connected by currents which carry and disperse fish larvae to other areas, both near and far. Most fishes on Hawaiʻi’s reefs are the result of other fishes upstream of that reef.56 The currents and conditions that control larval connectivity and dispersal processes are complex. The larvae of some species are able to travel between islands, while others do so to a lesser extent. For example, in one study, some yellow tang larvae on Hawaiʻi Island travelled on ocean currents for 15 km before settling on a reef while others traveled 184 km.57	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	Recent research into two species of small bodied surgeonfishes, including kole which is heavily targeted by the aquarium trade, has determined that populations of these fishes are genetically distinct on each of the main Hawaiian Islands. This means that, for at least these two species, there is little genetic mixing between islands, and once species are depleted on any given island, there is no other source for population replenishment. Further, connectivity and dispersal studies on the island scale for certain species have identified important spawning source areas that are essential for maintaining populations on other reefs across the island.	Your comment has been forwarded to the decision makers.
For the Fishes	This larval connectivity between coral reefs serves to highlight areas where secondary or indirect impacts of the Applicant's actions will manifest. Regardless of whether larval connectivity exists mainly intra-island or extends inter-island, reduced populations of reef fishes in their source areas will seriously impact reef fish abundance in their downstream, sink reefs, and thus the entire island.58 The RDEIS failed to account for this critically important reproductive strategy used by Hawai'i's reef fishes. The precautionary approach requires the determination of source areas for the White List species on Hawai'i Island and the establishment of protections for those populations to ensure local species survival, which was not provided in the RDEIS.	Your comment has been forwarded to the decision makers. As described in the EIS, the WHRFMA already contains a network of protected areas, including both FRAs (closed only to aquarium collection) and MPAs (closed to all fishing). Christie et al. (2010) found that around the island of Hawai'i, there is connectivity between adjacent reefs (up to 184 kilometers, with fish from protected FRAs being documented to seed unprotected areas, highlighting the effectiveness of protected areas.
For the Fishes	We reiterate here that HEPA requires that an EIS assess the potential cumulative impacts of what State regulations allow, not just what some permittees may claim they intend to do, or have historically done, with their permits. The RDEIS failed to address this.	Your comment has been forwarded to the decision makers.
For the Fishes	The analysis of cumulative impacts included the impact of the commercial aquarium fishery combined with non-aquarium commercial and recreational fisheries and other activities that impact population abundance, but reached a conclusion that is erroneous. Commercial and recreational fishing combined with the aquarium fishery have a substantial impact on targeted species. The RDEIS failed to determine the cumulative impact of all fishing on target species. In addition, the RDEIS failed to analyze indirect impacts from collection such as vessel traffic and accumulated reef damage due to vessel anchoring and collection practices.	Your comment has been forwarded to the decision makers. Under the Preferred Alternative, commercial aquarium collection would impact only the 8 species on the Revised White List, which have all had increasing or stable population trends under historic impacts. If population trends significantly decline, the DAR would need to review that information at that time when annual permits are issued.
For the Fishes	Also, the RDEIS failed to adequately evaluate the potential of cumulative impacts of climate change (warming, coral bleaching, and ocean acidification) on targeted fish species such as declining coral coverage which have been demonstrated to influence reef fish species diversity and abundance.59 The RDEIS recognized that climate change poses serious threats to Hawai'i's coral reefs and the species targeted by the Applicant, claimed that "the Preferred Alternative was specifically designed to help buffer climate change by creating individual catch quotas,"60 yet failed to quantify and evaluate the impacts of implementing the Preferred Alternative which includes the annual removal of 246,216 herbivores from reefs that are located within anywhere from 1 to 8 AQ zones.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	It is clear from an analysis of cumulative impacts that many of HEPA's "significance criteria" apply.61 Had proper analyses been conducted, the Preferred Alternative most certainly would have shown significant effects on the environment due to at the least, the following: the loss or destruction of natural and cultural resources; curtailing the range of beneficial uses of the environment; substantial degradation of environmental quality; cumulative effects on the environment; and potentially substantially affecting rare, threatened or endangered species, or its habitat.62	Your comment has been forwarded to the decision makers.
For the Fishes	Flawed analyses prevented the RDEIS from accurately assessing and addressing these effects, in part, because the RDEIS used as a baseline, current conditions, which have been impacted by decades of the aquarium collecting activity.63 Therefore, the scope fails to factor the impacts of collection pressure over time. Proper examination of the magnitude of the effect of aquarium collecting on natural populations and the coral reef ecosystem over time requires a proper baseline such as occur in MPAs, which reflect natural populations, before they were depleted by this activity, and have been used as such in numerous studies.64	Your comment has been forwarded to the decision makers. Additional information has been added to Section 5.4.3.3 to address past impacts of commercial aquarium collection. FRAs were used as the comparison, as MPAs ban all fishing, and are therefore not relfective of commercial aquarium collection alone.

Commentor	Comment	Response
For the Fishes	The RDEIS contains a faulty cost and benefit analysis (CBA) that is skewed heavily in favor of commercial aquarium collecting and omits essential information. Properly conducted, CBAs are useful in environmental impact studies and provides decision-makers "the balance required in complex regulatory decisions."65 A recent, independent CBA of the aquarium trade in Hawaiʻi (Schaar & Cox 2021) was conducted to provide necessary information to decision makers. Costs and benefits for various scenarios were determined and their distribution across stakeholder groups was assessed. Four past, current, and proposed management scenarios were explored, and the CBA results were compared to the recommendations and conclusions of the Applicant's initial EIS for the WHRFMA. The independent CBA of the Hawaiʻi aquarium trade determined that ending the trade was the only option that yielded positive annual benefits, and in addition, it negatively impacted the fewest stakeholders. The annual net positive benefit of banning the aquarium trade was upwards of $440,294,770 - factoring in potential costs, including on-reef tourism impacts which the RDEIS chose to exclude due to "limited data". The CBA included potential impacts on on-reef tourism – deferring to the precautionary principle articulated by the Hawaiʻi Supreme Court, where the Court concluded that, related to public trust resources, "where [scientific] uncertainty exists, a trustee's duty to protect the resource mitigates in favor of choosing presumptions that also protect the resource."67 Whereas, the initial EIS chose to omit these potential impacts and costs, by deferring to the lack of data, the independent CBA followed the precautionary principles set-forth by the Hawaiʻi Supreme Court and erred on the side of caution when making these critical assessments that ultimately impact public trust resources. Further, the independent CBA determined that the initial EIS did not assess the costs and benefits of the aquarium trade and their distribution across stakeholder groups. Again, the independent CBA deferred to the judicial authority of the Hawaiʻi Supreme Court, which reaffirmed "that all public resources are to benefit Hawaiʻi's people and that private or commercial use should receive a 'high' level of scrutiny" making "the size of the stakeholder group" of interest.68 While the estimated market benefits of the aquarium trade were similar between the independent CBA and the initial EIS, the estimated costs were not: • The initial EIS estimated the costs of the trade to Native Hawaiians and other stakeholder groups were negligible, and the EIS provided no justification for that estimation. • The independent CBA estimated that aquarium collecting scenarios resulted in annual net losses upwards of $440,594,770.	Your comment has been forwarded to the decision makers. The paper referenced here (Schaar and Cox 2021) did not analyze the current Preferred Alternative, which limits collection to 8 species, limits collection to the WHRFMA, and includes individual catch quotas providing a hard upper limit on the number that can be collected. Additionally, the Applicant questions the validy of the CBA referenced by the commenter because the study assumes a complete loss of the tourism industry under any alternative which includes collection. As stated in the EIS, Hawaiʻi's tourism industry achieved new records in total visitor spending and visitor arrivals in 2017, marking the sixth consecutive year of record growth in both categories. This occurred while commercial aquarium collection was permitted. Therefore, the loss of the entire tourism industry, for the entire state, based on issuance of permits for 8 species limited to the WHRFMA on the island of Hawai'i, does not seem reasonably foreseeable.

Commentor	Comment	Response
For the Fishes	Importantly, under PIJACs various EISs, the comparatively small market benefit of the aquarium trade in Hawaiʻi accrued to a small group of collectors, wholesalers and dealers (including 7 collectors in the RDEIS) while 1,415,872 residents, 83% of whom want to see an end to the trade due to environmental, cultural and ethical concerns with capturing marine life for the pet trade outside Hawaiʻi, suffer the losses.69	Your comment has been forwarded to the decision makers.
For the Fishes	The independent CBA concluded that "sustainable management requires that the costs and benefits accruing to all stakeholder groups be investigated to ensure policies are equitable. Relying on EIS recommendations that aim to support one group of stakeholders at the expense of others to determine policy could be considered biased."70 Because the RDEIS uses the same biased method that it used in the initial EIS to evaluate costs and benefits, it is deeply flawed and should be revised to consider costs and benefits to the multiple stakeholder groups who rely on our reef ecosystems.	Your comment has been forwarded to the decision makers.
For the Fishes	DLNR, in the Final Environmental Assessment, Notice of Determination, described five HEPA significance criteria and eleven additional areas requiring further analysis by the Applicant. In this RDEIS, a number of critically important areas remain unresolved as they are either incomplete, not properly analyzed, or patently false.	Your comment has been forwarded to the decision makers.
For the Fishes	A. HEPA Significance Criteria #1: To the question of "whether the annual take of cumulative numbers of fish as a percentage of estimated population results in irrevocable loss or destruction of populations of fish," the RDEIS wrongly concluded "the Preferred Alternative (i.e., Revised White List and Limited Permit Issuance Alternative) does not involve an irrevocable commitment or loss or destruction of any natural, historic, or cultural resource."	Your comment has been forwarded to the decision makers. The Preferred Alternative includes a Revised White List of 8 fish species which can be collected. Each of those 8 species has an individual catch quota, which provides a hard upper limit on the number which can be collected annually by commercial aquarium collectors who would recieve permits under this alternative Of the 8 fish species on the Revised White List, all have had stable or increasing population trends under historic rates of commercial aquarium collection.
For the Fishes	Fish Populations: Any and all substantial reductions in natural abundance of White List species in West Hawaiʻi indicate lost natural and cultural resources. The reduced populations of yellow tangs and other White List species in the FRAs, compared to baseline, natural populations found in the MPAs, even after 19 years of no aquarium collecting, is evidence of irrevocable losses that have occurred.	Your comment has been forwarded to the decision makers. The Preferred Alternative has been revised to include total allowable catch limits and reviosions to the White List, limiting collection to just 8 fish species which have had stable or increasing population estimates. MPAs do not provide a proper baseline, as they ban all fishing, not just commercial aquarium collection.
For the Fishes	Furthermore, severe coral bleaching caused by climate change has already reduced coral cover in West Hawaiʻi and is only expected to worsen, with annual bleaching, similar to that which occurred in 2015, expected to begin in 2040, and which will result in the loss of 70% of Hawaiʻi's reefs. This loss of White List habitat virtually assures that a depleted population will not be able to rebound to the same extent, or at all, in the future, though it may have in the past.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	Further evidence is found throughout this document and all combined point to significant adverse impacts and irrevocable losses to fish populations as a result of all proposed alternatives with the exception of the No Action alternative, which, according to DLNR data, is having a significant beneficial impact in the WHRFMA.	Your comment has been forwarded to the decision makers.
For the Fishes	In their first FEIS, the Applicant responded to our DEIS comments on this matter as follows: "The term "irrevocable" is defined by Webster's dictionary to mean "not able to be changed, reversed or recovered; final." The preferred alternative does not meet this definition because available scientific data indicate that the populations targeted by the fishery are naturally self-sustaining, and population levels for many of the species are stable or increasing. For species that are decreasing, they are decreasing in areas both open and closed to aquarium collection, indicating that aquarium collection is not driving the decline, and that banning aquarium collection would not reverse this decline. Consequently, the impacts of the fishery are will not cause an irreversible impact on either the populations or the ecosystems they inhabit.71 With the exception of Webster's definition, every statement in the above paragraph is false or skewed to the extreme. Available scientific data actually indicates that 19 years after aquarium collection pressure was removed, and including the 2014 anomalous fish recruitment pulse, the FRA populations of 7 of the 8 Preferred Alternative species have not recovered. Their abundance levels in the FRAs appear to have been permanently altered, having failed to return to natural, unfished abundance as is reflected by their populations in the MPAs, even after 19 years of no aquarium collection. The abundance levels of these species in the FRAs range from 45.1% to 4.6% lower than is found in the MPAs (see Table 3). Additionally, for 5 of the 8 species, the differences in abundance between the MPAs and FRAs has grown since 1999/2000 which is further indication of their inability to recover and an irrevocable commitment (see Table 3).	Your comment has been forwarded to the decision makers. As stated, MPAs do not provide a proper baseline, as they ban all fishing, not just commercial aquarium collection.
For the Fishes	Further, the Applicant's statement that "scientific data indicate that the populations targeted by the fishery are naturally self-sustaining..." is patently false and refuted by logic as well as by DLNR data and reports on aquarium trade impacts. Oxford languages defines "self-sustaining" as "able to continue in a healthy state without outside assistance." Obviously if this were the case for species targeted by the aquarium trade in West Hawai'i, there would have been no need to establish the WHRFMA fish replenishment areas.	Your comment has been forwarded to the decision makers. Of the 8 fish species on the Revised White List, all have had stable or increasing population trends under historic rates of commercial aquarium collection. In addition, as disclosed in the EIS, aquarium collection is not the only stressor in the WHRFMA.

Commentor	Comment	Response
For the Fishes	Moreover, if populations of aquarium-targeted species were naturally self-sustaining, DLNR would not have created an aquarium trade list of Species of Special Concern, which included a number of species that were "routinely seen in the 1970's, but are now rare." Those species included the Bandit Angelfish, Hawaiian Turkeyfish and Thornback Cowfish (see Figure 7). Also included in the presentation were species of butterflyfishes which had been heavily targeted by aquarium collectors for decades. The presentation showed that butterflyfish diversity and abundance had significantly declined, with particularly alarming declines in abundance at Puako and Honaunau ranging from 89% - 100% for the Teardrop Butterflyfish and the Bluestripe Butterflyfish which is a highly unique, endemic species, and is one of two Hawai'i reef fish species that have no sister species elsewhere in the Indo-Pacific, and are also known as relics (see Figure 7).	Your comment has been forwarded to the decision makers. The Preferred Alternative recognizes the various threats to White List species and specifically those that have shown declining populations and as a result limits collection to just 8 species, all of which have had stable or increasing population trends under historic rates of commercial aquarium collection.
For the Fishes	Additionally, the Applicant's claim that for species experiencing decreasing abundance in both open and closed areas, aquarium collecting is not driving the declines, and that banning aquarium collection would not reverse the decline is erroneous and unfounded. DLNR refers to two such species, both among the top 10 most collected by the trade, the Achilles tang and the ornate wrasse, writing in "[t]he fact that these two species had declines in both Open and protected areas (FRAs) suggests that factors other than aquarium collecting were also affecting their populations"	Your comment has been forwarded to the decision makers. The Preferred Alternative limits collection to just 8 species, all of which have had stable or increasing population trends under historic rates of commercial aquarium collection. Neither the Achilles Tang nor Ornate Wrasse on included on the proposed White List.
For the Fishes	(emphasis added).78 Nowhere does DLNR write that aquarium collecting had zero impact on their populations, which is understandable given that, for example, elsewhere DLNR reported that aquarium collecting removed upwards of 80% of Achilles tangs in the Open Area 30' – 60' range.	Your comment has been forwarded to the decision makers. The Preferred Alternative no longer includes collection of Achilles Tang. Furthermore, neither the RDEIS nor RFEIS claim that aquarium collection has not had an impact in the past, nor will it not have an impact in the future, only that based upon available data stopping collection alone would not reverse the declines.
For the Fishes	The Applicant's claim that "commercial aquarium collection under the Preferred Alternative is anticipated to have minimal impacts on populations in general is not supported by research which has found that aquarium collecting in West Hawai'i significantly impacts targeted populations.80 As explained throughout these comments, the existing and potential for even greater irrevocable losses of natural abundance caused by Applicant actions is irrefutable.	Your comment has been forwarded to the decision makers.
For the Fishes	Reef Habitat: The RDEIS claimed collection under the Preferred Alternative would be lower than the collection pressure that occurred under a 2003 study that found no significant differences in damaged coral or increases in macroalgae between control and collected sites.81 However, as detailed below there are numerous issues with those statements.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	During the Tissot survey years of 1997 to 1998, reported aquarium catch was approximately 8% higher than the 246,560 proposed under the Preferred Alternative.82 However, the collection pressure the preceded that study for over two decades was significantly lower: averaging approximately 181,600 fishes annually in the decade prior to Tissot's first survey year and 33,000 fishes annually in the decade before that (see Figure 11).	Your comment has been forwarded to the decision makers.
For the Fishes	Given that the impacts of aquarium collection certainly result from a combination of direct, indirect and cumulative effects of impacts, spanning years and decades, any conclusion that under the Preferred Alternative, reef habitat (or any) impacts would be less than found by Tissot and Hallacher is unsupportable. This is especially true, given that the collection pressure that has occurred since Tissot and Hallacher has significantly increased (e.g. was nearly double the Preferred Alternative a decade later).	Your comment has been forwarded to the decision makers.
For the Fishes	The RDEIS also claimed that "the pressures from commercial aquarium collection under the Preferred Alternative are anticipated to be lower than rates seen prior to the October 2017 ban on commercial aquarium collection; therefore, it is not anticipated that a significant impact on reef habitat as a result of the Preferred Alternative would occur." As explained above, under the Preferred Alternative, all 246,560 fish could be taken from a single zone. This distinct possibility was neither anticipated, nor analyzed in the RDEIS.	Your comment has been forwarded to the decision makers.
For the Fishes	Further, despite the claim of no coral damage by the 2003 study, damage to reef habitat from commercial aquarium collection is well documented. See "Damage to Reef Habitat" later in this document and also Appendix 2 where photographs of these practices and their effects can be found.	Your comment has been forwarded to the decision makers.
For the Fishes	Additionally, the Applicant relied upon the 2003 study to prove that aquarium collection of herbivores does not impact algae control, which does not stand up to scrutiny. Not only did the author's admit that further study was warranted because aquarium-targeted species primarily consume turf, not macro, algae, but macroalgae accounts for <2% of algal cover in West Hawai'i – the majority is turf algae, which renders the referenced study fairly irrelevant regarding algae, although it remains highly relevant regarding reduced fish abundance stemming from aquarium collecting.	Your comment has been forwarded to the decision makers. A statement has been added to the FEIS clarifying the importance of herbivores for controlling turf algae.
For the Fishes	The RDEIS cited a study that reported no significant differences between management areas for coral cover, total algal cover, or calcifying: non-calcifying ratio as of 2017, but that wasn't always the case.85 Prior to the 2015 catastrophic bleaching event, Open Areas had the lowest coral cover and the highest algal cover. Additionally, after that bleaching event, algal cover in both MPAs and FRAs increased to similar levels found in the Open Areas. (see Figure 8).	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	The Applicant stated that the Preferred Alternative would lessen the impact of aquarium fishing on herbivores via catch quotas, but did not quantify the so-called reduced impact.87 We estimate that under the Preferred Alternative collection of herbivore biomass would be approximately 6% less than occurred prior to the cessation of aquarium collecting in October 2017, but only under the hypothetical scenario where collection is spread evenly throughout the Open Areas (see Table 4). The fact is, that it could also increase within any of the AQ zones, should collection pressure increase compared to past pressure.	Your comment has been forwarded to the decision makers.
For the Fishes	The RDEIS referred to the increase in herbivore biomass within the WHRFMA that has occurred since 2003.88 However, the RDEIS omitted the connection between that increase and the 2014 anomalous recruitment pulse, and importantly, omitted the fact that herbivore biomass is still far below that which is needed to increase resilience and the chances for Hawai'i's coral reefs to persist with the climate catastrophe barreling down upon us. The aquarium trade's portion of reef fish biomass removal each year is substantial, and nearly 100% of it is herbivore biomass. Under prior collection rates it averaged 27% of the total reef fish biomass taken annually, and under the Preferred Alternative would represent 21% of the biomass. The RDEIS failed to analyze this significant reduction in herbivore biomass.	Your comment has been forwarded to the decision makers.
For the Fishes	Evidence throughout this comment document points to significant adverse impacts to reef habitat as a result of all proposed Alternatives with the exception of the No Action alternative, which is having a beneficial impact in the WHRFMA due to increased fish abundance since 2017.	Your comment has been forwarded to the decision makers.
For the Fishes	Cultural Resources: The flawed analyses used throughout the RDEIS, described in detail throughout these comments, led the RDEIS to anticipate no significant decline in the populations of the 8 White List species under the Preferred Alternative. However, that anticipation is unfounded given, for example, that the Preferred Alternative would allow collection of all 246,560 fish from a single zone—a scenario that was not analyzed. It therefore follows that cultural resources within or adjacent to a zone experiencing such pressure would be impacted.	Your comment has been forwarded to the decision makers. As stated in the EIS, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, all six action alternatives may impact cultural practices
For the Fishes	Moreover, the RDEIS acknowledged that for some native Hawaiians, any collection for aquarium purposes is contrary to cultural practices and beliefs, and that the Preferred Alternative may impact cultural practices, but then claimed that the extent of the impact is unknown. The Applicant may claim the extent of the impact is unknown, but that doesn't mean it can't be determined. White List species are currently in decline as a direct result of aquarium collecting and will continue to be for as long as aquarium collecting occurs on Hawai'i Island. Had the native Hawaiians who were consulted for the CIA been accurately informed in that process of the past and proposed impacts of the Applicant actions, the extent of the impacts to cultural practices would be better understood.	Your comment has been forwarded to the decision makers. None of the 8 species on the Revised White List are declining.

Commentor	Comment	Response
For the Fishes	Further evidence is found in the CIA which includes descriptions of significant adverse impacts to cultural resources as a result of all proposed alternatives with the exception of the No Action alternative, which is having a significant beneficial impact in the WHRFMA.	Your comment has been forwarded to the decision makers. As stated in the EIS, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, all six action alternatives may impact cultural practices
For the Fishes	The reduction of natural populations of species taken by the aquarium trade in any area (e.g. specific site, zone, coastline, island or statewide), and by any amount, whether one or one hundred percent, indicates an irrevocable commitment and loss of a natural and cultural resource.89 This very loss curtails the range of beneficial uses that would otherwise be provided by the natural abundance of these populations.90	Your comment has been forwarded to the decision makers.
For the Fishes	The RDEIS failed to accurately analyze the impacts of all alternatives, including the No Action alternative, which is having a beneficial impact in the WHRFMA. For example, the Preferred Alternative would allow 100% of the total allowable take to occur within one AQ zone. The RDEIS failed to analyze the impacts of that level of take in any of the 8 AQ zones and also failed to identify and factor the larval connectivity and dispersal patterns for the 8 White List species. Therefore, the question of whether the take of cumulative numbers of fish results in irrevocable loss or destruction of populations of fish, and how that loss relates to reef habitat and cultural resources, has not been adequately described.	Your comment has been forwarded to the decision makers.
For the Fishes	B. HEPA Significance Criteria #2: To the question of whether "the take of aquarium fish curtails the uses of the environment, including aquatic invasive algae control, the tourism industry, and the overall integrity of diverse aquatic ecosystems," the RDEIS wrongly concluded "the Preferred Alternative does not curtail the range of beneficial uses of the environment."	Your comment has been forwarded to the decision makers.
For the Fishes	Aquatic invasive algae control: The RDEIS claimed collection under the Preferred Alternative would be lower than the collection pressure that occurred under a 2003 study that found no increases in macroalgae between control and collected sites.91 However, as detailed above, the numerous issues with those statements include historical collection pressure prior to the 2003 study that was far lower than proposed in the Preferred Alternative, and the facts that the Open Areas had the highest levels of total algal cover and the lowest levels of coral cover until the 2015 catastrophic coral bleaching event that killed substantial amounts of corals and subsequently algal cover increased in the MPAs and FRAs.	Your comment has been forwarded to the decision makers.
For the Fishes	Reductions in herbivore biomass drive an increase of algae abundance. In West Hawaiʻi, herbivore biomass is as much as 2 times higher in the baseline MPAs than in the Open Areas and FRAs.92 Historically, 26.5% of the total biomass removed from West Hawaiʻi reefs in fishing and other extractive uses has been aquarium take, 98% of which are herbivores.93 Logically, it follows that algae control is being significantly curtailed by aquarium take in the Open Areas.	Your comment has been forwarded to the decision makers. As stated in the EIS, there is no signficant difference in herbivore biomass between FRAs and Open Areas, indicating that any declining trends or differences in herbivore biomass are not due to aquarium collection, but rather due to other types of fishing (i.e., food fishing).

Commentor	Comment	Response
For the Fishes	Tourism: The RDEIS claimed that "populations of the White List Species are not anticipated to significantly decline, therefore not significantly impacting viewing opportunities." The RDEIS failed to describe the significant population declines and viewing opportunities that have already occurred under decades of aquarium collecting: along 65% of the West Hawai'i coastline, Hawai'i's most iconic and brightly colored fish species, such as yellow tangs, Moorish Idols, and various butterflyfishes, have been reduced by staggering amounts ranging from 50% to upwards of 90% in some areas.	Your comment has been forwarded to the decision makers. Of the 8 fish species on the Revised White List, all have had stable or increasing population trends under historic rates of commercial aquarium collection.
For the Fishes	Additionally, the RDEIS failed to propose mitigation that would restore populations diminished by decades of over-collecting and would also prevent potentially significant declines that would occur within AQ trip zones that experience greater pressure than has occurred in the past.	Your comment has been forwarded to the decision makers.
For the Fishes	The annual "on-reef" tourism value for Hawai'i Island is estimated at $16,921,000, and that value is linked to the health and beauty of Hawai'i's reefs.94 As described below, viewing opportunities and "on-reef" tourism revenue losses resulting from depleted populations of brightly colored and beautiful fishes are captured in studies documenting willingness to pay and consumer surplus losses.	Your comment has been forwarded to the decision makers. As stated in the EIS, Hawai'i's tourism industry achieved new records in total visitor spending and visitor arrivals in 2017, marking the sixth consecutive year of record growth in both categories. This occurred while commercial aquarium collection was permitted.
For the Fishes	Integrity of Diverse Aquatic Ecosystems: The RDEIS claimed that "populations of the eight species on the proposed Revised White List are not anticipated to significantly decline."95 As described throughout this document, White List species are currently in decline as a direct result of aquarium collecting and will continue as such as long as aquarium collecting occurs on Hawai'i Island. Additionally, local extirpation has already been identified for some aquarium targeted species, which have been described by DAR and former aquarium collectors as "once common, now rare," a condition that likely exists for other species, as well.96	Your comment has been forwarded to the decision makers. All 8 species on the Revised White List have been stable or increasing, no species showing declines are included on the revised White List.
For the Fishes	The RDEIS failed to accurately analyze the impacts of all alternatives, including the No Action alternative, which is having a beneficial impact in the WHRFMA. For example, the Preferred Alternative would allow 100% of the total allowable take to occur within one AQ zone. The RDEIS failed to analyze the impacts of that level of take in any of the 8 AQ zones and also failed to identify and factor the larval connectivity and dispersal patterns for the 8 White List species. Therefore, the extent to which the take of aquarium fish curtails "the uses of the environment, including aquatic invasive algae control, the tourism industry, and the overall integrity of diverse aquatic ecosystems," has not been adequately described.	Your comment has been forwarded to the decision makers.
For the Fishes	Abundant and diverse coral reefs—put at risk by the Preferred Alternative—have a range of beneficial uses. The RDEIS failed to adequately assess the curtailment of the range of beneficial uses of the environment.97	Your comment has been forwarded to the decision makers.
For the Fishes	C. HEPA Significance Criteria #3: To the question regarding the extent to which the take of aquarium fish conflicts with the state's long-term environmental goals, the RDEIS wrongly concluded that "the Preferred Alternative does not conflict with the State's long-term environmental goals as established by law."	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	Among the state's long-term environmental goals, as plainly established in the Hawai'i Constitution, are to "conserve and protect Hawai'i's natural beauty and all natural resources" for the "benefit of present and future generations."98 Another of the state's long-term environmental goals is, unsurprisingly, provided for in HEPA itself: to "ensure that environmental concerns are given appropriate consideration in decision making."99 As an example of how the Applicant's RDEIS conflicts with these goals, the limited temporal scope of the Applicant's impacts analysis and failure to faithfully disclose the full range of impacts caused by the fishery pay no heed to the generational scope of state resource law, and certainly fall short of HEPA's disclosure requirements.	Your comment has been forwarded to the decision makers.
For the Fishes	Moreover, the RDEIS failed to appropriately consider the impacts of all alternatives, including the No Action alternative, which is having a beneficial impact in the WHRFMA. For example, the Preferred Alternative would allow 100% of the total allowable take to occur within one AQ zone. The RDEIS failed to analyze the impacts of that level of take in any of the 8 AQ zones and also failed to identify and factor the larval connectivity and dispersal patterns for the 8 White List species. Therefore, the extent to which the take of aquarium fish conflicts with the state's long-term environmental goals has not been adequately described.	Your comment has been forwarded to the decision makers.
For the Fishes	D. HEPA Significance Criteria #4: To the question of the impact of the take of aquarium fish on cultural practices in the state, the RDEIS wrongly claimed that "the Preferred Alternative does not substantially affect the economic welfare, social welfare, and cultural practices of the community or State, but plays an important role as a nearshore fishery in the State."100 The RDEIS failed to describe exactly how the conclusion was reached that the aquarium fishery, whereby 7 people profit through the taking and subsequent diminishment of populations of culturally important species, from culturally significant places, is more important than the cultural practices and concerns expressed by the dozens of people who participated in the CIA interviews.	Your comment has been forwarded to the decision makers.
For the Fishes	The RDEIS failed to accurately analyze the impacts of all alternatives, including the No Action alternative, which is having a beneficial impact in the WHRFMA. For example, the Preferred Alternative would allow 100% of the total allowable take to occur within one AQ zone, each of which is comprised of numerous ahupua'a. The RDEIS failed to analyze the impacts of that level of take in any of the 8 AQ zones and ahupua'a, and also failed to identify and factor the larval connectivity and dispersal patterns for the 8 White List species. Therefore, the impact on cultural subsistence practices has not been adequately described. Moreover, this misrepresentation of impacts to subsistence resources is then used to dismiss any concerns regarding non-subsistence cultural resources. One of the Applicant's fundamental errors, now and in previous iterations of its HEPA documents, is to equate "cultural impacts" with population counts for specific subsistence species, which is a false equivalency. The Applicant has never seriously addressed the aquarium trade's cultural impacts.	Your comment has been forwarded to the decision makers. As stated in the EIS, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, the Preferred Alternative may impact cultural practices, but the extent of the impact is unknown.

Commentor	Comment	Response
For the Fishes	E. HEPA Significance Criteria #8: To the question regarding the cumulative effect of the commercial take of aquarium fish using fine mesh nets when combined with the effects of: the commercial take of aquarium fish by other legal methods; the take of aquarium fish for recreational purposes; and, the commercial and non-commercial take of aquarium fish species for consumption as food, particularly including Achilles Tang and kole, the RDEIS wrongly concluded the Preferred Alternative does not involve a commitment for larger actions, because although there is a significant cumulative impact to some White List Species, the Preferred Alternative is not anticipated to be a significant contributor."101	Your comment has been forwarded to the decision makers.
For the Fishes	The RDEIS failed to accurately analyze the impacts of all alternatives, including the No Action alternative, which is having a beneficial impact in the WHRFMA. For example, the Preferred Alternative would allow 100% of the total allowable take to occur within one AQ zone. The RDEIS failed to analyze the impacts of that level of take in any of the 8 AQ zones and also failed to identify and factor the larval connectivity and dispersal patterns for the 8 White List species. Therefore, the cumulative effect of the commercial take of aquarium fish has not been adequately described.	Your comment has been forwarded to the decision makers.
For the Fishes	As described throughout this document, fundamental errors in the RDEIS's impact analyses resulted in failures to properly identify the varied and significant effects of commercial aquarium collection and led to erroneous conclusions and improper evaluations of these HEPA significance criteria.	Your comment has been forwarded to the decision makers.
For the Fishes	1) "The FEA identifies the scope of the analysis as one year and states that an EA with updated data and analysis would need to be completed on an annual basis. This improperly segments the analysis which must include the long-term and cumulative impacts over time of aquarium collection." The RDEIS failed to address this issue. See our detailed comment in the section, Failure to Adequately Analyze Long-Term Impacts	Your comment has been forwarded to the decision makers. The previous EIS and the REIS use a 5-year analysis period.
For the Fishes	2) "We appreciate that as an applicant action, the applicant can propose but not ensure regulations aimed at protecting and restoring populations of aquarium fish. We are interested in proposals for self-regulation by aquarium permit holders which could be incorporated into permit conditions even in the absence of or prior to establishing other regulations to accomplish the same purposes." The RDEIS assumed that the Preferred Alternative would be implemented though the aquarium permit terms and conditions.102 We note here that contrary to DLNRs above statement in the NOD, permit terms and conditions are legally binding, and are not simply a form of self-regulation.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	3) "Overall, we appreciate that certain alternatives have been proposed, but believe they are more appropriately proposed as mitigation measures in an environmental impact statement to mitigate potential environmental impacts, rather than as alternatives in an environmental assessment, which, if implemented, might result in a finding of no significant impact. The Department of Land and Natural Resources is obligated to ensure full analysis under HRS Chapter 343 of potential environmental impacts of its actions in issuing aquarium permits. We believe this is most appropriate in an environmental impact statement." The RDEIS failed to address this issue and proposed no mitigation measures because their flawed analyses led the Applicants to anticipate no impacts to populations of White List Species.	Your comment has been forwarded to the decision makers.
For the Fishes	The Board of Land and Natural Resources (BLNR), which oversees DLNR, published a Final Environmental Impact Statement (FEIS) Acceptance Determination in which they outlined 14 reasons for their non-acceptance of the Applicant's FEIS for the West Hawai'i Aquarium Fishery. Citing the Environmental Council's determinations that 3 of the reasons were arbitrary and capricious, the Applicant chose to address just 11 of the 14 reasons. The Applicant did so despite our advice to them that because the 3 so-called "arbitrary and capricious" reasons are pending further review by the court and Environmental Council, all 14 should be addressed in the RDEIS. As detailed below, a surprising number of the reasons for nonacceptance were not resolved in the RDEIS, which continued to fall far short of providing proper analyses, and failed to reach conclusions that are supported by the evidence.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	1. In order to properly assess the likely impact of the proposed take of the aquarium fish, the FEIS should contain a reasonably reliable estimate of the amount of future take. The RDEIS met the requirement to estimate the amount of future take, but failed to provide the constraints necessary to properly assess the likely impact. For example, the 246,560 fishes annually allowed under the Preferred Alternative might be taken from all 8 AQ zones within the WHRFMA, or from just one. Taking all 246,560 fishes from just one zone would have a significantly greater impact. This was not properly assessed. Commenters have repeatedly explained why this is essential, including in our consultation input to the Applicant, as follows: “An estimate of the amount of future take should be based upon a proposed maximum level of take, such as a determination of total allowable catch (TAC) for each White List species within a specific aquarium trip report sub-zone [AQ zone], or smaller area.” As described more in item 8. below, TACs should be based upon the unique life history traits of each species, the current status of the target species population within the AQ zone or smaller area (i.e. the impact of historical levels of take on the target species), whether or not a state of natural abundance has been achieved since 2018, and factor larval sources and sinks connected to or within that area. In addition, to ensure compliance, a catch verification system that does not rely upon funding from the Hawai'i Department of Land and Natural Resources (DLNR) for execution should be proposed.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	3. The existing regulations of the WHRFMA do not contain any daily or annual bag limits other than for the paku'iku'i, a "slot limit" for yellow tang, and a limit on kole over 4"long. To project how many fish are likely to be taken, the FEIS relies completely on the historical catch records of these ten fishers for the forty "White List" species. See Tables 5-2 and 5-11. The FEIS concludes that 160,832 fish would be taken annually, based on the maximum number taken by the ten permittees in any year, during the 2000-2017 period. See §5.4.1.5. The assumption that historical catch records adequately predict the future take has a number of shortcomings. As BLNR noted above, the FEIS concluded that a total of 160,832 fish would be taken annually by the 10 collectors, based on their prior (reported) efforts. Given that the RDEIS set total allowable catch limits for 8 species that amount to an annual total of 246,560 fish, by 7 collectors, representing an increase over the prior version of 53.3% in total take, and more than double by each collector, BLNRs concern over the shortcomings surrounding the Applicant's assumption that historical catch records adequately predict future take, were well founded, and we are left to wonder whether this increase might indeed reflect levels of prior unreported take.	Your comment has been forwarded to the decision makers.
For the Fishes	8. In order to assess the likely impact of the take, the FEIS should adequately analyze the sustainable level of take. The FEIS relies on Ochavillo and Hodgson (2006) for the proposition that 5-25% of a population is a sustainable level for annual take. The FEIS has an inadequate justification for the reliance on this publication as the best available science. The FEIS does not provide data for nor statistically analyze the sustainability of that level of take for each type of fish, given each fish species' life span, population size, reproductivity rates and age at first reproduction. The need for DLNR to define "sustainable" as it pertains to the diminishment of Hawai'i's reef wildlife for the pet trade outside the state, cannot be overstated. This must not be left to the Applicant. As a former DAR administrator wrote regarding the notion of "sustainability" and the aquarium trade, "the main management questions remain unanswered. Those questions are: what does sustainable mean, how do you measure it, what are the management goals, and how do you know if you are meeting those goals."103	Your comment has been forwarded to the decision makers. The Preferred Alternative is limited to species which have shown increasing or stable population trends, thereby using population trend data as the measure of sustainability, rather than the 5-25% range; therefore, the commentor's concern over the use of Ochavillo and Hodgson (2006) is moot as the EIS does not rely on that.

Commentor	Comment	Response
For the Fishes	One method used by fisheries managers bases sustainable levels of catch on the unique life history characteristics of each species, such as described by BLNR above and used by Ochavillo and Hodgson (2006). Another example is an ecosystem-based approach such as was used in a study cited in the RDEIS. That study determined that implementing a minimum size limit and reducing take to no more than 10% of natural biomass of a heavily targeted Caribbean herbivore added enough resilience to coral reefs in that area that they may persist into the future.104 Absent from each of those methods, however, is a cost and benefit analysis, such as the one referenced earlier for the Hawaiʻi aquarium trade, that equally factors all stakeholders and not just the fishers.	Your comment has been forwarded to the decision makers. The Preferred Alternative is limited to species which have shown increasing or stable population trends, thereby using population trend data as the measure of sustainability, rather than the 5-25% range. See earlier response related to the cost and benefit analysis paper referenced by the commenter.
For the Fishes	In any case, the RDEIS did not address this point and continued to use the life history characteristics for species not covered under the RDEIS and not occurring in Hawaiʻi (i.e. the Ochavillo and Hodgson manual) to justify so-called "sustainable" collection levels for the White List species, despite the facts that doing so is baseless, unprecedented, and unnecessary, given the decades of aquarium catch and species abundance data at relevant scales, that is available to the Applicant from DLNR. In addition to the detailed input we provided in our consultation letter to the Applicant on this issue, and the extensive comments we provided in the first DEIS on this issue, we note the following here regarding the Ochavillo and Hodgson (2006) manual (emphasis added in all cases): • "This manual has been developed as a guide for scientists to be able to analyze ornamental fisheries with limited historical data and to set total allowable catch limits for targeted ornamental populations" (see Manual, pg. 7) o This does not apply to Hawai'i which has detailed historical data on aquarium collecting including reported catch, by zone, and the impacts of that catch, by zone, as compared to natural, unfished abundance. • "Table 3: Proportion of populations of ornamentals suggested as sustainable collection levels based on estimated natural mortality rates." (see Manual, pg. 13) o Just 2 of the 33 species included in the table occur in Hawai'i, one of which, the bird wrasse, is on the White list. The Hawaiʻi data is far more relevant. o The RDEIS did not calculate natural mortality rates for any of the 8 White List species.	Your comment has been forwarded to the decision makers. The Preferred Alternative is limited to species which have shown increasing or stable population trends, thereby using population trend data as the measure of sustainability, rather than the 5-25% range; therefore, the commentor's concern over the use of Ochavillo and Hodgson (2006) is moot as the EIS does not rely on that.
For the Fishes	The RDEIS added a section discussing the role of herbivores, but failed to disclose and describe the impact of the Preferred Alternative on herbivore populations.	Your comment has been forwarded to the decision makers. As stated in the EIS, impacts under the Preferred Alternative are anticipated to be similar to those under the Pre-Aquarium Collection Ban Alternative. DAR (2019a) reported that herbivore biomass has not changed since 2003 in the Open Areas or FRAs.

Commentor	Comment	Response
For the Fishes	Abundant populations of herbivorous fishes are critically important to coral reefs. They keep algae from overgrowing corals or preventing new corals from starting. Reductions in herbivore biomass drive an increase of algae abundance. Important families of herbivorous fishes in Hawai‘i include surgeonfishes, damselfishes and parrotfishes.	Your comment has been forwarded to the decision makers.
For the Fishes	Historically 98% of the fishes taken by the aquarium trade in West Hawai‘i are herbivores, the vast majority of which are surgeonfishes. In the RDEIS, 7 of the 8 species under the Preferred Alternative are herbivores, and they represent >99% of the total allowable take proposed.	Your comment has been forwarded to the decision makers.
For the Fishes	Fishing and aquarium collecting are significantly impacting herbivore biomass in West Hawai‘i: herbivore biomass in MPAs is 70% greater than Open and FRAs.105 Importantly, the lowest levels are typically found in the Open Areas, which experience extraction pressure from both food fishing and aquarium collection. (See Figure 9).106	Your comment has been forwarded to the decision makers. As stated in the EIS, DAR (2019a) reported that herbivore biomass has not changed since 2003 in the Open Areas or FRAs and has increased by 30.8% in the MPAs. While there has been no significant change in Open Areas or FRAs, there has still been an increasing trend, with a 14.4% increase in herbivore biomass in FRAs and a 26.0% increase in herbivore biomass in Open Areas between 2003 and 2017 (DAR 2019a, Gove et al. 2019). This occurred even with the pressures from commercial aquarium collection, which was occurring during this time. Furthermore, the marked increase in herbivore biomass in more restrictive MPAs, and the fact that there is no significant difference between Open Areas and FRAs, indicates that any declining trends or differences in herbivore biomass are not due to aquarium collection, but rather due to other types of fishing (i.e., food fishing).
For the Fishes	The RDEIS avoided discussing this negative finding through its focus on before-after comparisons using arbitrary dates, and which hid the impacts, as we have discussed in these Comments, at length. Case in point: rather than describing the impacts of decades of aquarium collecting, as we have done in our comments, the RDEIS focused on a DAR statement “that herbivore biomass has not changed since 2003 in the Open Areas or FRAs and has increased by 30.8% in the MPAs,” and concluded that it “indicat[ed] that historic aquarium collection is sustainable,”107 a conclusion that was not reached in the DAR document cited.	Your comment has been forwarded to the decision makers. The text in the FEIS has been revised to make it clear that the sustainability conclusion is not from the DAR.
For the Fishes	Moreover, the RDEIS omitted the fact that herbivore biomass is still far below that which is needed to increase resilience and the chances for Hawai‘i’s coral reefs to persist with the climate catastrophe barreling down upon us. The aquarium trade’s portion of reef fish biomass removal each year is substantial, and nearly 100% of it is herbivore biomass. Under prior collection rates it averaged 27% of the total reef fish biomass taken annually, and under the Preferred Alternative would represent 21% of the biomass.	Your comment has been forwarded to the decision makers. As stated in the EIS, the marked increase in herbivore biomass in more restrictive MPAs, and the fact that there is no significant difference between Open Areas and FRAs, indicates that any declining trends or differences in herbivore biomass are not due to aquarium collection, but rather due to other types of fishing (i.e., food fishing).

Commentor	Comment	Response
For the Fishes	Though the RDEIS cited Gove and DLNR 2015, 2019 repeatedly, it excluded the information that unlike the MPAs, herbivore biomass in both FRAs and Open Areas exhibited significant declining long-term trends, and that increases in fish abundance in recent years were likely due to the 2014 fish recruitment anomaly.108, 109	Your comment has been forwarded to the decision makers. Gove et al. (2019) does not state that increases are "likely" due to 2014, but rather states "The recent increase in fish abundance observed across management areas may be attributed in part to high levels of recruitment in 2014. " Furthermore, the paper does not state that herbivore biomass has exhibited significant declining long-term trends, but rather "Herbivore biomass has not changed in open areas or FRAs in the past 14 years. However, herbivore biomass in MPAs has increased by nearly a third since 2003 and is currently (2017) 1.7 times greater compared to FRAs and open areas. "
For the Fishes	Additionally, the RDEIS claimed the Preferred Alternative would lessen the impact of aquarium fishing on herbivores by reducing the number of species that can be collected and establishing individual catch quotas for the 8 species on the Revised White List.”111 However, because that statement is inaccurate, and because the direct, indirect, and cumulative/long-term impacts of the proposed level of take are not described in the RDEIS, for the following reasons, it failed to meet HEPA requirements: • The RDEIS did not quantify the impact of aquarium collecting on herbivores. • The RDEIS did not quantify the reduced impacts the Applicant claims would occur under the Preferred Alternative. • Collection of herbivores in any given zone could increase under the Preferred Alternative. • The total allowable catch would be less than reported regularly since 2003, but more than was reported during the prior 27 years. • The total allowable catch would allow aquarium collectors to take more reef fish from West Hawai‘i reefs than all food fishers, combined (see Table 4). • Under the Preferred Alternative, aquarium collection would amount to 55.9% of the total number of reef fish and 20.6% of the total biomass taken from West Hawai‘i reefs, 99.9% of which would be herbivore biomass.	Your comment has been forwarded to the decision makers. The impact of aquarium collection on herbivores is discussed in Section 5.4 of the EIS. Collection under the Preferred Alternative would include up to a maximim of 246,560 individual fish, the majority of which are herbivirous. As detailed in the EIS, this is the only Alternative with a hard upper limit on collection, and excludes collection of the other 32 White List species or any fish from East Hawaii. The cumulative impacts of other fishing are discussed in Section 5.4.3 of the EIS.

Commentor	Comment	Response
For the Fishes	Further, the RDEIS claimed that collection rates under the Preferred Alternative would be lower than what occurred in the Tissot and Hallacher (2003) study which found no increases in the abundance of macroalgae where the abundance of herbivores was reduced by aquarium collecting.113 As explained below, that statement is both inaccurate and irrelevant. During the Tissot survey years of 1997 to 1999, reported aquarium catch averaged about 250,000 fishes each year—not much more than the 246,560 proposed under the Preferred Alternative.114 The impacts on the reefs were the result of that direct collection pressure combined with the indirect and cumulative impacts of collection pressure over the prior two decades, which occurred during periods of reported catch that was substantially lower, averaging approximately 181,600 fishes annually in the decade prior to Tissot's first survey year and 33,000 fishes annually in the decade before that (see Figure 11). Therefore, under the Preferred Alternative, collection pressure would be at least as much as, if not far greater than the collection pressure that caused the significant aquarium collecting impacts documented in the Tissot 2003 and 2004 studies.	Your comment has been forwarded to the decision makers. The text in the RFEIS has been revised to clarify.
For the Fishes	Further, the RDEIS omitted Tissot and Hallacher's conclusion that their study may not be a good test of that hypothesis for several reasons, including that herbivores taken by aquarium collectors primarily consume filamentous algae (i.e. turf), not macroalgae, and that further investigation is warranted.115 Additionally, most algal cover in West Hawai'i is from turf algae. Macroalgae accounts for <2% of algal cover in West Hawai'i which renders the referenced study fairly irrelevant regarding algae, although it remains highly relevant regarding reduced fish abundance stemming from aquarium collecting.116	Your comment has been forwarded to the decision makers. A statement has been added to the FEIS clarifying the importance of herbivores for controlling turf algae.
For the Fishes	Additionally, not only did the RDEIS omit the most important finding in Tissot et al. (2003), while including an irrelevant point regarding macroalgae, it also omitted research documenting that, for over a decade, the Open Areas had the lowest levels of hard coral cover and the highest levels of total algal cover, which is predominantly turf algae (see Figure 8).117 Total algal cover in the protected areas began significantly increasing following the crash in coral cover that resulted from the 2015 ocean heat wave and coral bleaching event.	Your comment has been forwarded to the decision makers. The figure included in the comment does not include significance of any differences. The EIS included this information on coral cover, including that Open Areas have lower coral cover, though the difference was not significant in any year of monitoring (2003, 2007, 2011, 2014, 2016, 2017); see Section 5.4.1.3 of the EIS. Language has been added to the FEIS stating that algal cover did not differ significantly between FRAs and Open Area (Gove et al. 2019).
For the Fishes	The RDEIS failed to discuss the relationship between the Open Area high levels of total algal cover, the extent to which the historical removal of hundreds of thousands of herbivores, representing upwards of 74,000 lbs. of herbivore biomass contributed to that algal cover, and how it relates to herbivores and algal cover under the Preferred Alternative.	Your comment has been forwarded to the decision makers. Gove et al. (2019) did not find a significant difference in algal cover or herbivore biomass between FRAs and Open Areas. This information has been added to the EIS.

Commentor	Comment	Response
For the Fishes	Further, the RDEIS downplayed the importance of herbivores taken by aquarium collectors, as follows: • Claimed that the smaller fish, which are the primary targets of the trade, are "the least effective sizes for cropping algae."118 • Ignored the fact that juvenile yellow tangs are 56% less abundant in the Open Areas.119 • Ignored the research documenting the importance of smaller bodied fish in reef algal consumption.120, 121, 122	Your comment has been forwarded to the decision makers. The following statement has been added to the FEIS: "It is noted that despite this increase in Open Areas, MPAs and FRAs still had significantly higher densities of juvenile Yellow Tang in 2017 when compared to Open Areas (Gove et al. 2019). " The following statement has been added to the FEIS: "It is noted that small grazers can be important for turf algae and macroalgal removal (Kelly et al. 2017).".
For the Fishes	In doing so, the RDEIS failed to discuss the extent to which aquarium collecting contributes to the total algal cover in the WHRFMA, particularly in the Open Areas.	Your comment has been forwarded to the decision makers. Gove et al. (2019) found that algal cover did not differ significantly between Open Areas and FRAs.
For the Fishes	The RDEIS attempted to downplay the impact of aquarium collecting on surgeonfish abundance with a misstatement from Foo et al. (2020) that, "Surgeonfish biomass declines linked most strongly to changes in reef rugosity."123 What Foo et al. (2020) actually reported was that grazer (i.e. surgeonfish) biomass increased with increasing rugosity and that it "showed the strongest positive relationship with rugosity. However similar relationships with rugosity were seen for all fish functional groups."124	Your comment has been forwarded to the decision makers. The commenter is not correct in referring to the statement in the EIS as a misstatement, as this line is a direct quote from the abstract of Foo et al. (2021). In addition, the two statements quoted by the commenter are not inconsistent with one another. It stands to reason that if surgeonfish biomass goes down when rugosity goes down, then surgeonfish biomass also goes up when rugosity goes up.
For the Fishes	Importantly, the RDEIS omitted negative findings that while surgeonfish biomass is significantly decreasing, Foo et al. (2020) documented that grazer biomass was the greatest in the areas where aquarium collection was banned.125, 126 These findings contradict the Applicant's claim that differences in herbivore biomass are not due to aquarium collection, but are due to food fishing.127	Your comment has been forwarded to the decision makers. Foo et al. (2021) actually conclude that biomass was significantly greater in areas that banned spear fishing compared to areas that did not ban spear fishing. Additionally, four of the five most abundant species from the surveys are primarily caught by spear. The EIS includes a statement about spear fishing impacts on herbivores based on this study.
For the Fishes	In 1987, the year when reported aquarium catch exceeded 100,000 for the first time ever, yellow tangs were considered the dominant herbivore in West Hawai'i (see Figure 11).128 The extent to which the reduction in yellow tang abundance on the majority of West Hawai'i reefs has impacted the key ecosystem function provided by yellow tangs—under past and future proposed aquarium collection that is 2-3 times higher than it was in 1987—was not discussed in the RDEIS.	Your comment has been forwarded to the decision makers.
For the Fishes	Additionally, the RDEIS failed to disclose the beneficial impact of the No Action alternative on the White List herbivores which is occurring as a result of the cessation of legal aquarium collection in the fourth quarter of 2017. The Applicant was asked to include information on the increasing species but did not do so and claimed that information was not available to their knowledge.129 This, despite the fact that the RDEIS included evidence of those increases for the top 2 most collected species, the yellow tang and kole.130	Your comment has been forwarded to the decision makers. Language has been added to the RFEIS related to projected population trends under the No Action Alternative.

Commentor	Comment	Response
For the Fishes	If the RDEIS is to be believed, the aquarium trade has not contributed to any of the reduced herbivore abundance and biomass that is so well documented by science. Magically, the 74,000 lbs. of herbivore biomass annually taken by aquarium collectors, which historically amounted to 26% of the total reef fish catch biomass (i.e. including all food fishers) in West Hawai'i, had no effect, whatsoever, and will continue to do so under their Preferred Alternative. Such wishful thinking has no place in an EIS, which requires complete and factual analyses under HEPA.	Your comment has been forwarded to the decision makers. As stated in the EIS, DAR (2019a) reported that herbivore biomass has not changed since 2003 in the Open Areas or FRAs and has increased by 30.8% in the MPAs. While there has been no significant change in Open Areas or FRAs, there has still been an increasing trend, with a 14.4% increase in herbivore biomass in FRAs and a 26.0% increase in herbivore biomass in Open Areas between 2003 and 2017 (DAR 2019a, Gove et al. 2019). This occurred even with the pressures from commercial aquarium collection, which was occurring during this time. Furthermore, the marked increase in herbivore biomass in more restrictive MPAs, and the fact that there is no significant difference between Open Areas and FRAs, indicates that any declining trends or differences in herbivore biomass are not due to aquarium collection, but rather due to other types of fishing (i.e., food fishing). As concluded by the DAR and cited in the EIS, 12 of the 40 White List Species have shown declining populations. These are occurring in both areas open and closed to commercial aquarium fishing for all but one species, indicating that aquarium collection is not driving the decline (DAR 2019a). Because these declines are occurring in FRAs and/or MPAs as well (i.e., areas not open to commercial aquarium collection) it is reasonable to assume that banning commercial aquarium collection would not halt the declines. In any case, none of the 12 speices with declining populations are included on the Revised White List.
For the Fishes	11. The FEIS does not adequately discuss relevant negative findings, for example, the reduced numbers of aquarium fish at collection sites found by Tissot and Hallacher (2003). The FEIS need not agree or disprove the negative findings, but it should discuss them. The RDEIS did not address this reason for nonacceptance, citing the Environmental Council's determination that it was "arbitrary and capricious," and refused to consider this item because it was under judicial review. Importantly, the Hawai'i State Environmental Court has since vacated the Environmental Council's determination and remanded this specific issue back to the Council for further proceedings. The Applicant's continual failure to address this issue may ultimately be reversed, which would prompt further environmental review.	Your comment has been forwarded to the decision makers. This concern was determined by the Environmental Council to be arbitrary and capricious.

Commentor	Comment	Response
For the Fishes	As Commenters advised in our consultation letter, "the disclosure and discussion of findings contrary to what is claimed by the Applicant (i.e. negative findings), which in many cases are contained within the RDEIS but neither disclosed, nor described, is key to a legal, adequate EIS." Numerous examples are found within the comments we've submitted beginning with the DEA and culminating with our testimony to the BLNR on the FEIS. In addition, comments from others describing other negative findings, and new research that has been published, should also be included. Additional details and examples are provided below.	Your comment has been forwarded to the decision makers. Relevant edits have been made to the RDEIS and RFEIS, inclcuding the addition of citations. All comments received have been included as appendices to appropriate documents.
For the Fishes	Examples of Negative findings: Tissot and Hallacher (2003); Tissot et al. (2004); U.S. Coral Reef Task Force; Clark and Gulko (1999); WHAP data 1999 - 2018; Gove et al. (2019): Tissot and Hallacher (2003) sought to quantitively estimate the effects of aquarium collecting on fishes on the Kona coast through a comparison of differences in fish abundance between sites open to collection and control sites where collection is prohibited.131 They concluded that "aquarium collectors have significant effects on the abundance of targeted fishes on the Kona coast of Hawai'i."	Your comment has been forwarded to the decision makers.
For the Fishes	In 2004, building on their earlier work, Tissot et al. reported on surveys from numerous additional sites and concluded that aquarium targeted fishes were significantly less abundant in the Open Areas compared to the MPAs, with differences ranging between 14-97%.132 They further noted that with two exceptions, the results were "remarkably similar" to their results reported in 2003.133 In 2005, the U.S. Coral Reef Task Force described those results as follows: "Severe overfishing for aquarium trade occurs even in the United States: Aquarium fishes outside of reserves [in West Hawai'i] experience significant declines – from 14% to 97%."134 Similarly, per a DLNR report on the state of Hawai'i's reefs, on Hawai'i Island, aquarium collecting was have a major impact and was one of the main causes of coral reef degradation.135	Your comment has been forwarded to the decision makers. The DLNR report mentioned by the commenter, stating that aquarium collection was having a major impact on coral reef degradation, is from 1999, prior to the creation of the WHRFMA. Therefore, it is not relevant to the current aquarium collection due to the 20 years of management in WHRFMA spcifically targeted at species collected by aquarium collectors. Nevertheless, a statement has been added to the cumulative effects section to reflect past impacts.
For the Fishes	The aquarium collecting effects they documented are presented below (see Table 5 and Figure 10). Table 5 presents the effects alongside the WHAP data from 2017/2018 for the same species, two of which are among those proposed for the new White List in the RDEIS. As shown in the table, aquarium collecting continues to have a significant effect on targeted species, even after the 2014 anomalous surge in fish abundance and the cessation of legal collection as of the fourth quarter of 2017.	Your comment has been forwarded to the decision makers. Historic data can at times be useful and informative, but shouldnot be used at the exclusion of the most current and up-to-date data. The EIS uses more recent population trend data, and all 8 species on the Revised White List have had stable or increasing populations. Comparing densities within MPAs, which ban all fishing, to Open Areas is not an adequate analysis of the impacts of aquarium collection, which is more acurately analyzed by comparing FRAs with Open Areas.
For the Fishes	Importantly, the collection impacts reported by Tissot in both papers resulted, at least in part, from collection rates that were substantially lower than the 246,560 total allowable take proposed under the Preferred Alternative, which is contrary to the assertion made in the RDEIS that collection was higher under Tissot.138	Your comment has been forwarded to the decision makers. The EIS uses more recent population trend data, and all 8 species on the Revised White List have had stable or increasing populations.

Commentor	Comment	Response
For the Fishes	During the Tissot survey years of 1997 to 1999, reported aquarium catch averaged about 250,000 fishes each year—not much more than the 246,560 proposed under the Preferred Alternative.139 The impacts on the reefs were the result of that direct collection pressure combined with the indirect and cumulative impacts of collection pressure over the prior two decades, which occurred during periods of reported catch that was substantially lower, averaging approximately 181,600 fishes annually in the decade prior to Tissot's first survey year and 33,000 fishes annually in the decade before that (see Figure 11). Therefore, under the Preferred Alternative, collection pressure would be at least as much as, if not far greater than the collection pressure that caused the significant aquarium collecting impacts documented in the Tissot 2003 and 2004 studies.	Your comment has been forwarded to the decision makers. The Tissot survey years were conducted prior to establishment of the WHRFMA. The Preferred Alternative includes only 8 species which can be collected, and includes a continuation of existing regulations (FRAs, MPAs, bag/slot limits).
For the Fishes	Additionally, as early as the mid 1980's, when reported catch had yet to exceed 100,000, aquarium collecting impacts were already noticeable to dive tour operators, who in 1987 negotiated a voluntary agreement with the trade to refrain from collecting in certain areas.140	Your comment has been forwarded to the decision makers.
For the Fishes	Therefore, the Applicant's claim that "commercial aquarium collection under the Preferred Alternative is anticipated to have minimal impacts on populations in general" is unsupported by both scientific and anecdotal findings summarized in this section which unequivocally show that aquarium collecting at rates similar to or less than proposed in the RDEIS, significantly impacts targeted populations in West Hawai'i.141	Your comment has been forwarded to the decision makers. The Revised White List includes only 8 species, all of which have had increasing or stable population trends.
For the Fishes	The RDEIS cited Gove et al. (2019) numerous times, but omitted highly relevant, although negative, findings, such as the significant impacts of aquarium collection on the most heavily targeted fish, the juvenile yellow tang. Gove reported that juvenile yellow tangs in the MPAs and FRAs are 66% and 90% more abundant than in the Open Areas (i.e. 56% less abundant in the Open Areas), a difference that increased from 2003 to 2017.143 The RDEIS also failed to discuss the extent to which the significantly reduced abundance of juvenile yellow tangs in the Open Areas has contributed to the significantly increased total algal cover in those same areas (see Figure 12).	Your comment has been forwarded to the decision makers. Details on juvenile yellow tang and algal cover from Gove et al. (2019) have been added to the FEIS.
For the Fishes	Ignoring the negative findings, the RDEIS instead provided the statistic that juvenile yellow tangs significantly increased by 60.8% in the Open Areas between 2003 and 2017, and although that before-after comparison uses arbitrary dates that do not represent a time before aquarium collecting (a problem throughout the RDEIS).145 This is another example of the RDEIS omitting negative findings which are based upon the same data and found in the very reports and studies it uses to make claims and inferences that aquarium collecting does not impact targeted fish species.	Your comment has been forwarded to the decision makers. Additional data from Gove et al. (2019) has been added to the FEIS. The date range (2003-2017) is from the citation, and were not dates chosen by the Applicant, however, they do represent a timeframe during which aquarium collection was occurring within the WHRFMA.
For the Fishes	Further examples of negative findings occur throughout these Comments and include data and conclusions found in these studies and reports: Bozec (2016); DLNR (2004, 2010, 2015, 2019); DLNR Species of Concern; DLNR/South Kohala Reefs in Dire Straits; Schaar and Cox (2021); Williams and Walsh (2007).	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	12. The extreme threat of climate change on our reefs warrants extreme caution in reviewing activities that may affect them. The FEIS should further discuss potential effects of present and future levels of climate change including ocean warming, ocean acidification, coral bleaching, extreme storms, and resulting reef destruction and algae growth, and the potential for mitigating harm (i.e. further regulation) if the proposed fishery has unanticipated or greater negative effects with climate change. The RDEIS failed to adequately evaluate the extreme threat to targeted fish species and coral reefs from the combination of aquarium collection and climate change. The RDEIS recognized that climate change poses serious threats to Hawai'i's coral reefs and the species targeted by the Applicant, claimed that "the Preferred Alternative was specifically designed to help buffer climate change by creating individual catch quotas," yet failed to quantify and evaluate the impacts of the Preferred Alternative which includes the annual removal of 246,216 herbivores—representing 20% of the total reef fish biomass taken annually from West Hawai'i reefs—from reefs located in areas ranging in size from 1 to 8 AQ zones.146	Your comment has been forwarded to the decision makers.
For the Fishes	Further, the RDEIS completely ignored a key aspect of this nonacceptance item: a discussion or proposal for mitigation in the event of unanticipated or greater than anticipated negative impacts from aquarium collecting stemming from climate change. For example, under the Preferred Alternative, should climate change result in habitat destruction (e.g. from storms, ocean heat waves, or acidification) or reduce the abundance of any of the White List species, during any permit period, nothing prevents the 7 aquarium collectors from focusing all of their effort in a single zone, or from removing all of any given species (in a "get it while you can" mentality).147 As we explain elsewhere, this is not mere speculation, as it has already happened on O'ahu. The RDEIS did not address this, although further analysis of impacts and exacerbation of impacts due to climate change is required, as is mitigation.	Your comment has been forwarded to the decision makers.
For the Fishes	One such mitigation measure might be, for example, a proposal for minimum thresholds for coral cover, total algal cover, species abundance, and herbivore biomass, which when crossed, as indicated by WHAP monitoring, would automatically trigger the closure of the impacted zone(s) and/or set the total allowable catch to zero for the impacted species until the population is restored.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	13. The FEIS failed to sufficiently consider cultural impacts. The FEIS improperly concluded that the impacts to cultural resources under any of the proposed alternatives would be less than significant based on the flawed premise that cultural impacts would only occur if the proposed action would cause a significant decline in the population of a White List Species considered to be a cultural resource. A number of testimonies expressed misgivings from a cultural standpoint with the proposed activity itself, regardless of impact on resources, and this was not adequately considered in concluding no significant impact. See pages 28, 31; and, Section VII. Flawed Analysis of Cultural Impacts and Lack of Proposed Mitigation Measures	Your comment has been forwarded to the decision makers. The FEIS states "given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, the Preferred Alternative may impact cultural practices, but the extent of the impact is unknown."
For the Fishes	Environmental impacts from aquarium trade activities have been documented for over forty years. Under the Preferred Alternative, which lacks take limits tied to specific sites, major impacts, with potential catastrophic effects to the 8 White List species could still occur within any of the 8 AQ zones and countless smaller bays and reefs that make up the WHRFMA.	Your comment has been forwarded to the decision makers.
For the Fishes	As has been long recognized, the impact of commercial aquarium fish collecting is a complicated issue. The fish community members are highly dependent on one another. There is a constant interaction between predators and competitors, as well as other members of the food web. There is a lot of variability in the system, even when it is not disturbed by man. Reefs seem to undergo natural cycles. At times they may be very abundant. There is also natural variation in the fish community at different locations.148	Your comment has been forwarded to the decision makers.
For the Fishes	The RDEIS failed to assess the high aesthetic value of this beautiful marine life as well as impacts to the complex relationships inherent in coral reef ecosystems and impacts to overall coral reef health. “Animal communities” are included in the rule definition for “environment,” however the RDEIS excluded any mention of the impact to fish and invertebrate communities, or the impact to the animals themselves.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	A. Damage to Reef Habitat In nearly every encounter with commercial aquarium collectors on West Hawai'i reefs, snorkelers, and divers have witnessed and documented destructive practices that harm corals, with the most damage coming from vessel anchors and chains. Additionally, nets, weighted with lead, are placed in the corals, materials mimicking sand is laid on top of corals, sticks are hit against corals to chase the target fishes into the nets, buckets, underwater propulsion devices (scooters) are laid in the corals and the fins, knees and legs of collectors often come in contact with the reef—in fact, they are typically described as "crawling across" or "standing" on the corals. Furthermore, for two of the White List species, the Chevron Tang and Potter's Angelfish, capture frequently involves the use of sticks which are thrust into fragile finger coral habitat in order to flush out the hiding fish.149 The results of these actions include abrasion and coral breakage. The RDEIS referred to a study that determined there was no evidence to indicate the presence of destructive fishing practices (e.g. breaking apart corals to capture hiding fishes) from just two sites.150 However, there is an abundance of photographic evidence documenting coral breakage from vessel anchoring and fish capture activities that means these impacts cannot be dismissed and must be evaluated in the RDEIS. Photographs of these practices and their effects can be found at Appendix 2.	Your comment has been forwarded to the decision makers. The EIS cites the two publicly available articles related to coral damage and commercial aquarium collection in Hawaii, and concludes that, while these two studies do not indicate significant differences between fished and unfished areas, that does not mean that no damage occurs. However, until further studies are conducted, they provide the best available science on the direct effects of commercial aquarium collection on coral.
For the Fishes	B. Examples of Impacts in Various Hawai'i Island Regions Baseline fish population data from the 1970's at Honaunau in West Hawai'i were compared to data gathered in surveys conducted 1998 – 2001. The results indicated that nearly all small bodied surgeonfish, butterflyfish and angelfish (i.e. species targeted by the aquarium trade) declined in abundance. Commercial aquarium collecting was implicated in the decline (see Figure 13).151 Similar results were found at Ke'ei where the site had been intermittently surveyed since 1979.152 "Of the 20 most collected aquarium species, 18 declined in abundance with the species facing the heaviest fishing pressure typically showing the greatest declines."154	Your comment has been forwarded to the decision makers. The figure and studies referenced by the commenter are comparing fish abundance from the 1970s to 1998-2001, at the beginning of the establishment of the WHRFMA, and prior to the implementation of the White List and other regulations and management specifically targeting White List species over the past 20 years..
For the Fishes	In addition to documenting the impact of aquarium collecting in these areas, these studies also document baselines for abundance levels of aquarium targeted and other impacted species. Examinations of reported catch, as documented by DLNR, serve to further highlight the impacts of the trade. 155 The documentation shows that the initial surveys were conducted during a time when the aquarium trade reported taking fewer than 33,000 fish annually from West Hawai'i reefs. In subsequent years, from 1987 to the final surveys in 2001, reported aquarium fish catch in West Hawai'i had skyrocketed to an annual catch of more than 218,000 individuals, on average. Since then the annual West Hawai'i aquarium fish catch has ranged between 250,00 and 550,000 fish.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	Under the Preferred Alternative, 246,560 fish could be taken, making this especially relevant. Additionally, with the closure of approximately 32% of the reefs in West Hawaiʻi with the implementation of the FRAs in 2000, this increased fishing pressure was focused in smaller areas with likely intensified results. The RDEIS failed to acknowledge this example of significant aquarium collecting impact in these areas.	Your comment has been forwarded to the decision makers. The EIS uses data from 2000-2017, during a time when the current FRA and MPA system was in place, to evaluate impacts. All 8 species on the Revised White List have had stable or increasing populations during this time, even with potentially increased pressures in Open Areas.
For the Fishes	Another long-term study looked at reefs in South Kohala and determined that reef fish abundance was in “drastic decline” and reefs were in “dire straits”.156 Populations of all of the top five most abundant fish families had declined since the original surveys conducted in 1979-1981 (see Figure 14). Thirty-one of the thirty-five most abundant fish species had declined, including 19 species targeted by the aquarium trade. Most of the aquarium targeted species had declined by more than 50% and many were down by more than 80%.157 The extent to which the massive increase in reported take contributed to this decline was not studied in the RDEIS. Nor was this reduced fish abundance factored into the Preferred Alternative with zone and site-specific take limits to address these situations.	Your comment has been forwarded to the decision makers. The paper and figure referenced by the commenter also state the following "the widespread declines in families of fish not typically targeted either for food use or for the aquarium fishery suggest that other, more widespread factors are additionally contributing to the overall long term declines in fish abundances".
For the Fishes	As the Applicant noted in the FEISs’ responses to this comment, DLNR reported that “given the length of protection at these sites and the overall decline in habitat quality and fish populations in South Kohala it seems unlikely that the declines are due primarily to aquarium collecting.” 158[emphasis added] Rather than rebutting the argument that further analysis is needed, this statement only served to highlight why the RDEIS needed to also evaluate the potential of cumulative impacts of other factors (e.g. pollution, and sedimentation) on targeted fish species, such as decline of coral coverage, which have been demonstrated to influence reef fish species diversity and abundance.159 Here, too, the flawed analyses failed to accurately identify impacts.	Your comment has been forwarded to the decision makers.
For the Fishes	The areas south of these reefs are subject to some of the most intense aquarium collecting pressure in the state. Aquarium take between Keahole Point and these reefs in South Kohala, in one year alone, exceeds the aquarium take from the entire Great Barrier Reef in Australia, which has a reef area that is 300 times larger than Hawaiʻi’s. For example, in 2014 aquarium collectors reported taking 191,083 fish from the two zones that make up this area. 161 By comparison, 2014 reported aquarium take from the Great Barrier Reef was 112,000.162 Under the preferred alternative, all 246,560 could be taken from just one of these zones, with disastrous consequences.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	The Dire Straits study also documented a 90% decline in herbivorous surgeonfish and damselfish populations, while parrotfish populations had actually increased over time.163 That 90% decline in herbivores contributed to a 35% reduction in coral cover, a 64% reduction in coral building coralline algae, a 38% increase in algae at one site and a staggering 322% increase in algae at another. Claims by the Applicant that parrotfishes are more important herbivores than surgeonfishes when it comes to keeping algae in check on coral reefs are challenged by this study given the parrotfish increases. On these South Kohala reefs, the increased parrotfish populations were not enough to offset the loss of surgeonfishes and damselfishes, and the algae still outcompeted the corals. The notion that surgeonfishes taken by the aquarium trade are not an important component to coral reef health is challenged by this study.	Your comment has been forwarded to the decision makers. Both areas included in the "Dire Straits" study are closed to commercial aquarium collection. As stated in the paper, "the widespread declines in families of fish not typically targeted either for food use or for the aquarium fishery suggest that other, more widespread factors are additionally contributing to the overall long term declines in fish abundances".
For the Fishes	Further, a more recent assessment of ecosystem trends in West Hawaiʻi includes, among other data, the differences in herbivore biomass and coral cover between reefs on the northern portion of the West Hawaiʻi coast (which encompasses the South Kohala area described above and extends from Keahole Point, northward) and reefs on the southern portion (from Keahole Point, southward).164 The data shows that herbivore biomass in the north is significantly lower than that found on the south.165 Additionally, while the northern reefs are now dominated by algae, and coral cover has declined by ~30%, the same not true for the southern reefs.166 Notably, though the northern area is ~33% smaller than the area to the south, catch reports do not indicate a corresponding reduction in take. In fact, in 2014 take was higher in the north than in the south.167 The extent to which heavy collection pressure in the north has contributed to this shift was not addressed in the RDEIS. Neither does it propose any mitigation or plan to prevent it from worsening.	Your comment has been forwarded to the decision makers. The study referenced here, Gove et al. (2016), is referenced in the EIS, as well as a more recent study with updated data (Gove et al. 2019). The EIS discloses the differences between north and south in Section 4.4.5.
For the Fishes	The selection criteria used to determine the species for inclusion on the revised white list is highly problematic because it ignores the impacts to species that have occurred from decades of aquarium collecting that occurred without HEPA review. Here again, the RDEIS relied upon a before-after comparison using an irrelevant 'before' date that reflected the start of the WHRFMA, rather than the start of aquarium collection impacts on those species.	Your comment has been forwarded to the decision makers.
For the Fishes	Additionally, it included species that did not meet all of the criteria. For example, Black Surgeonfish only meet the criteria related to Open Area population density using the data from 2017/2018 which incorporated years when they were not facing collection pressure. Using years when they faced heavy collection pressure such as 1999/2000 and 2012/2013, their Open Area population density was 0.17 and 0.25/100m2, well below the 0.5 fish/100m2 threshold in the criteria.	Your comment has been forwarded to the decision makers. The criteria used the most recent population estimates available (2017/2018); it would not be relevant or prudent to use an outdated population estimate from 8-22 years ago. The FEIS has been revised to explain what population estimate was used.

Commentor	Comment	Response
For the Fishes	The RDEIS stated that "populations of the eight species on the proposed Revised White List are not anticipated to substantially decline under the Preferred Alternative," which is a misleading statement that omitted the fundamental facts that they are currently in significant decline as a result of aquarium collection (see Table 1). 168	Your comment has been forwarded to the decision makers. All 8 species on the Revised White List have been stable or increasing, no populations with significant declines were included. The commenter is erroneously comparing MPAs and Open Areas to illustrate population declines; this is not appropriate, as MPAs prohibit all fishing. Population trends are calculated by comparing population data from two or more different periods in time. The DAR determined population trends by comparing population estimated from 1999/2000 to 2017/2018, and these data were used as the basis for determining whether a species should be included on the Revised White List.
For the Fishes	Aquarium collectors in West Hawaiʻi historically took 1.8X more reef fish than recreational and other commercial fishing combined, most of which were yellow tangs and the results of that heavy collection pressure are described throughout these comments.169 Under the Preferred Alternative, 200,000 yellow tangs would be taken annually, and although the Applicant claimed it would not cause a substantial decline in their abundance, in part because it's lower than prior collection pressure, it's important to note that in 2002, the last time approximately 200,000 yellow tangs were taken, their abundance in the Open Areas was 9/100m2, which is below the 2018 levels of 24/100m2, and even farther below their natural abundance of 40/100m2 as of 2018 (see Figure 15).	Your comment has been forwarded to the decision makers. The EIS discloses that commercial aquarium collection collects 1.8X the number of fish, and discloses the density of White List species within Open Areas, FRAs and MPAs for comparison (see Table 5-7 and 5-11 in the EIS).
For the Fishes	The majority of West Hawaiʻi reefs are open to the aquarium trade and subject to diminishment by the trade. For example, the reduction in yellow tang abundance is apparent below in the large gap between the green line (Open Areas) and blue line (MPAs which serve as a proxy for natural abundance) and which represents millions of missing yellow tangs on West Hawaiʻi reefs. (see Table 1 and Figure 15).	Your comment has been forwarded to the decision makers.
For the Fishes	Further countering the Applicant's claim of no substantial decline is, the increase in FRA yellow tang abundance that began in 2003, three years after establishment of these replenishment areas, and the increase in Open Area abundance that began in 2017 after the cessation of aquarium collecting throughout West Hawaiʻi. These clear examples help to reveal the impacts of the trade on natural populations: when collection pressure was removed, populations significantly increased. As noted earlier, those increases are separate from the overall increase in yellow tang abundance that have occurred since 2014 is due to the anomalous recruitment pulse that coincided with warming waters in 2014.172 Typical recruitment pulses, such as those that occurred in 2002 and 2009, have resulted in short-lived increases in fish populations that were followed by prolonged or short and steep population declines (see Figure 15).	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	In addition to the impacts to biodiversity, ecosystem function, and other fisheries, aesthetic and other social values are also heavily impacted.174 Species experiencing the heaviest collection pressure, with a corresponding reduction in natural abundance, are Hawai'i's most beautiful, charismatic and iconic fishes. The diminished aesthetic value from the cumulative and substantial reductions in species such as yellow tangs, butterflyfishes and Moorish Idols, which are dominated by vibrant yellows and oranges and striking white and black patterns, cannot be overestimated (see Figure 16). These colors are more than aesthetically pleasing, as our eyes are physiologically attuned to them. The frequencies and wavelengths of yellows, oranges and reds allow them to strike our eyes much faster than the other colors. By removing the species with prominent yellow, orange, red or white coloration and markings, the palette and very essence of what makes a coral reef beautiful to the human eye is diminished and degraded. It is impossible to decrease populations of a coral reef's beautiful wildlife without greatly decreasing the natural beauty of the place. Divers who have frequented these coral reefs, such as some of the Commenters, have noticed decreased abundance of colorful fish in recent years. The RDEIS failed to address these cumulative losses and propose proper mitigation measures.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	The RDEIS failed to acknowledge and address the effects of the trade on the recreational value of this marine life and their coral reef homes and propose proper mitigation measures. The annual estimated expenditures related to marine life viewing (i.e. snorkeling and scuba) in Hawai'i is $551 million. Reef-adjacent marine tourism expenditures (including hotel rooms) within 30 km of the coastline are an annual $680 million.176 These amounts exclude the lost value from declining fish abundance which is captured in willingness to pay surveys and summarized below: • Healthier reefs lead to substantial economic gains. o Recreational users are willing to pay higher rates for a healthier marine environment.177 o Snorkel/dive businesses benefit when there are more fish for their clients to see.178 One recent study showed divers were willing to pay $93 to $110 more to dive with abundant fish life. 179 • Without new regulations the potential for increasing losses is real. o Inability to stem declining reef fish numbers could cause significant losses to dive tourism industry (i.e. reductions in willingness to pay).180 o These consumer surplus losses could range from $1.2 million to $12.2 million annually.181 o Areas with degraded reefs and low fish populations could also see significant losses from a decrease in their share of the global dive market.182 o Anecdotal reports from long-time residents and visitors point to revenue loss already occurring from reduced abundance of beautiful fishes on Hawai'i reefs.	Your comment has been forwarded to the decision makers. As stated in the EIS, Hawai'i's tourism industry achieved new records in total visitor spending and visitor arrivals in 2017, marking the sixth consecutive year of record growth in both categories. This occurred while commercial aquarium collection was permitted.

Commentor	Comment	Response
For the Fishes	The RDEIS failed to acknowledge and analyze the effects of the trade on the substantial non-use values of this marine life and their coral reef homes and propose proper mitigation measures. Intrinsic and social values associated with coral reefs are diminished by reduced fish populations. Concern for the marine environment has increased in recent years and people now place tremendous value on coral reef ecosystems. Many people value beautiful and healthy coral reef ecosystems as part of their legacy and responsibility to ensure future generations are able to experience them. A 2011 NOAA report estimated the passive use annual value of Hawaiʻi's coral reef ecosystems through a willingness to pay survey of U.S. households. The survey included a visual representation of an overfished and an abundant coral reef (see Figure 17). The project determined that increased protections and restoration of degraded coral reefs in Hawaiʻi is worth about $288 to the average U.S. household which aggregated over all U.S. households amounts to a $34 billion annual passive use value for Hawaiʻi's coral reefs.184 This and other socio-economic values described here provide meaningful insights into the public's concerns and should be addressed in a comprehensive RDEIS.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	A major factor that drives the rates of collection is premature mortality rates in captivity. According to a long-time industry insider, most yellow tangs die within the first month in a hobbyist tank and fewer than 1% of those captured survive one year in captivity, although in the wild their lifespan is upwards of 41 years.185, 186 One of the core requirements of the aquarium collection statute is that aquatic life taken under the permit is maintained alive and in reasonable health.187 The RDEIS included a discussion on the post-collection mortality as an indirect effect. The RDEIS claimed that no post-collection data are available for fish collected in Hawai'i.188 However, as described below, that statement is incorrect: • A 2012 study of the aquarium trade included a consumer survey and an aquarium trade supply chain analysis. Hawai'i's yellow tang ranks among the top ten fish sold in the marine aquarium trade and was included in both aspects of the study.189, 190 In addition to 72 species that do not occur in Hawai'i, the analysis included Hawai'i's yellow tang and 12 additional species taken by Hawai'i aquarium collectors which also occur elsewhere in the Indo-Pacific. The analysis determined that mistreatment in capture, handling, transport, and holding plays a larger factor in these premature deaths rather than hobbyist inexperience.191 • A 2002 study documented mortality rates self-reported by Hawai'i aquarium collectors and dealers: o 0.5 – 2% during collection; 0 - 1% from collection to wholesaler; <1% - 2% in wholesaler tanks; .75% - 2% during shipping.192 o Aquarium catch reports differences between numbers caught and sold indicate that an average of 3% of captured fishes die at this stage of the chain of custody.193 • Wholesalers receiving fish from Hawai'i have reported a similar average "dead on arrival" rate of 0 - 3%, and note that the industry standard is to allow up to 5% to arrive dead with no charge-back to the shipper for losses.	Your comment has been forwarded to the decision makers. Post-collection mortality is discussed in Section 5.4.2. The study referenced by the commenter, Cartwright et al. (2012) is disclosed in the EIS, and included fish collected using cyanide and other methods not permitted in Hawaii. There were no post-collection mortality rates specific to Yellow Tang, and Yellow Tang references in the paper are limited to consumer willingness to pay surveys. The post-collection mortality rates from Dierking et al. (2002) have been added to the FEIS.
For the Fishes	Per Commenter's original consultation letter, we continue to assert the Applicant must provide the average and maximum annual mortality rates for the 8 White List species fish taken by each of the 7 collectors in order for DLNR to fulfill its statutory duties to exercise discretion in granting permits. Without this information the state has no way of assessing whether these permittees are responsible aquarium collectors that deserve these exclusive privileges. Furthermore, the public needs this information, as well, which is one of many reasons why withholding the identities of the 7 collectors until publication of the FEIS is unacceptable.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	A number of practices frequently utilized as cost saving measures by the aquarium trade in Hawai'i are inhumane and significantly contribute to the stressors that accumulate and ultimately lead to premature deaths of captive marine life. One such practice is the rapid surfacing of fish from the reef depths to the surface which causes an injury known as barotrauma that may impact the internal organs, eyes and brains of fishes. The fish captured by Hawai'i collectors typically are "partially decompressed with the residual trauma relieved by purging air from the fish's swim bladder using a hypodermic needle." (emphasis added)194 The purging of residual air from fish swim bladders is a technique known as "fizzing" among trade members. Per a marine aquarium trade best practices manual, "the use of a sharp instrument to deflate the swim bladder, a procedure known as "fizzing," or "needling" is not advisable."195 Instead, the best practice calls for the following: "When collecting fishes deeper than 30 feet (10m), raise holding containers at a rate no faster than 3 feet every 10 minutes."196	Your comment has been forwarded to the decision makers.
For the Fishes	In addition to being ill-advised, and traumatic to the animal, by knowingly and recklessly causing substantial bodily injury, it is also illegal according to Hawai'i's misdemeanor animal cruelty statute, which provides protections for all non-human animals.197 Further, the fact that collectors use practices that cause barotrauma counters the assertion made in the RDEIS that collectors use methods that avoid barotrauma.	Your comment has been forwarded to the decision makers.
For the Fishes	Other harmful practices include starving fish for 2 – 10 days prior to transport, and spine cutting, both of which are prohibited under the animal cruelty statute. Alternatives to these practices include withholding food for no more than 48 hours and transporting fish in larger volumes of water to dilute any waste produced by fishes during transport, and transport in hard plastic containers that cannot be punctured by fish spines.	Your comment has been forwarded to the decision makers.
For the Fishes	Every fish who dies early results in additional pressure then put on natural resources though the take of their replacements. There is a general consensus in many countries that it is not ethical to trade in live animals, unless their health and welfare are ensured. These unnecessary and early deaths have given the trade a poor image. A $20 million, multi-stakeholder reform effort, referred to as the Marine Aquarium Council, failed, in part, because of the trade's reluctance to address, and take steps to reduce, mortality rates.	Your comment has been forwarded to the decision makers. The Preferred Alternative includes a hard upper limit on collection, regardless of post-collection mortality rates. The post-collection mortality rates from Dierking et al. (2002) have been added to the FEIS, which are specific to Hawaii.

Commentor	Comment	Response
For the Fishes	Among the 8 White List species in the Preferred Alternative, two, the endemic Potter's Angelfish and the Black Surgeonfish (aka Chevron Tang), are sold through online retail outlets without the minimal and standard "arrive alive" guarantee that is provided to most species (see Appendix 3). They are considered by many trade members as species unsuitable for the hobby due to their especially high mortality rates during their first month in captivity. For example: • Potter's Angelfish was described by one industry expert as "doomed despite anything you might be able to provide or do."198 • Potter's Angelfish is said to suffer from Post Traumatic Shipping Disorder (PTSD, aka Delayed Mortality Syndrome) which "affects a large number of seemingly well-adjusted fish who die suddenly, days or weeks after transport."199 The cause may be inadequate nourishment during a period of significant (stress-induced) metabolic demand.200 • "Unfortunately, the Potter's is very prone to loss [without] much notice. Most die 'mysteriously' during the night. . . 'Looking perfectly fine' the day before. Following up on the issue of PTSD, the species is simply given to a low tolerance to stress."201 • "Historically the Potter's angel has a lousy survival record in captivity. Likely less than five percent are alive within one month of capture. . . Most of this attrition can be traced to damage in collection (getting thrashed by nets, their gill/opercular spine getting caught in netting), holding (totally unnatural "cubicle" settings or mixed in with fishes with no cover to hide in), shipping in too small bags . . . Along with dealers' and hobbyists practiced ignorance in keeping the species in inappropriate settings."202	Your comment has been forwarded to the decision makers.
For the Fishes	Further, the conditions described above (e.g. injury during collection, holding in unnatural "cubicle" settings, shipping in too small bags), and more, apply to all wild marine life captured for the aquarium pet trade. This helps explain why the remaining 6 White List species are sold without guarantees to stay alive beyond arrival or purchase for amounts of time ranging from 0 to 14 days. For example, saltwater fish at Petco stores are sold with zero guarantee to stay alive and purchases are nonrefundable, while freshwater fish are sold with a 30-day guarantee to stay alive, and Petco will "gladly refund your money" if they die within that time frame.203	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	Aquarium collectors and dealers need only to get these animals on a plane and out of Hawaiʻi in order to profit. The next level of profits flow to PIJAC members throughout the rest of the country (e.g. marine life wholesalers) who need only to sell these animals to the retailers, who, in turn, need only sell them to the hobbyist. At each of these steps, the risk of premature death to these animals is passed on to the buyer, and in any case, research shows that each step in the supply chain significantly profits from customer purchases to replace fish that die prematurely, and that profits from replacement fish sales are so high, sellers have no incentive to take action to reduce deaths.204	Your comment has been forwarded to the decision makers. The Preferred Alternative includes a hard upper limit on collection, regardless of post-collection mortality rates.
For the Fishes	The inherent harm, disrespect, and waste of Hawaiʻi's precious reef wildlife, that goes hand-in-hand with their capture and sale for profit in the pet trade, creates ethical and cultural conflicts that have has long been a point of contention between Hawaiʻi residents and the Applicant. For example, as noted by Tissot (2005) regarding conflicts with native Hawaiian culture: "Malama aina involves asking permission prior to fishing, taking only what you need, sharing your catch with your extended ʻohana or community and having respect for the sacredness of the process. Clearly, harvesting live fish for economic gain and shipping them in a bag for a long, convoluted odyssey, potentially resulting in mortality and waste, violates the very core of these traditional values."205	Your comment has been forwarded to the decision makers. As stated in the EIS, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, the Preferred Alternative may impact cultural practices, but the extent of the impact is unknown.
For the Fishes	The RDEIS failed to accurately describe the impacts to the White List species during and post-capture, and failed to provide mitigation measures to meaningfully reduce those impacts. Further, the RDEIS failed to describe why the Applicant's desire to profit from 4,376 Potter's angelfish, 3,152 black surgeonfish, 5,872 orangespine unicornfish, 30,000 kole, 344 bird wrasse, 2,016 Thompson's surgeonfish, 800 brown surgeonfish, and 200,000 yellow tang—nearly all of whom will die prematurely from the stress of captivity—is more important than their value to the reef and their value to Hawaiʻi residents.	Your comment has been forwarded to the decision makers.
For the Fishes	As set forth in HAR §§ 11-200-10, 16-18, a complete analysis and discussion of impacts to cultural resources is required. The RDEIS failed to accurately analyze the direct, indirect, and cumulative impacts on cultural resources, because it (1) fundamentally failed to accurately assess the reductions in fish abundance, and (2) artificially narrowed the scope of cultural impacts disclosed. The loss and harm caused by the irrevocable commitment of natural resources equally applies to impacts to cultural resources, as well. The RDEIS also failed to acknowledge and address the effects of the trade on native Hawaiian's traditional reliance on species targeted by the trade for subsistence, and most importantly, propose proper mitigation measures.	Your comment has been forwarded to the decision makers. As stated in the EIS, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, the Preferred Alternative may impact cultural practices, but the extent of the impact is unknown.

Commentor	Comment	Response
For the Fishes	Decades of the Applicant's actions have directly impacted more than 200 species and indirectly impacted an unknown number of additional vertebrate and invertebrate species found in Hawai'i's coral reefs, one of the most complex ecosystems on Earth, where the fate of each species is determined by the existence, abundance and diverse actions of a multitude of other species that inhabit or otherwise rely upon these unique places.	Your comment has been forwarded to the decision makers. Impacts under the Preferred Alternative would be limited to 8 species, and no other vertebrate or invertebrate species would be collected.
For the Fishes	While the CIA provided an extensive history of native Hawaiians and their symbiotic relationship with the ocean and its animal inhabitants, it completely dismissed the overwhelming oral testimonies in opposition to206 both past and current trade practices and impacts. More than 90 percent of those interviewed noted how the trade both directly and indirectly impacts their cultural resources, beliefs, practices and values, yet none of these concerns were addressed and no mitigation measures were proposed.	Your comment has been forwarded to the decision makers. As stated in the EIS, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, the Preferred Alternative may impact cultural practices, but the extent of the impact is unknown.
For the Fishes	The CIA also failed to propose any substantive mitigation measures to address the biological and various socio-economic impacts to cultural resources and the ethical concerns and harm done to the animals, themselves.	Your comment has been forwarded to the decision makers.
For the Fishes	The CIA initially acknowledged "As stated in the OEQC Guidelines for Assessing Cultural Impacts, the goal of the oral interview process is to identify information 'relating to the practices and beliefs of a particular cultural or ethnic group or groups' (State of Hawai'i, Office of Environmental Quality Control 2012:11). It is our contention that, in addition to assessing the significance of any identified traditional cultural properties, oral interviews should also be used to augment the process of identifying traditional cultural properties." Thus, it is the researcher's responsibility to utilize the gathered cultural-historical background information, as well as the information collected through the consultation process, to identify and describe potential cultural impacts to resources, practices, and beliefs, and to propose appropriate mitigative measures for those impacts as necessary.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	The RDEIS further stated: "As discussed in Section 4.2, detailed in the CIA, and mentioned by commenters during the comment periods of the previous EA and FEIS, many of the 40 White List Species have a cultural significance in Hawai'i, and there are distinct differences between the traditional Native Hawaiian approach to fish harvest and management and the western model approach" (emphasis added).207 However, the above statements and subsequent lack of proposed mitigation measures, do not reflect these findings. Fifty-five individuals were consulted for the CIA, 50 of whom voiced strong concern with the trade.	Your comment has been forwarded to the decision makers. As stated in the EIS: Measures included in the Preferred Alternative (e.g., limited permit issuance, Revised White List, and implementation of individual catch quotas) will mitigate potential impacts to cultural resources by halting collection of 32 species in the WHRFMA, and by limiting the number of the remaining 8 species which can be collected by any fisher in a given year. These measures may increase the number of White List Species available for cultural practices and traditional subsistence fishers, and potentially decrease user conflict between commercial aquarium collectors and subsistence fishers or cultural practitioners, though conflicts with other user groups may still remain. Although cumulative cultural resource impacts would be lower under the Preferred Alternative, the Applicant acknowledges that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices.
For the Fishes	The false equivalency declared in the CIA and parroted by the Applicant in its RDEIS is that "…if the issuance of commercial aquarium permits leads to a significant depletion of the populations of the above-mentioned species (either directly or indirectly through habitat disruption), then the result would be a cultural impact. Conversely, if the biological assessments (conducted by others) indicate that the issuance of the fourteen commercial aquarium permits will have no significant effect on either the fishes or their habitat, then the issuance of the permits would not result in a cultural impact."(emphasis added)208 Cultural impacts cannot be assessed only by counting fish. As well as unreasonably constraining the range of metrics by which cultural impacts may be evaluated, the biological assessments used to arrive at those metrics and analyze the impacts of the trade are extremely flawed, thus, the conclusion that the issuance of 14 permits will have no significant impact, is equally flawed, and barely begins to paint a picture of the trade's impacts to cultural resources. We continue to agree with a number of concerns earlier raised by DLNR, and respectively, the Office of Hawaiian Affairs (OHA): "Cultural impacts of aquarium fishing need significantly more analysis than provided in the FEA. The OEQC guidelines should be followed for assessing cultural impacts, including consulting with traditional cultural practitioners and other knowledgeable informants and sources about cultural resources, cultural practices, and the proposed action's potential impacts. Traditional Hawaiian practices and subsistence uses, local place-based and life-cycle knowledge, and traditional Hawaiian cultural significance of each type of aquarium fish taken should be reviewed. The indirect impact of modem technologies for highly efficient catch methods on traditional harvest capabilities should be included in the analysis." (emphasis added)	Your comment has been forwarded to the decision makers. As stated in the EIS, given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, the Preferred Alternative may impact cultural practices, but the extent of the impact is unknown.

Commentor	Comment	Response
For the Fishes	The RDEIS failed to respond to our questions regarding what type of gear/nets that are currently being used to collect animals (outside of fine mesh nets). The CIA failed to include a discussion on gear types or recommend any regulations or prohibitions on the use of aquarium collection gear, that allows for the take of hundreds more animals per day, than if using traditional subsistence fishing methods. Further, there is no discussion about additional species take-prohibitions, bag limits (less reducing the daily bag limit of Achilles Tang from 10 to 5), "pono" fishing practices, the foundation of which is taking only what is needed, or a discussion on "resting" (closing) certain areas from commercial extraction.	Your comment has been forwarded to the decision makers.
For the Fishes	OHA also states it "anticipates that the RDEIS will include a broader scope of analysis and include a consideration of all consequences on the environment, including both direct and indirect effects, in accordance with Hawaiʻi Administrative Rules § 13-200-17(i)…" yet the scope of the discussion of impacts is limited to 14 collectors who made up nearly 80 percent of the total catch even in years when not all 14 collectors were reporting take. The CIA also failed to include any legally required proposed mitigation measures, to address cumulative (past, present, and reasonably foreseeable future) impacts to cultural resources.210	Your comment has been forwarded to the decision makers. As stated in the EIS: Measures included in the Preferred Alternative (e.g., limited permit issuance, Revised White List, and implementation of individual catch quotas) will mitigate potential impacts to cultural resources by halting collection of 32 species in the WHRFMA, and by limiting the number of the remaining 8 species which can be collected by any fisher in a given year. These measures may increase the number of White List Species available for cultural practices and traditional subsistence fishers, and potentially decrease user conflict between commercial aquarium collectors and subsistence fishers or cultural practitioners, though conflicts with other user groups may still remain. Although cumulative cultural resource impacts would be lower under the Preferred Alternative, the Applicant acknowledges that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices.
For the Fishes	In yet another gross contradiction, the CIA states that: "According to those guidelines: In scoping the cultural portion of an environmental assessment, the geographical extent of the inquiry should, in most instances, be greater than the area over which the proposed action will take place. This is to ensure that cultural practices which may not occur within the boundaries of the project area, but which may nonetheless be affected, are included in the assessment. (State of Hawaiʻi, Office of Environmental Quality Control 2012:11) For this reason, for assessing the potential cultural impacts of the issuance of fourteen commercial aquarium permits within the WHRFMA, the entire fishery management area along the western coast of Hawaiʻi Island is considered, not just those areas within which commercial aquarium fishing will be permitted. To Hawaiʻi's host culture, the ocean is viewed as an integrated whole, flowing unrestrained by politically imposed boundaries…" but failed to consider the impacts to the entire island of Hawaiʻi, including the East side of the island which is seeing increased take rates from those seen in the past, with no disclosure or discussion of current gear-take methods, or the impacts of reducing species in one area impacting their health and abundance in other areas.	Your comment has been forwarded to the decision makers. The EIS concludes that all action alternatives may have a cultural impact, and does not limit that impact spatially.

Commentor	Comment	Response
For the Fishes	The CIA concludes with the following inadequate and/or unmeasurable recommendations, that in no way could be considered substantive mitigation measures, especially based on the numerous oral interviews and testimonies proposing a full closure of the trade or significant remedies to past and continuing conflict: "It is clear that the nearshore waters of West Hawai'i Island, along with all of its contributing tangible and intangible elements and associations, could be considered a traditional cultural property significant under Criteria a, b, and e. Having a comprehension of the traditional cultural significance of nearshore waters of West Hawai'i Island by all of its user constituencies, is a first step in ensuring that the activities of any one user group does not in any significant way conflict with the activities of another user group. As part of any future permitting processes associated with the WHRFMA, it is recommended that DLNR-DAR provide to potential permit issuees a document that provides a synopsis of the traditional cultural significance of the fishery" (emphasis added). It is woefully inadequate to attempt to simplify this complex issue by only providing collectors with "a" document. There is no way to ensure that collectors even read the document let alone take any actions not to impact cultural resources, beliefs and practices.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	The CIA then states: "… the authors recommend that PIJAC, and any commercial aquarium fishers who intend to conduct their operations within the WHRFMA, consider developing or partnering with governmental and/or local organizations to help improve the management and sustainability of the nearshore fishery as a means to not only sustain, but actually improve reef-fish populations in the take areas . . ." (emphasis added). The CIA notes that aquarium collectors should "consider developing or partnering with governmental and/or local organizations to help improve management and sustainability of the nearshore fishery . . ." yet failed to provide even the most basic information, timeline, or explanation as to how any partnership would proceed. The CIA further states the hope of improving reef-fish populations in the take areas, yet goes on to support the status quo, "it is recommended that the existing bag limits and no-take areas within the WHRFMA remain in-place . . .". The CIA adds "Furthermore, it is recommended that the applicant (PIJAC) continue to work with the approving agency (DLNR), and the various other user groups within the WHRFMA, to help improve the transparency of the accounting methods for fish takes, and the enforcement of the existing rules and regulations that govern those takes. With respect to limiting the potential for cultural impacts, DLNR-DAR plays a significant role in managing and enforcing the rules and regulations that are intended to support the sustainability, viability, and fecundity of the WHRFMA . . ." yet provides no information or guidance on actually improving the transparency of catch/accounting records and enforcement. This approach removes any all responsibility and accountability from the collectors and offers no solutions to the issues of enforcement, compliance and oversight. The CIA continues, "As voiced by many of the consulted parties, the lack of support and funding have hampered DNLR DAR's ability to fulfill its fiduciary responsibility, namely to enhance, protect, conserve, and manage Hawai'i's unique and limited resources, which are supposed to be held in public trust for the current and future generations of the people of Hawai'i nei, and visitors alike. While achieving this goal is not an easy task, and it certainly cannot be achieved by any single means, DLNR-DAR should be proactive in seeking additional funding sources, and work with the various user groups who are most familiar with the WHRFMA, including the commercial aquarium fishers, to improve its enforcement capacity." (emphasis added) Again, this empty statement provides no information on mitigation measures, including proposed regulations, or funding sources, that could encourage better compliance or enforcement.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	Finally, the CIA notes "As expressed by multiple community members, the lack of enforcement by DLNR-DAR has resulted in community members feeling the need to police their respective areas themselves, which ultimately diverts time and energy from their desire to educate the next generation of Hawaiʻi and to perpetuate their own cultural practices. As part of improving enforcement, as expressed by some of the consulted parties, the DLNR-DAR should consider incorporating more traditional Hawaiian fishery resource management practices (as detailed above) into the management of the WHRFMA, and representatives from the aquarium fishing industry should continue to work with the other user constituencies (i.e., native Hawaiian organizations) that maintain an interest in the WHRFMA" yet failed to include any discussion on what, if any, traditional Hawaiian fishery resource management practices should be considered, when they might be considered or how.217 In summary, the CIA remains extremely flawed and inadequate, with its inherent purpose—to identify the full range of potential cultural impacts and propose mitigations measures to limit such impacts—not being met.	Your comment has been forwarded to the decision makers.
For the Fishes	The RDEIS failed to describe the potential effects on the environment or provide meaningful and accurate analyses for any of the alternatives, both proposed and dismissed, because it used an incorrect and irrelevant baseline, hypothetical scenarios, expanded spatial scales, and omissions of essential data in its analyses.	Your comment has been forwarded to the decision makers.
For the Fishes	The Revised White List and Limited Permit Issuance Preferred Alternative is not reasonable, as is required by HEPA.218 The Preferred Alternative ignores the vast majority of the input and comments submitted throughout this process by the Commenters and Consulted Parties, as well as the many public comments naming locations where the impacts of collecting pressure are of concern. Contrary to what is claimed in the RDEIS, this alternative does not ensure the Applicant's Actions do not lead to degradation of fish populations and the habitats in which they occur, and does not specifically addresses concerns related to declining populations and sustainable collection.	Your comment has been forwarded to the decision makers. The Revised White List and Limited Permit Issuance (Preferred) Alternative was developed in response to the fundamental and most prevalent comment received on previous HEPA documents, including numerous comments from the commentor. That is, the concern that the preferred alternatives in the FEA and FEIS could lead to unlimited collection. In direct responce to those comments, the preferred alternative in the RDEIS and RFEIS addresses this issue by creating a hard upper limit on collection, thereby preventing unlimited collection. In addition it does not include collection of 32 species which do not meet the criteria recommended by the DAR for inclusion on the Revised White List, limits the number of permits, and does not propose any collection outside of the WHRFMA.

Commentor	Comment	Response
For the Fishes	A reasonable alternative would require the Applicant to first determine: 1) the life history, spawning grounds and offspring/recruitment patterns for each species to be collected for aquarium purposes; 2) natural abundance (i.e. unfished) levels and complete stock assessments, for each AQ zone, for those same species (see DLNR map of aquarium trip zones at Appendix 4);220 3) a definition for "sustainable" as it relates to the natural abundance of coral reef species taken in Hawai'i for aquarium purposes; and 4) annual total allowable catch, by species, designed to restore and then sustain natural abundance levels, with negligible impacts as defined in the Queensland Ecological Risk Assessment of the Marine Aquarium Fish Fishery, for each species to be taken for aquarium purposes, in each zone. After making these necessary threshold determinations, the Agency would issue up to 7 Aquarium Permits, by zone and by species with corresponding total allowable catch limits, per the above parameters.	Your comment has been forwarded to the decision makers.
For the Fishes	Another example of a reasonable alternative would be a moratorium on the take of herbivores, which was considered but dismissed in the RDEIS, based on an erroneous and outrageous claim that aquarium collection is not causing a decline in herbivores.222 As described above, aquarium collection certainly is contributing to the reduced herbivore biomass in the Open Areas as shown by the herbivore biomass in the MPAs which is far greater.	Your comment has been forwarded to the decision makers.
For the Fishes	Furthermore, the costs to administer the aquarium trade was omitted from analyses of the alternatives, including the No Action Alternative, which would incur costs associated with enforcement, as indicated by the 3 cases and 8 individuals in 2020 alone who were involved with large scale poaching in West Hawai'i. DLNR has estimated that the costs to administer the aquarium trade, including resource monitoring, but excluding enforcement, ranges from $300,000 to $500,000 annually, statewide.223 Additionally, DLNR has estimated that commercial fisheries cost the state $1,000,000 annually, above and beyond license fees, which amounts to approximately $333 per commercial marine license. All of those administrative costs and their funding sources, together with enforcement costs and funding sources, should be described for each alternative.	Your comment has been forwarded to the decision makers.
For the Fishes	Moreover, the No Action Alternative was not analyzed or described properly. Obvious beneficial impacts to populations of targeted species have occurred since the cessation of aquarium collection in 2017. Data presented in the RDEIS included some of those benefits, but it was not described as such or analyzed.	Your comment has been forwarded to the decision makers. To the Applicant's knowledge, no statistical analysis has been conducted on population trends since commercial aquarium collection was ended in October 2017.

Commentor	Comment	Response
For the Fishes	Additionally, that information was requested of the Applicant in the consultation letter, and the Applicant responded in the RDEIS that the information is not available to their knowledge. Commenters are left to assume that the Applicant did not actually attempt to obtain the information, because we requested, and received, a subset of that data for 2019 from DAR. Since then, DAR has conducted WHAP surveys for 2020, as well. Describing the beneficial impacts of the No Action Alternative, rather than pretending that they don't exist, is required under HEPA.	Your comment has been forwarded to the decision makers.
For the Fishes	HEPA also requires an EIS to consider mitigation measures, however, such a discussion is plainly absent from the RDEIS. Decades of Applicant actions have directly impacted the 8 White List species in addition to the more than 200 other fish species previously collected; and, indirectly impacted an unknown number of additional vertebrate and invertebrate species found in West Hawai'i's coral reefs, one of the most complex ecosystems on Earth, where the fate of each species is determined by the existence, abundance, and diverse actions of a multitude of other species that inhabit or otherwise rely upon these unique places.	Your comment has been forwarded to the decision makers. As stated in the EIS: Measures included in the Preferred Alternative (e.g., limited permit issuance, Revised White List, and implementation of individual catch quotas) will mitigate potential impacts to cultural resources by halting collection of 32 species in the WHRFMA, and by limiting the number of the remaining 8 species which can be collected by any fisher in a given year. These measures may increase the number of White List Species available for cultural practices and traditional subsistence fishers, and potentially decrease user conflict between commercial aquarium collectors and subsistence fishers or cultural practitioners, though conflicts with other user groups may still remain. Although cumulative cultural resource impacts would be lower under the Preferred Alternative, the Applicant acknowledges that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices.
For the Fishes	Further, collection rates under the Preferred Alternative are higher than those that occurred in the 1970's when a decline in yellow tang and other reef species was reported by the Division of Fish and Game (now DLNR); and, higher than those that occurred in the 1980's when conflicts arose between marine tour operators and aquarium collectors as the trade expanded and conservation concerns increased; and, higher than those that occurred through much of the 1990's, just prior to the Tissot studies that found aquarium collecting was significantly impacting populations of targeted species.	Your comment has been forwarded to the decision makers.
For the Fishes	Yet, the RDEIS claimed the Preferred Alternative is not anticipated to cause population declines and, therefore, proposed no mitigation measures. Such an outrageous claim is made possible only through the deeply flawed impact analyses presented throughout the RDEIS that rendered invisible the significant impacts that are evident and have been so for decades.	Your comment has been forwarded to the decision makers.
For the Fishes	The flawed impact analyses also led the RDEIS to omit any proposals to mitigate the biological and related impacts to the various socio-economic values, to cultural resources, and to address the ethical concerns, violations of Hawai'i's animal cruelty statute and harm done to the animals, themselves, described herein.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	The Applicant failed to conduct the required early consultations prior to submitting its Draft and Final Environmental Assessments, despite the HEPA requirement that the Applicant must "at the earliest practicable time, . . . consult with . . . those citizen groups and individuals which the approving agency reasonably believes to be affected." In this case, it is clear from the long history of litigation that Commenters, at the very least, should have been consulted. The Applicant should also have consulted native Hawaiian groups (outside of those contacted as part of CIA). To this end, we expected the Applicant to comply with the requirement "to develop a fully acceptable draft EIS prior to the time the draft EIS is filed with the office, through a full and complete consultation process, and shall not rely solely upon the review process to expose environmental concerns."	Your comment has been forwarded to the decision makers. Consulted parties are described in Section 6.1 of the EIS. Furthermore, the public has had the opportunity to comment on the previous HEPA documents as well.
For the Fishes	Further, we expected our substantive comments on the first DEIS to be incorporated and our January 2021 consultation to be responded to in writing and incorporated into the RDEIS by the Applicant prior to the filing of the RDEIS with DLNR and Office of Environmental Quality Control. We also expected that the responses would not be merely self-serving recitations of benefits and/or rationalizations of the proposed actions. However, these expectations were not met. See Appendix 1 for a detailed description of how the Applicant's responses to the questions we raised during consultation process were inadequate.	Your comment has been forwarded to the decision makers. As required, all comments received regarding each of the HEPA documents were disclosed. In addition, responses were provided in writing, as shown in Appendix B of the DEIS, and incorporated into the RDEIS as appropriate.

Commentor	Comment	Response
For the Fishes	The Certificate of Origin proposed in the RDEIS to allow for better tracking and enforcement amounts to a small step in the right direction but is rife with issues that must be addressed to ensure compliance. In its current form the Certificate of Origin is little more than a duplication of the existing permit system which is easily manipulated. For example: • Collectors must already report their catch; and name the dealer sold to. • Dealers must already report purchases from collectors. • Hawai'i Department of Agriculture must already inspect and approve shipments (inter-island). Gaping holes in process and resources facilitate the intra and interstate movement of unreported, uninspected, unidentified coral reef wildlife in the aquarium trade. For example, DLNR lacks the resources and capacity to enforce these existing requirements via real time comparisons of catch records and dealer reports. Additionally, the Hawai'i Department of Agriculture (HDoA) inspectors have been video recorded giving collectors the green inspection tags without even leaving their offices to look at the boxes. In another recorded incident, a green tag was simply taped to the outside the door for a collector to pick up, without any direct contact between the inspector and the collector. Moreover, collectors and dealers can easily conspire to ensure that sales records match purchase records, given they share the same interest in protecting profits. There is nothing that would prevent collectors and dealers from continuing to conspire through underreporting, or nonreporting, to ensure any quota is not met, so that collection and profits can continue.	Your comment has been forwarded to the decision makers. This section has been revised in response to comments on the proposed additional enforcement and compliance measures.

Commentor	Comment	Response
For the Fishes	Adequate enforcement to ensure compliance is best handled by DLNR and DOCARE, not HDoA. Given the loopholes in the Applicant's plan, and the decades-long compliance issues, we propose the following inspections by DOCARE officers and DAR staff to ensure compliance: • Upon return to harbors or ramp facilities (date/time confirmed in advance): DOCARE verification of required licenses and permits; zone where collection occurred (per vessel GPS); species and numbers collected; fish mortalities; and, next immediate destination (i.e., warehouse, holding facility). • At warehouses/holding facilities (unannounced): DOCARE inspections to ensure terms and conditions of the aquarium permit which requires the animals to be held in good conditions, to verify equipment (tanks, oxygen levels) are functioning and maintained, that record keeping, and reporting requirements are being met, including catch and sales reports, and verify mortality. • At air cargo carriers (date/time confirmed in advance): DOCARE inspections of containers to be transported off-island and packing lists (or similar document) to verify number and species, and destination/receiver information. Forward federal Lacey Act documentation, labeling and other potential violations to USFWS. • Administrative (monthly): DAR inspections and comparisons of collector catch reports, dealer reports and packing lists/invoices to ensure accurate accounting; and coordination with DOCARE to ensure catch quotas are not exceeded. • State and Federal Taxes: additional permit term and condition requiring tax clearance certificates for state and federal taxes prior to issuance of permit.	Your comment has been forwarded to the decision makers. DOCARE has the authority to perform additional inspections as outlined by the commenter, and the DNLR/BLNR have the authority to impose additional permit conditions as appropriate upon permit issuance.
For the Fishes	Permittees would bear the full burden of expenses associated with needed staff through fees to the state. Costs related to the Certificate of Origin and enforcement measures described above should be calculated and obtained from DLNR. Additionally, DLNR has estimated the current costs to administer the aquarium trade (statewide), including resource monitoring in West Hawai'i at $300,000 to $500,000 annually, statewide.230 Permit fees should be collected that meet those costs, in addition to the commercial fisheries shortfall related to the permittees under the Applicant's proposal, and all resources needed to ensure compliance with species, catch numbers, catch locations, and all other terms and conditions, as outlined above.	Your comment has been forwarded to the decision makers. This section has been revised in response to comments on the proposed additional enforcement and compliance measures.
For the Fishes	For the reasons explained above, the RDEIS was patently insufficient in its analysis of the impacts of commercial aquarium collection permits. Therefore, as the impacts remain unevaluated, so too, are the alternatives and the mitigation measures necessary to eliminate, reduce, and rectify those impacts.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
For the Fishes	The legislature has decreed it the "policy of the State" that DNLR and other agencies must "[c]onserve natural resources . . . by preserving or augmenting natural resources, and by safeguarding the State's unique natural environmental characteristics . . . ." The Agency must also "[e]ncourage management practices which conserve . . . all natural resources," and encourage all individuals "to fulfill the responsibility as trustees of the environment for the present and succeeding generations." In enacting HEPA, the State legislature found "that the quality of humanity's environment is critical to humanity's well-being, [and] that humanity's activities have broad and profound effects upon the interrelations of all components of the environment . . . ." The Agency simply cannot meet these mandates by allowing any aquarium collection resulting from this flawed evaluation, in light of the serious environmental consequences of those permits that have yet to be accurately described by the Applicant.	Your comment has been forwarded to the decision makers.
Diane Ware	Sierra Club strongly believes that "the No Action Alternative regarding openocean aquarium collecting is the best and only acceptable alternative". I concur with this evaluation and support research to develop and sustain captive breeding for species used in the aquarium trade.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Diane Ware	The applicant did not adequately address several concerns of BLNR's denial of the first DEIS. In particular the deficiencies include #13 regarding adverse cultural impacts revealed and confirmed by numerous Kanaka Maoli. The dismissal of impacts and devaluing of the Hawaiian culture and its practices has been ongoing for 200 years of white colonial domination. As quoted in the CIA , "Kānaka Maoli participation gradually waned (Glazier 2007). As the commercial fishing industry continually expanded to meet the demands of the growing consumer population in the islands, the fish and other marine resources became more scarce. With the shift to a market economy and a commercial fishery these marine resources were valued mostly for their economic potential, and little to no regard was paid to the myriad of traditional values and more that emphasized the spiritual, cultural, familial, and ecological importance of the fish and other marine species. Maly and Maly (2003:ix) contend that "this trend has continued through the present-day and fostered the decline in health and well-being of the broad range and diversity of Hawaiian fisheries". Key words here are "more scarce", "shift to a market (profit) economy" and "no regard to the myriad and ecological importance of the fish." This process of diminishing the indigenous culture for the profit and control of land and resources has had the effect of a "knee on the neck" of the Hawaiian culture and the few kanaka maoli who have survived two centuries of western supremacy. I would suggest a very comprehensive and inclusive ho'oponopono to achieve some degree of reconciliation and repair of injustices incurred. Making a pause in the practice of aquarium reef fish extraction would be a genuine beginning of the process and result in a return to natural abundance of the reef ecosystem. Regarding the inadequacy of the RDEIS to address the cultural impacts past, present and future, the document states correctly, "...the Preferred Alternative may impact cultural practices, the extent of the impact is unknown". Furthermore the precautionary principle now applies since the RDEIS does not identify the degree of impact, which will preclude the accepting agency from meeting the requirements of Act 50 and the subsequent state Supreme Court ruling. Since "No cultural impacts would occur under the No Action Alternative", this action is the best choice.	Your comment has been forwarded to the decision makers. As noted by the commenter, the EIS acknowledges cultural impacts. The EIS states "given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, all six action alternatives may impact cultural practices".

Commentor	Comment	Response
Diane Ware	Re: the 14th reason for non acceptance of the FEIS by BLNR statements made by the applicant regarding poaching seem disingenuous or feigned ignorance of the circumstances of the arrest of 6 collectors over the past year for poaching and at least 1 other collector for boat and safety violations. It is true that many complaints have been made by community members for years but many of the complaints were ignored or acted upon too late. It seems that DOCARE has been more willing to respond since the lawsuits and as complaints have been more insistent although sometimes anonymous. I see no reason to believe the applicant's statement "In the case of the aquarium industry, community-based enforcement (backed by state regulations) has been adequate to ensure compliance with FRA." I see no assurance that poaching in FRA's will not occur under the proposed system of annual quotas. What will deter a collector to continue collecting past the limit and shipping the fish disguised as some other commodity?	Your comment has been forwarded to the decision makers. This section has been revised in response to comments on the proposed additional enforcement and compliance measures.
Diane Ware	Re: #10 and #8 of BLNR denial of acceptance in regard to the inadequate discussion of the role of herbivores and sustainability of collection, I will deflect to the scientific study and evaluation of Greg Asner. The continued reliance on the outdated data by Ochavillo and Hodgson are inexcusable and irrelevant to the Hawaiian reef system.	Your comment has been forwarded to the decision makers. The Preferred Alternative is limited to species which have shown increasing or stable population trends, thereby using population trend data as the measure of sustainability, rather than the 5-25% range; therefore, the commentor's concern over the use of Ochavillo and Hodgson (2006) is moot as the EIS does not rely on that.
Diane Ware	Re: Cumulative effects of collection are inadequately addressed in the discussions about climate change and the environmental effects of inhumane practices in the warehousing, shipping out of state and placement in hobbyist's tanks. The applicant falsely claims the trade will lawfully execute their extraction of our precious resources. In reality the trade violates the constitution's Public Trust Doctrine in Article XII, and the rules overseeing aquarium collection during the warehousing phase. This phase has been ignored by applicant and DLNR which has difficulty enforcing any rules on the books. I am referring specifically to Hawai'i Cruelty to animals Statute 711-1109 and the Aquarium collection permitting rule 1.2.2–"Except as prohibited by law, the permits shall be issued only to persons who can satisfy the department that they possess facilities to and can maintain fish and other aquatic life alive and in reasonable health." There is also a law against breaking or damaging coral that is dismissed or ignored by the applicant and DLNR. The applicant proposes that coral damage is infrequent and inadvertent while repeated complaints often accompanied by photos demonstrate the occurrence is quite common. It is rather obvious that coral would frequently be adversely damaged during the practices of collection.	Your comment has been forwarded to the decision makers. The 7 fishers who would receive permits under the preferred alternative would comply withall laws, regulations, and permit conditions regarding harvest, storage, transport, and reporting of catch.
Diane Ware	For these reasons and more I urge No Action Alternative as the only environmentally sound course of action.	Your comment has been forwarded to the decision makers.
Mark O. Tang	The proposed regulatory scheme of the Revised Draft Environmental Impact Statement (RDEIS) is as unworkable as any prior submissions and/or actual agency provisions underwritten by DAR. It also continues to fail any test of intellectual integrity and can only hope to succeed through institutional connivance.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Mark O. Tang	The commercial aquarium trade has long operated with fewer regulations, oversight and compliance-verification mechanisms than those that commercial food fisheries must adhere to. The effect has been to create unwarranted 'benefit of the doubt' advantages for both legal and illegal (poachers) collectors. And yet, assertions (without data or evidence) that 'food fishers' may be to blame for some admitted reductions are scattered about in this document. This 'blame shifting' scheme does not belong in such a document.	Your comment has been forwarded to the decision makers. The EIS does not place the blame on food fishers, but rather discloses conclusions made by the DAR (2019a) in their review of the WHRFMA to the legislature. In that paper, the DAR states that declining populations in areas other than Open Areas indicate that factors other than aquariun collection are affecting the populations.
Mark O. Tang	The data submitted through the RDEIS continues to make a 'shell game' of numbers that fail to account for actual reductions and harms to target species in specific coastal 'neighborhoods'. Meaningful limits should be based on specific areas and biological communities rather than at island wide scale. This complaint has been made by many reviewers in past editions and yet must be made again.	Your comment has been forwarded to the decision makers. The RDEIS disclosed impacts at three populations scales: island-wide, WHRFMA, and Open Areas within the WHRFMA.
Mark O. Tang	The socio-economic analysis is faulty on several grounds and ignores recent research that poses compelling evidence contrary to the document's stated conclusions ie:, 'Managing Near-shore Fisheries in Hawaiʻi: A Policy Analysis of the State's Marine Aquarium Fishery', (Schaar, 2020). I call on the accepting agency to incorporate by reference this study and ask that it be addressed in any succeeding effort by the applicant.	Your comment has been forwarded to the decision makers. The paper referenced here (Schaar and Cox 2021) did not analyze the current Preferred Alternative, which limits collection to 8 species, limits collection to the WHRFMA, and includes individual catch quotas providing a hard upper limit on the number that can be collected. Additionally, the Applicant questions the validy of the CBA referenced by the commenter because the study assumes a complete loss of the tourism industry under any alternative which includes collection. As stated in the EIS, Hawaiʻiʻs tourism industry achieved new records in total visitor spending and visitor arrivals in 2017, marking the sixth consecutive year of record growth in both categories. This occurred while commercial aquarium collection was permitted. Therefore, the loss of the entire tourism industry, for the entire state, based on issuance of permits for 8 species limited to the WHRFMA on the island of Hawai'i, does not seem reasonably foreseeable.
Mark O. Tang	The RDEIS uses misleading statements such as from page 164: "The Coral Bleaching Recovery Plan looked at a temporary moratorium on aquarium collecting as a management action for increasing herbivores, but it was one of the lowest ranked management actions for effectiveness (19th of 22 management actions) (University of Hawai'i 2017). It should be noted that among the top 10 management actions was prohibition of all take (commercial and non-commercial) of herbivorous fish (ranked 4th)." (My emphasis in bold is to indicate the modifier 'Temporary' is not a lessening of the quality of the action as apparently represented. Rather, it is automatically superseded within the higher rating, as with the taking of any and all herbivores.)	Your comment has been forwarded to the decision makers. The EIS disclosed the rankings provided in the Coral Bleaching Recovery Plan, which chose to look at a temporary moratorium on aquarium collecting vs a prohibition of all take of herbivorous fish.

Commentor	Comment	Response
Mark O. Tang	On page 177, the document proclaims, "The Preferred Alternative was specifically designed to help buffer climate change by creating individual catch quotas (i.e., hard upper limits on the number of individuals that could be collected) and implementation of a Revised White List limiting the number of species that could be collected." It is impossible to understand any 'take' as a 'buffer to climate change'. On the contrary, every fish on the reef already serves as a tool for reef recovery AND as a buffer to climate change. Therefore, they. should all be conserved!	Your comment has been forwarded to the decision makers.
Mark O. Tang	But perhaps the biggest lie that needs to be challenged is this; "Research suggests collection of between 5%-25% is sustainable for various reef species similar to those on the White List (e.g., tang, wrasse, butterflyfish, angelfish, triggerfish), and that collection below 10% of the biomass can increase reef resilience." (Italics added) This wild assertion needs to be backed up, but in truth can't be!	Your comment has been forwarded to the decision makers. The following text has been added to the RFEIS: "More importantly, populations of all eight species have been either stable or increasing under even higher levels of historic annual collection, and it is therefore anticipated that those population trends would continue under the lower collection proposed under the Preferred Alternative. "
Mark O. Tang	Finally, this industry is defined by waste and destruction. And the drive to scarcity for increased value and profitability should be seen as part of its 'business model'. In pursuit of target species from the reef, the collector's 'pattern and practice' necessarily damages living coral and disrupts other living organisms as they plant and then move their feet and gear around the reef. Then too, at every step up the captivity chain, from puncturing swim bladders, to confinement in holding tanks, to shipping via air freight, losses are built in as part of the market pricing system. But no accounting is attempted in the current or proposed system.	Your comment has been forwarded to the decision makers.
Mark O. Tang	The 'tragedy of the commons' is on clear display! Since no individual permittee knows to what extent other permittees are taking and perhaps approaching theoretical regulatory limits on a yearly basis, the 'tragedy of the commons' promotes unrestrained taking at every opportunity by individuals in the water.	Your comment has been forwarded to the decision makers. The preferred alternative includes individual catch quotas that place a hard upper limit on the number of individuals of each of the 8 species on the Revised White list which could be collected within any given year. Existing size and bag limits would also remain in effect, as would existing MPAs and FRAs. The individual catch quotas are for each individual fisher, and therefore, no one fisher could collect more than was analyzed in the EIS.
Mark O. Tang	This motivation is deeply offensive and completely at odds with a conservation ethic and restraint built into centuries old Hawai'ian cultural traditions. For these reasons, the accepting agency, on behalf of the public's interest, rights and responsibilities, should reject this Revised Draft Environmental Impact Statement.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Judith Graham	Thank you for this opportunity to comment. I'm Judith Graham from Waimea, and have thoughts in three areas.	Your comment has been forwarded to the decision makers.
Judith Graham	MAJOR FINANCIAL ELEMENTS OF AN ACCEPTABLE EIS ARE MISSING The applicant, Pet Industry Joint Advisory Council, is a commercial enterprise although parts of its mission statement are altruistic. It represents retailers, wholesalers and manufacturers in the aquarium industry, and its true basic interest in preparing this revised draft is to ensure that its membership has a supply of Hawaiian reef fish, an important part of the world market. The applicant's final EIS acknowledged that most of Hawaii's reef fish are shipped out and sold to the mainland US, Europe and Asia. But despite the fundamental and underlying commercial trajectory here, there is no market analysis or cost/benefit analysis. These have been standard elements in Hawaii EISs for years. Below is a chart showing the current retail prices quoted by US mainland online retailers. These online sites are set up similarly to Amazon, and their algorithms now follow me repeatedly online after only a brief inquiry. In short, a sophisticated business. See Comment for retail prices of fish	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Judith Graham	Why are these prices important? Because this represents the true value of what the State of Hawaii is virtually giving away to this extractive industry. But none of this appears in the revised draft, despite the fact that PIJAC, through its membership, would have market values easily accessible. The revised draft sets an upper limit on fish to be collected annually under the preferred alternative. It is 246,560 (3.7.1). Lowballing for simplicity an average price per fish as $100, the total is then $24.7 million. The price spreads above mostly reflect fish size, although often vendors' varying prices. And some fish not on the "approved" list are considerably more valuable and are reasonably likely to be snagged in the 30 x 6 foot nets that collectors set. Will the collectors let them all go? Here are some samples--I'll skip the vendors. A market analysis is within PIJAC's easy reach. It would have national scope at least, including prices and projected price increases over the five-year timeframe of the revised draft EIS. A little more complex is a Hawaii-centered cost/benefit analysis. The multiplier effect counted on the benefit side needs more detailed and authoritative treatment than is given in the current document. PIJAC has done such a thorough job of correlating marine studies and numbers (a valuable contribution) that it could bring its revised draft into conformity with Hawaii standards by adding these analyses. It should do so.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Judith Graham	THE PROPOSED MONITORING PLAN IS SKETCHY AND INADEQUATE The applicant, PIJAC, has put forth a preferred alternative to address many concerns expressed by the Board of Land and Natural Resources. This new alternative includes a rather elaborate count and number system, and has limited the number of collectors. Seven collectors will receive permits Eight fish species can be legally collected An annual limit is set on the number of each species collected An annual limit is set per species per collector Obviously, to ensure the implementation of this proposal, monitoring has to be top-notch (and incidentally would entail extra work for DLNR staff). The monitoring plan (3.7.2) describes a triplicate form to be signed off on by the collector, the dealer and a State Department of Agriculture inspector at the airport. There is at least one major problem here, and perhaps more. The Department of Agriculture will require statutory authority to do this, which it does not now have; and may require federal concurrence and/or extra staff. This analysis was provided to me by an Aquatics Specialist at the Department by telephone on March 12, 2021.	Your comment has been forwarded to the decision makers. This section has been revised in response to comments on the proposed additional enforcement and compliance measures.
Judith Graham	A second problem, about which I am uncertain, is that the DLNR may not legally be able to delegate its monitoring function in this way. I recall a state Land Use Commission reclassification case in the 1990s when it was ruled that the DLNR's Historic Sites Division could not legally delegate its oversight of historic sites to the County of Hawaii, which was seeking a large land reclassification. The Native Hawaiian Legal Corporation provided the decisive brief. The applicant will want to propose a different monitoring plan in a final EIS. However, to come up with something workable, given the complexity of its preferred alternative, may be a challenge.	Your comment has been forwarded to the decision makers.
Judith Graham	CULTURAL ATTITUDES NEED MUCH MORE ATTENTION The Cultural Impact Assessment here (appendix A) is very well done. However, interviews of 53, mostly ethnic Hawaiians are not analyzed and reported in the revised draft main text. For example, of the 53, 35 individuals opposed this industry, 5 supported it, and the rest expressed diverse thoughts including misgivings. (My counts.)	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Judith Graham	The BLNR drew to the applicant's attention a too-limited approach to misgivings about the industry itself from a cultural standpoint (p. 8). Hawaii's environmental law, HRS 343, and Hawaii Administrative Rules 11-200 both convey that cultural concerns may extend beyond an ethnic group, to the welfare of the wider community. PIJAC candidly acknowledged that "many local residents hold a negative view of the aquarium industry" and that it 'has a long and contentious history, and it remains a point of conflict" (5.3.1). But the applicant's revised draft section, intended to address the BLNR's observation, is but two pages in a main document of some 200 pages. This is not thorough or sufficient Main themes of Hawaiian respondents were the industry's lack of malama aina, or care for the land and ocean; and taking without giving back. Some quotations: Why should people take our fish just for pleasure?--Leslie, 114 What [is] the aquarium fishing industry's contribution to the public trust, that includes aquatic resources?--Springer, 113 . . . during the late 1980s when aquarium fishing began to expand, there were huge public rallies where people paraded through the streets of Kona to stop taking the fish for the aquarium industry-- Repogle, 122 . . . in some smaller Hawaiian communities, especially in South Kona where traditional methods of harvesting fish are still practiced, the aquarium industry has created serious discord and tension amongst its members--Nakachi, 125 there's a long history of mistrust and no openness between local fishers and aquarium collectors--Cho, 132 I have selected points representing dislike, perhaps not sufficiently emphasizing other thoughtful points raised. However, to the extent that the broader community is aware of this industry and its practices (and as a longtime resident I know that many citizens are unaware), polls show that the public would like the practice banned. A 2012 poll was reported in the Hawaii Tribune Herald of Hilo: 66% wanted to end the trade (HTH 6/14/12). In another poll in 2017, 83% statewide supported a ban (humanesociety.org/news/poll-shows-near-total-support-legislation-protecting-hawaii's-reef-and-marine-life) . The Humane Society of the United States commissioned both polls, by two different Honolulu firms. It has also been a plaintiff in the recent court case on this matter.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Judith Graham	A remarkable marine science article, several times cited in the revised draft, Rossiter and Levine (2013), actually makes quite a point of how "social pressure" effectively enforces the West Hawaii Regional Fishery Management Area. The DLNR lacks funds and staff to enforce, the authors say. But: "community enforcement works in this context because the local community does not favor aquarium fishing." The authors comment on the "social marginalization" of collectors who "cannot easily hide" because the DLNR requires their boats to be marked.	Your comment has been forwarded to the decision makers. As noted, this paper is cited in the document, including a direct quote from the paper on why community enforcement works in the FRA network in Section 1.2.4.2.
Judith Graham	Note that the community-pressure approach will not serve to enforce the applicant's preferred alternative because citizens have no way of observing the species collected or how many there are. The WHRFMA is much easier to monitor. I might add several other instances--an underwater attack by a collector on a supposedly interfering scuba diver (5/8/14); or the extraordinarily bitter comment by the president of Snorkel Bob's business on the applicant's draft EIS: "The PIJAC PROMO piece supports a mainland amusement industry that condemns reef wildlife to a vicious cycle of replacement." (pdf p. 2112) It's clear that attitudinal concerns and misgivings of ethnic Hawaiians and the wider public deserve to be brought forward in a prominent way in the revised draft EIS. They are a significant adverse effect from a cultural standpoint.	Your comment has been forwarded to the decision makers. The EIS acknowledges cultural impacts. The EIS states "given that some native Hawaiians believe any collection for aquarium purposes is contrary to cultural practices, all six action alternatives may impact cultural practices".
William Graham	The Hawaii courts have ruled that aquarium fishing must cease until environmental review has been conducted in conformance with the Hawaii Environmental Protection Act (HEPA). The limited number and resources of the aquarium fishers in Hawaii are not sufficient to fund such a substantial undertaking as to complete all the requirements of HEPA. However, the scale of the world-wide retailers and wholesalers is large enough to justify an effort to satisfy the courts' requirement. Thus the Pet Industry Joint Advisory Council (PIJAC) has endeavored to do just that.	Your comment has been forwarded to the decision makers.
William Graham	Three strong headwinds compromise their effort. First, the public is clearly in opposition to the taking of colorful reef fish from our waters to be sold elsewhere for confinement in aquariums. Second, it is very difficult to responsibly predict future impacts from the the extraction of the reef fish, who are largely herbivores. This is next to impossible given that climate change effects are and will be very damaging to the reefs irrespective of any aquarium fishing. And third, the very actions of the aquarium fishers themselves has been underhanded and unlawful.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
William Graham	The resulting situation has PIJAC initiating some ill-defined "Project" where the fishers are not identified and are not the actual applicants for licenses. Once their final EIS was rejected for numerous reasons PIJAC has now come back with a revised draft EIS in an effort to sidestep the objections.	Your comment has been forwarded to the decision makers. The following language has been added to the Revised FEIS: The seven permittees covered by this Revised FEIS have verified that they are each legally qualified to apply for, and hold, an Aquarium Fishing Permit, Commercial Marine License, and West Hawai'i Aquarium Permit. The seven permittees covered by this Revised FEIS will file individual permit applications with Department of Land and Natural Resources (DLNR) in parallel with the submission of this Revised FEIS to Office of Environmental Quality Control (OEQC) and DLNR. DLNR will review such applications and take action upon them after further consideration of the Revised FEIS.
William Graham	The bulk of my testimony challenges the legal and procedural framework that underlies this unusual application and the current revised draft EIS. I will also make further comments on the content of the DEIS, largely regarding the fishers, the quotas and their enforcement. Others will be providing testimony on the environmental and cultural effects of aquarium fishing. I trust that the applicant will respond meaningfully to the questions I pose.	Your comment has been forwarded to the decision makers.
William Graham	A. The procedural history of this application shows that it is unsuitable as a single, lawful HEPA invocation. Hence the current revised DEIS document is not appropriate.	Your comment has been forwarded to the decision makers.
William Graham	The Hawaii court system has ruled that the issuing of aquarium permits by the DLNR cannot proceed without proper review in accordance with the Hawaii Environmental Procedures Act (HEPA). The trigger for HEPA is an action initiated by an applicant requiring agency approval. In this case the specific approval sought is for aquarium fishing permits. Thus the EIS documents in this matter must be in support of such an action.	Your comment has been forwarded to the decision makers.
William Graham	The applicant (PIJAC) is seeking aquarium permits not for itself but for unnamed third parties. Is it intended that the agency approval being sought is to immediately issue permits to PIJAC for distribution to those third parties? Alternatively the agency approval being requested might be a commitment to respond favorably to applications to be submitted by these individuals in the future. Or is the intention something different? This is all unclear. What specific approval by DLNR is now requested? Please clarify.	Your comment has been forwarded to the decision makers. The following language has been added to the FEIS: The seven permittees covered by this Revised FEIS have verified that they are each legally qualified to apply for, and hold, an Aquarium Fishing Permit, Commercial Marine License, and West Hawai'i Aquarium Permit. The seven permittees covered by this Revised FEIS will file individual permit applications with Department of Land and Natural Resources (DLNR) in parallel with the submission of this Revised FEIS to Office of Environmental Quality Control (OEQC) and DLNR. DLNR will review such applications and take action upon them after further consideration of the Revised FEIS.

Commentor	Comment	Response
William Graham	Additionally, the third parties (fishermen) are changing in number at different stages of this lengthy process. First 14, then 10, now 7. There is no public record of the composition of those 14, 10 or 7 third parties. Furthermore, in the current revised draft EIS the applicant is asking for permits to be issued under a regulatory structure which is hypothetical and does not currently exist. The DLNR has no authority to issue such permits at this time. Thus the HEPA act is not properly invoked or consistently adhered to.	Your comment has been forwarded to the decision makers. This section has been revised in response to comments on the proposed additional enforcement and compliance measures.
William Graham	I include as an Appendix the official applicant's "action" in the various stages of Environmental Assessment, Draft EIS, Final EIS, and revised Draft EIS. These actions are reproduced using the applicant's own words. Even if the first 3 of the 4 were to be deemed acceptable as a single, somewhat modified action, surely the 4th does not qualify as such. Note that in Hawaii Administrative Rules 11-200 a "Project" is defined in the following manner: "Project means a discrete, planned undertaking that is site and time specific, has a specific goal or purpose, and has potential impact to the environment." The project here does not adhere to those specifications. It has changed and evolved.	Your comment has been forwarded to the decision makers.
William Graham	In the past few years the DLNR has caught, cited and prosecuted several major violations of the no-fishing rule. This applicant has seen its prior EIS rejected by the DLNR board. If the DLNR wishes to have aquarium fishing resume in the future it should adopt rules and procedures that would properly regulate the fishing. Thereafter the applicant or the fishers could resubmit a request for fishing in the WHRFMA with fine mesh nets.	Your comment has been forwarded to the decision makers.
William Graham	In prior EIS documents by this applicant the primary basis for evaluating impacts has been the historical take by the fishers who are to receive permits. One finds on page 139 of the final EIS (April 2020), that the impact on fish populations by the preferred alternative "...is based on the average and maximum collection of the 10 fishers in the WHRFMA, ...". A similar statement appears on page 136 of the draft EIS (November 2019).	Your comment has been forwarded to the decision makers. The Preferred Alternative uses historic population trends as the sustainablilty measure and limit collection to the 8 species who have had stable or increasing populations under historic levels of commercial aquarium collection, and furthermore would add individual catch quotas to limit the number of each species which could be collected within any year.
William Graham	The 14 fisher preferred alternative in the prior Draft EIS provided specific counts of historical take by those to whom permits were to be granted (Table 5-2). The 10 fisher preferred alternative in the prior Final EIS also provided specific counts of historical take by those to whom permits were to be granted (Table 5-2). But there appear to be no historical counts shown for the 7 fishers designated in the preferred alternative within this Revised DEIS. These counts should be included. Why aren't they? Why is the historical collection of fish by the permittees no longer a basis for quotas and expected population impacts? It appears that the proposed annual quotas will far exceed the historical annual collections of the 7 fishers. This change of methodology must be explained.	Your comment has been forwarded to the decision makers. As stated in Section 5.4 of the EIS, "Biological impacts are calculated based on historic trends for the CML-only Alternative, Pre-Aquarium Collection Ban Alternative, WHRFMA-only Alternative and the Limited Permit Issuance Alternative. Biological impacts are calculated based on the individual catch quotas (Section 3.7.1) for the Revised White List and Limited Permit Issuance Alternative. Therefore, historic trend data are provided for the entire fishery and for the 10 fishers who would be issued permits under the Limited Permit Issuance Alternative but are not applicable for the 7 fishers who would be issued permits under the Revised White List and Limited Permit Issuance Alternative. "

Commentor	Comment	Response
William Graham	One can see that the revised DEIS is purposely proposing quotas that are not related to the issuance of the 7 permits. Nevertheless it asks that the overall quota be divided amongst the 7. This is clearly disingenuous. Simply put, the proposed quotas do not correspond to the permit issuance being sought. They must be adjusted downward appropriately.	Your comment has been forwarded to the decision makers. The Preferred Alternative would limit collection to the 8 species who have had stable or increasing populations under historic levels of commercial aquarium collection, and furthermore would add individual catch quotas to limit the number of each species which could be collected within any year.
William Graham	In the first sentence of section 3.7.2 the applicant specifically acknowledges that the problem of poaching and otherwise illegally obtained fish has "undermined the conservation and management of the aquarium fishery". . The proposed actions in the various EIS incarnations prepared by this applicant have cited "lawful, responsible, and sustainable commmercial collection" within the Proposed Action. Have any individuals in these groups of 14, 10, and 7 fishers been cited for unlawful aquarium fishing related actions? Which, if any? I refer to the proposed permit recipients in the prior DEIS, the prior FEIS, and the current revised DEIS respectively.	Your comment has been forwarded to the decision makers.
William Graham	In her letter of July 2018 whereby Chairperson Case informed the applicant of the need for an EIS, she spoke to the role of proposed regulations versus self-regulation by the fishers. (One notes that the applicant is not a fisher!) The pattern of recent well documented illegal activities by aquarium fishers certainly renders unconvincing any proposal for self-regulation.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
William Graham	In section 3.7.2 of the DEIS the applicant is proposing the introduction of a new method of tracking and enforcing the catch quotas of the fishers, a "Certificate of Origin" paper trail. Certainly this is a worthwhile objective. Unfortunately the proposal contains lots of potential leakage opportunities which could perhaps be minimized by additional safeguards. By leakage I mean opportunities to subvert the system. A more detailed description in the EIS of the ways that fishes are shipped is necessary to better evaluate the efficacy of the proposed sampling control. Here are my observations in regard to the weak points of the proposed quota system: a) The dealer is the key - If the dealer is not rigorous in his/her implementation of the proposal, it fails completely. I see no information as to how many dealers are potentially involved, and where they are located. The EIS must provide this information. And for the system to have any strong control the dealers should be licensed. Plus the regulations must be amended to make it illegal for any shipping to occur outside of the licensed dealer network. Otherwise a fisher could completely avoid the paper trail that is designed to validate the shipment. b) At the airport - We need a description of the shipping containers and the number of fish usually contained within them. From which airports and by which air carriers can the fish be shipped? This information is of primary importance to understand the scale of the enforcement undertaking. c) Role of the Department of Agriculture - Has the applicant discussed this proposal in detail with the DOA? We certainly need an evaluation of the cost, staffing, training and logistics that would accrue to the DOA. The DOA response and analysis should have been a part of this revised DEIS. d) Efficacy of the 1 in 10 inspection - The applicant suggests a sampling approach to inspection. It is understandable but questionable. This directly pertains to (b) above. How many shipping containers are used for a shipment, what is the container physically like, is it amenable to inspection? Outside of Hawaii, have sampling inspections like this been implemented to control illegal take by aquarium fishers? Have they been successful?	Your comment has been forwarded to the decision makers. This section has been revised in response to comments on the proposed additional enforcement and compliance measures.
Gregory P. Asner PhD, Sawna A. Foo PhD, Rachel R. Carlson MS, Roberta E. Martin PhD	The Pet Industry Joint Advisory Council submitted a Revised Draft Environmental Impact Statement (RDEIS) based on their analysis of the ecological and cultural impacts of issuing aquarium collection permits for the West Hawai‘i Regional Fishery Management Area. Our review focuses on the scientific integrity and validity of data and conclusions provided in the RDEIS. We do not address cultural issues in our review. The RDEIS has not adequately represented fish population trends in Hawai‘i, has ignored public comments in response to past DEIS and FEIS that requested more information, and omits certain facts and data that would allow an objective overview of the impacts of permitting aquarium fish collection.	Your comment has been forwarded to the decision makers. Responses to comments on previous drafts of this document have been provided as appendices to those documents, and incorporated into the document as applicable.

Commentor	Comment	Response
Gregory P. Asner PhD, Sawna A. Foo PhD, Rachel R. Carlson MS, Roberta E. Martin PhD	In response to the 2020 FEIS, we asked the applicant to present both the WHAP and CREP (now referred to as PIFSC-ESD in the RDEIS) datasets equally to allow a visualization of population trends over the total length of the survey years. Despite citing the full PIFSC-ESD dataset, the new 2021 RDEIS only presents 2019 surveys for this dataset, only a subset of the 257 surveys cited on RDEIS page 115. Furthermore, for the WHAP data, the RDEIS presents 1999/2000 data and 2017/2018 data to estimate population trends for the white-list species. There are two issues with this: 1) Population data after January 2018 should be excluded from trend estimates because no legal aquarium collecting occurred after January 5th 2018, and 2) Analysis of annual, long-term data is needed to understand population trends, not just a comparison of a few years.	Your comment has been forwarded to the decision makers. The EIS discloses the data provided from the PIFSC-ESD and the DAR (2019a). The DAR (2019a) analyzed population trends using data from 1999/2000 to 2017/2018. Both the PIFSC-ESD data and the DAR WHRFMA population data represent the most current population estimates available from which to evaluate impacts.
Gregory P. Asner PhD, Sawna A. Foo PhD, Rachel R. Carlson MS, Roberta E. Martin PhD	The RDEIS presents a reduced whitelist of eight species, where the species chosen were based on: "Additionally, these impacts would be limited to only eight species, all of which have had stable or increasing populations under even higher rates of historical collection." (Page 176) All available survey years of data for Hawai'i Island should be considered using both WHAP and PIFSC-ESD datasets to determine whether populations are stable or increasing (Figure 1, Figure 2). To allow an assessment of survey trends across both datasets, we plotted all available data for West Hawai'i from WHAP and PIFSC-ESD. For WHAP data (Figure 1), aquarium fish show extremely variable decreases and increases across survey years, indicating they are not necessarily stable. In particular, Bird Wrasse, Orangespine Unicornfish, and Thompson's Surgeonfish do not show an increasing trajectory.	Your comment has been forwarded to the decision makers. The EIS discloses the data provided by the DAR (2019a), including their statistical analysis of population trends which compare 1999/2000 to 2017/2018 population estimates.
Gregory P. Asner PhD, Sawna A. Foo PhD, Rachel R. Carlson MS, Roberta E. Martin PhD	To make PIFSC-ESD data comparable to WHAP, we only show West Hawai'i data, where open collection areas and areas that ban aquarium fishing were delineated (Figure 2). In PIFSC-ESD, not all reduced white-list species show a trajectory of increasing abundance. Of note, the two top aquarium fish species, Yellow Tang and Kole, both show decreases in abundance between 2016 and 2019 in open collection areas in the PIFSC-ESD data.	Your comment has been forwarded to the decision makers. As stated in the EIS, the trend data used for inclusion on the Revised White List was based on the time period from 1999/2000 to 2017/2018. The text in Section 3.7.1 has been revised to clarify that WHAP population trend data is from DAR (2019a).

Commentor	Comment	Response
Gregory P. Asner PhD, Sawna A. Foo PhD, Rachel R. Carlson MS, Roberta E. Martin PhD	The RDEIS does not provide the raw data, or full calculations of population estimates. The RDEIS explains: "PIFSC-ESD provided the Applicant with the estimated population size for each White List Species for the island of Hawai'i by converting survey counts to abundance per unit area, and then multiplying by the estimated area of hardbottom habitat in <30 meters of water (8,995 Ha in East Hawai'i and 5,727 Ha in the WHRFMA). Approximate confidence intervals (95%) were estimated using two times the standard error of the estimated population size, as provided by PIFSC-ESD, with the lower bound set to zero when needed since populations cannot be negative." (Page 114) The RDEIS should provide West and East Hawaiʻi means for the survey data, with the confidence intervals calculated from the original dataset with the number/replicates of surveys included. Long-term data (WHAP and PIFSC-ESD) exist for the reduced whitelist of aquarium fish species and are publicly available. Additionally, extrapolating population estimates based on hardbottom area is an inaccurate method for estimating island-wide populations, which ignores basic fish ecology because the extrapolation assumes that fish equally inhabit all hardbottom habitat area across all of Hawaiʻi Island. Prior studies (e.g., Friedlander and Parrish 1998; Wedding et al. 2008), as well as a recent analysis by Donovan et al. (2020), for Hawaiʻi Island show that fish have a highly variable distribution across Hawaiʻi (Figure 3). The analysis, which combines all available fish surveys from multiple organizations throughout Hawaiʻi, shows enormous spatial variability in herbivorous fish populations across hardbottom habitat around the island (Figure 3).	Your comment has been forwarded to the decision makers. As disclosed in the EIS, the PIFSC-ESD provided the Applicant with the estimated population sizes, as well as the standard errors to calculate the confidence intervals. This was calculated as two times the standard error provided by PIFSC-ESD, as disclosed in the EIS. The methods for how PIFSC-ESD calculates population size were determined by PIFSC-ESD, and provided to the Applicant.

Commentor	Comment	Response
Gregory P. Asner PhD, Sawna A. Foo PhD, Rachel R. Carlson MS, Roberta E. Martin PhD	Lastly, the RDEIS heavily bases its "sustainable" levels of catch on one manual focused on species from the Phillipines (Ochavillo and Hodgson 2006). The manual gives a list of total allowable catch (TAC) values for common species in the Philippines, which the RDEIS uses directly for Hawaiian species that never appear in the guide. Determining sustainable catch rates is not a straightforward process and involves a deep understanding and long-term record of population size, recruitment, mortality and growth (as considered for Hawaiian species in Nadon et al. 2017). Other methods using size-structure abundance data and a more data-limited approach, rather than catch-per-unit methods, have been developed, but still vary on a species-by-species basis (Jerald et al. 2018). Thus, directly borrowing values for species in the Philippines is not an adequate method to determine whether aquarium collection catch rate is sustainable for Hawaiian species, especially as TAC will be specific for each species. To be scientifically defensible, the RDEIS should conduct stock assessment modelling for target species. Strong resources exist for this, such as Nadon et al. (2017), which provides stock assessment methods and examples for coral reef fishes of Hawaiʻi. Without a statistical analysis of population growth, reproduction and mortality rates, TAC cannot be calculated and the true impacts of aquarium fishing, including sustainable levels for Hawaiʻi Island, cannot be determined. Population modelling is absent in the RDEIS and is critically needed to allow appropriate estimation of the impacts of aquarium fishing. Critical information needed to understand impacts of aquarium fishing, and whether proposed individual catch quotas (Table 1) are appropriate, were missing. For example, what is the total open area that could be fished, and what size classes are expected to be targeted? What reef area would be affected based on fishing effort?	Your comment has been forwarded to the decision makers. The Preferred Alternative is limited to species which have shown increasing or stable population trends, thereby using population trend data as the measure of sustainability, rather than the 5-25% range; therefore, the commentor's concern over the use of Ochavillo and Hodgson (2006) is moot as the EIS does not rely on that.
Gregory P. Asner PhD, Sawna A. Foo PhD, Rachel R. Carlson MS, Roberta E. Martin PhD	Importantly, to put the proposed total potential catch numbers into perspective, we present the total reported catch for the past 20 years for all of Hawaiʻi Island nearshore (0-2 nmi) waters for the reduced white-list species, with the total potential catch indicated on the graph (Figure 4). For five species, the proposed catch is higher than the annual catch data previously reported in the majority of the last 20 years. Of note, for Potter's Angelfish (C. potteri) and Thompson's Surgeonfish (A. thompsoni), the total proposed catch is much higher than all previously reported catch numbers. For A. thompsoni, the limit is twice as high as the maximum reported catch in 20 years. Therefore, even if only seven aquarium fishers are permitted, they will still be impacting the system similarly, and in some cases, more than previous years.	Your comment has been forwarded to the decision makers.

Commentor	Comment	Response
Gregory P. Asner PhD, Sawna A. Foo PhD, Rachel R. Carlson MS, Roberta E. Martin PhD	The RDEIS does not adequately cover relevant scientific literature, especially Hawai'i-specific examples, thereby ignoring the impacts of aquarium collection on the Hawaiian reef system. We base the examples we discuss here on the main justifications of the applicant for allowing aquarium collection. Herbivores are critically important for resisting coral to algae regime shifts (Graham et al. 2015), and scientific data show that appropriate herbivore management maintains coral reef resiliency through frequent bleaching events (Chung et al. 2019). Hawai'i has suffered multiple bleaching events in the past decade, and the U.S. federal government and international organizations predict more frequent and severe bleaching events in the future (van Hooidonk et al., 2016; Hughes et al., 2017). Therefore, retaining strong populations of herbivores on Hawai'i's reefs must become a top priority to maintain reef condition and associated economic and cultural benefits over the next several decades. The RDEIS acknowledges the importance of herbivores for coral resilience but does not fully quantify aquarium fishing impacts on herbivory. Using the reduced white-list aquarium species provided in the RDEIS, we indicate which are herbivores, classified using data from Heenan et al. (2016) (Table 2). Herbivorous fish can be categorized into various groups depending on their feeding preferences such as grazers, detritivores, and browsers, indicated in Table 2. As shown in Table 2, six out of eight of the reduced white-list species are herbivores. In addition, the non-herbivorous species on the reduced white-list represent only 1% of the total proposed annual catch (2360 out of 246,560 aquarium fish). The new, reduced white-list primarily targets herbivorous fish, where each species has a different and important role in maintaining Hawai'i's coral reef ecosystem.	Your comment has been forwarded to the decision makers. The EIS discloses which of the White List species are herbivorous in Table 5-14, including all 40 species on the current White List, as well as the 8 species which would be on the Revised White List. While it is true that 6 of the 8 species on the Revised White List are herbivorous (as noted in the EIS in Table 5-14), all 8 species, including the 6 herbivores, have had stable or increasing populations under historic aquarium collection. The criteria for inclusion on the Revised White List are included in Section 3.7.1 of the EIS, and the fact that 6 of the 9 herbivores on the current White List (out of 40 species total) meet the criteria for inclusion further illustrates that aquarium collection is not driving herbivore declines (since those 6 species were all stable or increasing). As stated in the EIS "DAR (2019a) reported that herbivore biomass has not changed since 2003 in the Open Areas or FRAs and has increased by 30.8% in the MPAs. While there has been no significant change in Open Areas or FRAs, there has still been an increasing trend, with a 14.4% increase in herbivore biomass in FRAs and a 26.0% increase in herbivore biomass in Open Areas between 2003 and 2017 (DAR 2019a, Gove et al. 2019). This occurred even with the pressures from commercial aquarium collection, which was occurring during this time. Furthermore, the marked increase in herbivore biomass in more restrictive MPAs, and the fact that there is no significant difference between Open Areas and FRAs, indicates that any declining trends or differences in herbivore biomass are not due to aquarium collection, but rather due to other types of fishing (i.e., food fishing). "

Commentor	Comment	Response
Gregory P. Asner PhD, Sawna A. Foo PhD, Rachel R. Carlson MS, Roberta E. Martin PhD	"Two studies have concluded that the aquarium fishery has no significant impact on coral or the reef ecosystem. In addition, herbivores collected by the aquarium fishery typically consist of the smaller size classes which are the least effective sizes for cropping algae. One study found there were no increases in the abundance of macroalgae where the abundance of herbivores was reduced by aquarium collecting." (Page 16) There are two problems with this statement. First, targeting mostly immature fish has huge implications for sustainable usage of the resource. Protecting immature fish is key to keeping any fishery sustainable in the long term where catching juvenile fish removes them, and future offspring. In aquatic systems, body size and individual trophic level are tightly linked (Jennings et al. 2001; Barnes et al. 2008), where size-targeted fishing degrades the variation in size structure in coral reef fish (Robinson et al. 2017). Moreover, smaller fishes are important dietary resources for predatory species. Furthermore, in Hawai'i, there are highly seasonal peaks in fish recruitment in June/July and February/March (Walsh, 1987) – if aquarium fishing peaked during these times of the year, impacts on population dynamics would be magnified. Multiple studies show the importance of small herbivorous fish to reef ecosystem balance. Despite small body sizes, small grazers can have disproportionately large impacts on plant and algal biomass (Silliman et al. 2013), where smaller herbivores can occur in higher densities, having disproportionately higher impacts on algae in comparison to larger, less abundant herbivores (Ng and Micheli, 2020). Therefore, targeting only small fish is not a good justification for allowing aquarium collection. Further, there is no reporting of the size of aquarium fish that are caught and therefore size-specific impacts cannot be assessed.	Your comment has been forwarded to the decision makers. The following statement has been added to the FEIS: "It is noted that small grazers can be important for turf algae and macroalgal removal (Kelly et al. 2017). "
Gregory P. Asner PhD, Sawna A. Foo PhD, Rachel R. Carlson MS, Roberta E. Martin PhD	The RDEIS only presents part of the results from prior, peer-reviewed literature on the aquarium industry. One example is its use of Tissot and Hallacher (2003). Despite the RDEIS citing this reference at least eight times, the RDEIS fails to acknowledge the primary finding of Tissot and Hallacher (2003): that seven of the ten aquarium fish species surveyed were significantly reduced by collecting. This missing information is presented below. In sites which permitted aquarium collection, aquarium fishes were significantly reduced, up to 75% lower than control sites where no aquarium fishing was permitted (Figure 5). Although aquarium fishing may not directly damage coral, the study found significant effects of aquarium collectors on the abundance of aquarium fishes. We indicated these findings in our reviews of the DEIS and FEIS, yet the authors of the RDEIS continue to select and report partial information rather than acknowledge the primary conclusions of this study.	Your comment has been forwarded to the decision makers. The collection that was occurring during the Tissot and Hallacher study was before the establishment of the WHRFMA, including the implementation of the current White List, and therefore the impacts on fish populations were not as relevant as more recent data from the DAR focused on the time period since the WHRFMA went into effect (i.e., the time period from 1999/2000-2017/2018).

Commentor	Comment	Response
Gregory P. Asner PhD, Sawna A. Foo PhD, Rachel R. Carlson MS, Roberta E. Martin PhD	The RDEIS is biased in the presentation of facts and figures in favor of aquarium collectors in a number of ways: • The available monitoring data have not been represented sufficiently and has not adequately estimated fish populations from all available data; the RDEIS is based on a reduced list of species which have been misrepresented. • Although limiting the number of aquarium fishers to seven, the RDEIS has proposed high annual catch limits, and in cases, higher than any previous years for specific aquarium fish. Catch limits have not been calculated for target species using best available methods. •The RDEIS does not include a proper literature review of Hawai'i-specific findings, instead selecting a few results that support their viewpoints and omitting results that indicate impacts of aquarium fishing.	Your comment has been forwarded to the decision makers.

APPENDIX D—DISTRIBUTION LIST FOR THE REVISED FEIS

Distribution List for the FEIS

GOVERNMENT OF THE STATE OF HAWAI'I(S)

Agency	Mailing Address	Electronic Mail or Internet Address	Telephone
State of Hawai‘i Department of Agriculture	1428 S. King Str. Honolulu, HI 96814	hdoa.info@hawaii.gov	(808) 973-9550
State of Hawai‘i Department of Accounting and General Services	P.O. Box 119 Honolulu, HI 96810	dags@hawaii.gov	(808) 586-0400
State of Hawai‘i Department of Business, Economic Development and Tourism	P.O. Box 2359 Honolulu, HI 96804	dbedt.director@hawaii.gov	(808) 586-2355
State of Hawai‘i Department of Business, Economic Development and Tourism, Research Division Library	No. 1, Capitol District Bldg. 250 S. Hotel Street, Ste. 435 Honolulu, HI 96813	Tammy.Lam@hawaii.gov Joseph.A.Roos@dbedt.hawaii.gov	(808) 586-2481
State of Hawai‘i Department of Business, Economic Development and Tourism, Strategic Industries Division	235 S. Beretania St., 5th Flr. Honolulu, HI 96813	dbedt.energyoffice@hawaii.gov	(808) 587-3812
State of Hawai‘i Department of Business, Economic Development and Tourism, Office of Planning	235 S. Beretania St., 6th Floor Honolulu, HI 96813	maryalice.evans@hawaii.gov	(808) 587-2846
State of Hawai‘i Department of Defense	3949 Diamond Head Road Honolulu, HI 96816	hi.dod.pa@icloud.com	(808) 733-4258
State of Hawai‘i, Department of Education, Hawaii State Library, Hawai‘i Documents Center	478 S. King Street Honolulu, HI 96813	http://www.librarieshawaii.org/locations/index.htm	(808) 586-3555
State of Hawai‘i Department of Hawaiian Home Lands	P.O. Box 1879 Honolulu, HI 96805	dhhl.icro@hawaii.gov	(808) 620-9501
State of Hawai'i, Department of Health, Environmental Health Administration	P.O . Box 3378 Honolulu, HI 96801	webmail@doh.hawaii.gov	(808) 586-4424
State of Hawai‘i, Department of Land and Natural Resources	P.O. Box 621, Honolulu, HI 96809	dlnr@hawaii.gov	(808) 587-0400
State of Hawai‘i Department of Land and Natural Resources State Historic Preservation Division	601 Kamokila Blvd., Rm. 555 Kapolei, HI 96707	Alan.S.Downer@hawaii.gov	(808) 692-8015
State of Hawai‘i Department of Transportation	869 Punchbowl Street Honolulu, HI 96813	dotpao@hawaii.gov	(808) 587-2160
University of Hawai‘i Water Resources Research Center	2540 Dole Street, Room 283 Honolulu, HI 96822	thomas@hawaii.edu	(808) 956-7847
University of Hawai'i Environmental Center Patricia Hirakawa	2500 Dole Street Krauss Annex 19 Honolulu, HI 96822	hirakawa@hawaii.edu	(808) 956-7362
University of Hawai‘i Thomas H. Hamilton Library	2550 McCarthy Mall Honolulu, HI 96822	uhmlib@hawaii.edu	(808) 956-8264
University of Hawai‘i at Hilo Edwin H. Mo‘okini Library	200 W. Kawili Street Hilo, HI 96720	mookini@hawaii.edu	(808) 974-7346

University of Hawai'i Maui College Library	310 Ka'ahumanu Avenue Kahului, HI 96732	uhmclib@hawaii.edu	(808) 984-3233
University of Hawai'i Kaua'i Community College Library	3-1901 Kaumualii Highway Lihu'e, HI 96766	kauailib@hawaii.edu	(808) 245-8233
Office of Hawaiian Affairs	711 Kapi'olani Blvd., Suite 500 Honolulu, HI 96813	info@oha.org	(808) 594-1835
Legislative Reference Bureau Library	State Capitol 415 S. Beretania St., Rm. 005 Honolulu, HI 96813	lrb@capitol.hawaii.gov	(808) 587-0690

GOVERNMENT OF THE COUNTY OF HAWAI'I(H)

Agency	Mailing Address	Electronic Mail or Internet Address	Telephone
County of Hawai'i Department of Environmental Management	Pu'ainako Town Center 2100 Kanoelehua Avenue, Bay C-5, Hilo, HI 96720	cohdem@hawaiicounty.gov	(808) 961-8083
County of Hawai'i Department of Parks and Recreation	101 Pauahi Street, Suite 6 Hilo, HI 96720	parks_recreation@hawaiicounty.gov	(808) 961-8311
County of Hawai'i Planning Department	101 Pauahi Street, Suite 3 Hilo, HI 96720	planning@hawaiicounty.gov	(808) 961-8288
County of Hawai'i Department of Public Works	101 Pauahi Street, Suite 7 Hilo, HI 96720	public_works@co.hawaii.hi.us	(808) 961-8321
County of Hawai'i Department of Water Supply	345 Kekuanao'a Street, Suite 20, Hilo, HI 96720	dws@hawaiidws.org	(808) 961-8050

GOVERNMENT OF THE UNITED STATES OF AMERICA (USA)

Department of the Interior, Geological Survey, Pacific Islands Water Science Center	677 Ala Moana Boulevard, Ste. 415, Honolulu, HI 96813	santhony@usgs.gov	(808) 587-2400
Department of the Interior Fish and Wildlife Service	300 Ala Moana Boulevard, Room 3-122, Honolulu, HI 96850-0056	pifwo_admin@fws.gov	(808) 792-9400
Department of Commerce National Marine Fisheries Service	Pacific Islands Regional Office, 1611 Kapi'olani Boulevard, Suite 1110, Honolulu, HI 96814	pirohonolulu@noaa.gov	(808) 944-2200
Department of the Interior National Parks Service	Pacific Islands Support Office, 300 Ala Moana Boulevard. Room 6-226, Honolulu, HI 96850	melia_lane-kamahele@nps.gov	(808) 541-2693
Department of Agriculture National Resources Conservation Service	Pacific Islands Area Office, P.O. Box 50004, Honolulu, HI 96850	travis.thomason@usda.gov	(808) 541-2600
Department of Transportation Federal Aviation Administration	300 Ala Moana Boulevard, Room 7-128 Honolulu, HI 96850-7128	kevin.h.nishimura@faa.gov	(808) 541-1232

Department of Transportation Federal Transit Administration	201 Mission St., Ste. 1650 San Francisco, CA 94105- 1839	ted.matley@dot.gov	(415) 744-3133
Department of Homeland Security Coast Guard	Commander, 14th Coast Guard District, 300 Ala Moana Boulevard, Room 9-204, Honolulu, HI 96850-4982	julia.i.mundy@uscg.mil	(808) 535-3201

LIBRARIES AND DEPOSITORIES (LD)

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North Kohala Public Library	54-3645 Akoni Pule Hwy Kapaau, HI 96755	http://www.librarieshawaii.org/locations/index.htm	(808) 889-6655
Hilo Public Library Attn: Justin Rajkowski	300 Waianuenue Ave. Hilo, HI 96720	justin.rajkowski@librarieshawaii.org	(808) 933-8890
Kailua-Kona Public Library	75-138 Haulalai Rd. Kailua-Kona, HI 96740	http://www.librarieshawaii.org/locations/index.htm	(808) 327-4327
Honokaa Public Library	45-3380 Mamane St., Bldg #3 Honokaa, HI 96727	http://www.librarieshawaii.org/locations/index.htm	(808) 775-8881
Kealakekua Public Library	81-6619 Mamalahoa Hwy Kealakekua, HI 96750	http://www.librarieshawaii.org/locations/index.htm	(808) 323-7585
Pahoa Public and School Library	15-3070 Pahoa-Kalapana Rd. Pahoa, HI 96778	http://www.librarieshawaii.org/locations/index.htm	(808) 965-2171
Thelma Parker Memorial Public and School Library	67-1209 Mamalahoa Hwy Waimea, HI 96743	http://www.librarieshawaii.org/locations/index.htm	(808) 887-6067
Naalehu Public Library	95-5669 Mamalahoa Hwy Naalehu, HI 96772	http://www.librarieshawaii.org/locations/index.htm	(808) 939-2442

NEWS MEDIA (NM)

Organization	Mailing Address	Electronic Mail or Internet Address	Telephone
Honolulu Star Advertiser	Restaurant Row 7, Waterfront Plaza, Suite 210, 500 Ala Moana Boulevard, Honolulu, HI 96813	citydesk@staradvertiser.com	(808) 529-4747
Hawai'i Tribune Herald David Bock, Publisher and Editor	P.O. Box 767 Hilo, HI 96721	dbock@hawaiitribune-herald.com	(808) 930-7323
West Hawai'i Today Chelsea Jensen, Editor	P.O. Box 789, Kailua-Kona, HI 96745-0789	cjensen@westhawaiitoday.com	(808) 329-93 I I
The Garden Island	P.O. Box 231, Lihu'e, HI 96766	bbuley@thegardenisland.com	(808) 245-3681
Maui News	100 Mahalani Street, Wailuku, HI 96793	citydesk@mauinews.com	(808) 244-3981

Moloka'i Dispatch	P.O. Box 482219, Kaunakakai, HI 96748	editor@themolokaidispatch.com	(808) 552-278 I

ELECTED AND OTHER OFFICIALS (EO)

Official	Mailing Address	Electronic Mail or Internet Address	Telephone
U.S. Senator - Mazie K. Hirono	300 Ala Moana Blvd., Rm 3-106 Honolulu, HI 96850	hawaiioffice@hirono.senate.gov	(808) 522-8970
U.S. Senator - Brian Schatz	300 Ala Moana Blvd., Rm 7-212 Honolulu, HI 96850	brian_schatz@schatz.senate.gov	(808) 523-2061
U.S. Representative - Ed Case	2443 Rayburn House Office Building Washington, DC 20515	ed.case@mail.house.gov	(202) 225-2726
U.S. Representative - Kaiali'i Kahele	1205 Longworth House Office Building Washington, DC 20515	kai.kahele@mail.house.gov	(202)225-4906
State Senator - vacant Senate District 1	Hawaii State Capitol, Rm 203		(808) 586-6760
State Senator - Joy A. SanBuenaventura Senate District 2	Hawaii State Capitol, Rm. 213	sensanbuenaventura@capitol.hawaii.gov	(808) 586-6890
State Senator - Dru Mamo Kanuha Senate District 3	Hawaii State Capitol, Rm. 206	senkanuha@capitol.hawaii.gov	(808) 586-9385
State Senator - Lorraine Inouye Senate District 4	Hawaii State Capitol, Rm. 210	seninouye@capitol.hawaii.gov	(808) 586-7335
State Senator - Senate President - Ron Kouchi Senate District 8	Hawai'i State Capitol, Rm. 409 415 South Beretania St. Honolulu, HI 96813	senkouchi@Capitol.hawaii.gov	(808) 586-6030
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Distribution List for the FEIS

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APPENDIX E— CHANGES MADE TO THE REVISED DEIS AND INCORPORATED INTO THE REVISED FEIS

APPENDIX E –CHANGES MADE TO THE REVISED DEIS AND INCORPORATED INTO THE REVISED FEIS

Revisions made to the Revised DEIS, which are reflected in this Revised FEIS, are summarized below:

- Addition of appendices
  - Appendix C – Revised DEIS Comments and Applicant Responses
  - Appendix E – Changes Made to the Revised DEIS and Incorporated into the Revised FEIS
- General edits throughout document:
  - Corrected grammatical or spelling errors as appropriate
  - Updated date of document on title page
  - Change draft to final or DEIS to FEIS
  - Added West Hawai'i Aquarium Permits where relevant
  - Revised discussions to reflect a change from a reliance on Ochavillo and Hodgson to a reliance on population trend data and projected population trends, where appropriate
  - Removed language related to "higher" collection rates where appropriate
- Project Summary
  - Added language clarifying that the DLNR and/or BLNR has the authority to impose specific permit conditions or alter the proposed White List or catch quotas, as appropriate
- Executive Summary
  - Added language about the role of herbivores related to turf algae
- Section 1.0 Introduction
  - Replaced language about the names of the permittees with language about the seven permittees and their plans for filing individual permit applications
  - Clarified that CMLs for aquarium collection now require HEPA review
  - Added language that MPAs restrict additional types of fishing/collection beyond commercial aquarium collection
  - Added in paragraph about Revised DEIS
- Section 2.0
  - Clarified that supplemental HEPA may also include additional HEPA review
- Section 3.0
  - Clarified some of the criteria for the Revised White List, including noting that the data are from DAR (2019a).
  - Added language about aquarium reporting zones and the potential for take to occur in concentrated areas
  - Added language clarifying that changes to catch quotas may require additional HEPA review
  - Removed the proposed "Additional Enforcement and Compliance Measures" based on comments received on the RDEIS
  - Added "Captive Breeding Program" to the alternatives considered but dismissed in response to public comments
- Section 4.0
  - Clarified language in Section 4.1.1 related to a DAR (2019a) quote
- Section 5.0

- Added language to Section 5.1.1 on “traditional and customary practices” in response to public comments
- Added “negative” to cultural impact language as appropriate in response to public comment
- Clarified that population trend data are not available for East Hawai’i
- Added a sentence to 5.4.1.3 related to densities of juvenile Yellow Tang in response to public comment
- Added a statement to Section 5.4.1.3 that small grazers are important for turf algae and macroalgal removal in response to public comment
- Changed “resiliency” to “recovery” in Section 5.4.1.3 related to Adam et al. (2015) in response to comments received from the DAR during the public comment period.
- Added language to Section 5.4.3.3 related to results from Gove et al. (2019) and a comparison of the management areas related to commercial aquarium collection.
- Added Graham et al. (2020) citation to Section 5.4.3.5 in response to public comment
- Removed language related to poaching under the Preferred Alternative from Section 5.4.3.6 due to the changes made to the proposed additional enforcement and compliance measures.
- Added language to section 5.4.3.7 related to additional HEPA review and cumulative impacts in response to public comments.
- Added summary table to Section 5.5.2 for the 8 species on the Revised White List
- Section 5.6 has been revised to clarify that the evaluation is the Applicant’s, and that the DLNR and the BLNR will conduct their own independent evaluations of the HEPA significance criteria