THE HAWAI'I OCEAN RESOURCES MANAGEMENT PLAN

2020

COLLABORATIVE COASTAL ZONE MANAGEMENT FROM MAUKA TO MAKAI

CZM Hawaii
Coastal Zone Management

A PUBLICATION OF THE HAWAI'I OFFICE OF PLANNING, COASTAL ZONE MANAGEMENT PROGRAM, PURSUANT TO NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION AWARD NO. NA17NOS4190102 AND AWARD NO. NA18NOS4190082, FUNDED IN PART BY THE COASTAL ZONE MANAGEMENT ACT OF 1972, AS AMENDED, ADMINISTERED BY THE OFFICE FOR COASTAL MANAGEMENT, NATIONAL OCEAN SERVICE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, UNITED STATES DEPARTMENT OF COMMERCE. THE VIEWS EXPRESSED HEREIN ARE THOSE OF THE AUTHOR(S) AND DO NOT NECESSARILY REFLECT THE VIEWS OF NOAA OR ANY OF ITS SUBAGENCIES

TABLE OF CONTENTS

WELCOME LETTER i

ELEVATING TRADITIONAL ECOLOGICAL KNOWLEDGE ii

ACKNOWLEDGEMENTS v

INTRODUCTION & VISION 1
The coastal zone is recognized as a critical area for management and collaboration. Learn why this Plan was created and how it has evolved.

ORMP GOVERNANCE 11
Introducing the Plan's structure and coalition of diverse and dedicated implementation partners.

THE FOCUS AREAS 25
Three topical subjects selected by government and community members as priorities for Plan implementation between 2020-2030.

MANAGEMENT PRIORITIES 47
Work areas championed by Federal, State, and County agencies which are supportive of the holistic management of Hawai'i's coastal zone.

THE FUTURE OF HAWAI'I'S COASTAL RESOURCES 57
A 'deep dive' into Hawai'i's coastal issues, divided into three main sections: Land Use Pressures, Socioeconomic Pressures, and Ocean and Nearshore Pressures.

CLOSING REMARKS 90

RESOURCES 92

ACRONYMS

ACT	Action Team
BLNR	Board of Land and Natural Resources
BOEM	United States Bureau of Ocean Energy Management
BWS	Honolulu Board of Water Supply
CBFA	Community Based Fishing Areas
CERT	Community Emergency Response Team
CNPCP	Coastal Nonpoint Pollution Control Program
CWG	Coordinated Working Group
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
DBEDT	Department of Business, Economic Development and Tourism
DBEDT-HGBP	Department of Business, Economic Development and Tourism - Hawai'i Green Business Program
DHHL	Department of Hawaiian Home Lands
DLNR	Department of Land and Natural Resources
DLNR-CWRM	Department of Land and Natural Resources - Commision on Water Resource Management
DLNR-DAR	Department of Land and Natural Resources - Division of Aquatic Resources
DLNR-DOBOR	Department of Land and Natural Resources - Division of Boating and Ocean Recreation
DLNR-DOCARE	Department of Land and Natural Resources - Division of Conservation and Resources Enforcement
DLNR-DOFAW	Department of Land and Natural Resources - Division of Forestry and Wildlife
DLNR-OCCL	Department of Land and Natural Resources - Office of Coastal and Conservation Lands
DOH	Department of Health
DOH-CWB	Department of Health - Clean Water Branch
DOH-WWB	Department of Health - Waterwater Branch
DOT-HARBORS	Department of Transportation – Harbors Division

DPP	City and County of Honolulu, Department of Planning and Permitting
ESA	Endangered Species Act
HCEI	Hawai'i Clean Energy Initiative
HDOA	Hawai'i Department of Agriculture
HGBP	Hawai'i Green Building Program
HI-EMA	Hawai'i Emergency Management Agency
HOST	Hawai'i Ocean Science and Technology Park
HRS	Hawai'i Revised Statutes
IPCC	Intergovernmental Panel on Climate Change
LUC	Land Use Commission
MACZAC	Marine and Coastal Zone Advocacy Council
MLCD	Marine Life Conservation Districts
MMA	Marine Managed Areas
MS4	Municipal Separate Storm Sewer Systems
NARS	Natural Area Reserves System
NELHA	Natural Energy Laboratory of Hawai'i Authority
NERR	National Estuarine Research Reserve
NOAA	National Oceanic and Atmospheric Administration
NOAA C-CAP	National Oceanic and Atmospheric Administration - Coastal Change Analysis Program
NOAA-CRCP	National Oceanic and Atmospheric Administration - Coral Reef Conservation Program
NOAA-Fisheries	National Oceanic and Atmospheric Administration - Fisheries
NOAA-MDP	National Oceanic and Atmospheric Administration – Marine Debris Program
NOAA-NMS	National Oceanic and Atmospheric Administration – National Marine Sanctuaries
NOAA-OCM	National Oceanic and Atmospheric Administration – Office for Coastal Management
NPDES	National Pollutant Discharge Elimination System

OCS	Outer Continental Shelf
OHA	Office of Hawaiian Affairs
OP	Office of Planning, State of Hawai'i
OP-CZM	Office of Planning - Coastal Zone Management Program, State of Hawai'i
ORMP	Ocean Resources Management Plan
OTEC	Ocean Thermal Energy Conversion
PacIOOS	Pacific Islands Ocean Observing System
QA/QC	Quality Assurance/ Quality Control
SMA	Special Management Area
SLR-XA	Sea Level Rise Exposure Area
TEK	Traditional Ecological Knowledge
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
UH	University of Hawai'i
UH-SOEST	University of Hawai'i - School of Ocean and Earth Science and Technology
USACE	United States Army Corps of Engineers
U.S.C.	United States Congress
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Service
WEC	Wave Energy Conversion
WPRGMC	Western Pacific Regional Fishery Management Council

ALOHA!

It is our pleasure to share this document, the *2020 Ocean Resources Management Plan: Coastal Zone Management Mauka to Makai* with you. The Office of Planning (OP) has the unique charge to work amongst Departments and facilitate efforts to achieve shared ocean resource protection goals for the State of Hawai'i. Thus, we are honored to serve as the lead agency to coordinate the implementation of the Hawai'i Ocean Resources Management Plan (ORMP).

The intention for this Plan is to provide a focused effort to improve State policies for ocean resources by addressing management gaps in our State. In order to do so, the framework of the ORMP brings together a diverse group of stakeholders and experts to collaborate on statewide issues, identify management gaps, and utilize this information to change policy.

The ORMP was developed by conducting statewide public input in addition to collaborating with stakeholder agencies to create the resulting Plan. As a living document, the ORMP has evolved throughout the decades and it is the shared vision that this Plan will bring a renewed focus on implementation.

We want to express our thanks to members of the public who contributed their time to share their feedback; to the Marine and Coastal Zone Advocacy Council (MACZAC) who serves as advisory to the OP and participated in this Plan; and to the many stakeholder agencies who work daily to manage environmental impacts, and have contributed their intentions for where the ORMP might facilitate their role to address gaps in these environmental challenges.

Lastly to those stakeholders who have participated in the ORMP process throughout the decades and continue to support collaboration as a key tool for addressing ocean resource protection challenges, it is because of your efforts that the ORMP continues to thrive. We welcome opportunities to continue to partner with you now and in the future.

MARY ALICE EVANS
OFFICE OF PLANNING
DIRECTOR

JUSTINE NIHIPALI
COASTAL ZONE MANAGEMENT PROGRAM
PLANNING PROGRAM MANAGER

ELEVATING TRADITIONAL ECOLOGICAL KNOWLEDGE IN PLANNING PROCESSES

Nearly 200 years before the Hawai'i Coastal Zone Management (CZM) Program was established (1977), British explorers came into contact with a rich island culture surviving and thriving in the most remotely inhabited place on the planet. They found complex systems of food production and land management unlike any other they had encountered in the Pacific. These systems included upland agricultural complexes, nearshore fishponds and fisheries connected by a series of complex irrigation systems running from mauka, *mountains* to makai, *the sea* where they meet nearshore waters and the ocean beyond. Perhaps most significant of the discoveries was that the intellect and knowhow responsible for this unique place-based system of behavior and resource management was the product of thousands of years of experience and wisdom being passed from one generation of practitioners to the next via an oral and aural knowledge transfer system referred to locally as "Hawaiian ways of knowing" and more widely referred to by native and indigenous communities elsewhere as traditional ecological knowledge (TEK).

Historically, TEK for Kānaka Maoli, *Native Hawaiians*, was about establishing and maintaining an intimate relationship with the natural world that would not only ensure their physical survival, but the ability of future generations to do the same while doing no harm to the environment. One might argue that the initial purpose of the CZM program to "create a common focus for state and county actions dealing with land and water uses and activities" was a return to the ways of knowing that enabled Kānaka Maoli to adapt and live in harmony with the natural world, and that TEK is as relevant in the 21st century as it was in the 18th century.

Generations of Kānaka Maoli lived harmoniously with nature, recognizing and acknowledging that the realms of land, sky and sea were interconnected and

Kānaka is the general reference to *"humans"* or "*people"*, while maoli refers to *"original"* or *"true"*. Combined, Kānaka Maoli refers to Native Hawaiians (and their descendants), the aboriginal Polynesian people who first populated and settled the Hawaiian archipelago between the 3rd and 5th centuries, AD.

interrelated. By taking cues from the environment, Ka Po'e Kahiko, *the people of old*, learned to live in alignment with the creatures and plant life of these realms.

By aligning their practices and behaviors with the rhythms of nature, Native Hawaiians learned to harvest ocean resources more sustainably. Centuries of observations and interaction with their surroundings enabled them to effectively assess ecosystems health and better prepare and adapt to coastal hazards, and when necessary, to adjust their resource management strategies. Strict adherence to and enforcement of a system of kapu, *sacred rules of conduct and behavior*, helped protect and preserve natural resources from being overfished or overharvested ensuring that future generations might benefit from the land and sea as their ancestors had.

Ka Po'e Kahiko captured some of these lessons in 'Ōlelo No'eau, *wise proverbs and sayings*.

Sky

The realm of sky brings life through rainfall and wind but also delivers storms which can cause damage and endanger lives. The 'iwa, *frigate bird*, served as an early indicator of changes in weather and impending coastal hazards. By observing the 'iwa, lawai'a, *fishermen*, were able to make decisions in anticipation of the forces of nature and their impacts.

Lele ka ʻiwa, mālie kai koʻo.
When the ʻiwa heads out to sea, the rough winds will be calm.

Kīkaha ka ʻiwa, he lā makani.
When the ʻiwa soars high, it is going to be windy.

Land
The realm of land is a series of interconnected systems which communicate through subtle seasonal variations. Mauka practitioners such as the mahiʻai, *farmers*, relied on knowing when certain upland plants were fruiting to sustainably harvest corresponding sea creatures. In the following ʻōlelo noʻeau, practitioners acknowledge the connection between the harvest of upland hala, *pandanus plant*, and the abundance and availability of the reef-dwelling ʻuhu, *parrotfish*, in nearshore waters.

Pala ka hala, momona ka ʻuhu.
When the hala fruit is ripe, the ʻuhu is fat.

Sea
The realm of the sea is considered momona, *abundant and bountiful,* by Native Hawaiians and seen as a source of sustenance that could be impacted positively or negatively by activities on land. By adopting sound aquaculture and agricultural practices and techniques, erosion and runoff were minimized, effectively limiting the impact on the health of ʻuhu and other reef life by reducing the delivery of sediment to nearshore waters. Skilled and knowledgeable practitioners adhered to a strict system of kapu for proper species and resource management. When environmental conditions warranted, lawaiʻa and mahiʻai adjusted their practices to help maintain balance and ecosystem health.

In this document, the ʻiwa, hala, and ʻuhu serve as examples reflecting the symbiotic relationship between sky, land, and sea, as well as the role they play as

Notes for navigating this document:

ʻOlelo Hawaiʻi, *Hawaiian language*, is a multilayered, multifaceted, elemental language deeply rooted in metaphor and allegory. Consequently, Hawaiian words can have many nuanced meanings, and multiple English translations that are determined by context and pronunciation. Hawaiian words that have become local professional vernacular are used throughout this document.

Upon the first use of Hawaiian words, their common English translations, appropriate to the context in which the Hawaiian word is used, are provided after the term in italics as in the examples below:

The honu, *sea turtle*, is recognized as a symbol of traditional knowledge and wisdom in Native Hawaiian culture. Throughout this document, the use of the honu icon will signify traditional knowledge important for the reader to carry with them on this journey.

Laulima, *community cooperation*, is an islander value that made it possible for Polynesians to sail the Pacific and build a flourishing Hawaiian society. Today, the call to laulima, *work together for the good of the whole*, is as relevant as ever to address the pressures of human impacts being imposed on land and sea. Throughout the Plan opportunities for community action are symbolized by many hands in a starfish pattern.

indicators of change in the coastal environment in aiding those who reside there. These species appear throughout the Ocean Resources Management Plan (ORMP) to celebrate and reiterate this interconnectivity. It should be noted that these symbols are not ubiquitously associated with sky, land, and sea among cultural practitioners, but rather have been selected to illustrate the critical connections between healthy ecosystems, and the importance of considering these connections in the implementation of this Plan.

This Plan update is intended to acknowledge and respect the traditional knowledge that enabled Kānaka Maoli to survive and thrive in Hawai'i for multiple centuries prior to Western contact, influences, and world views. However, the integration of TEK into contemporary planning processes and governance structures sometimes encounters challenges. For instance, TEK practitioners observe "natural time" with an eye focused on a long view. This multi-generational perspective can conflict with the pragmatism of "artificial time", which is ruled and governed by rigid accounting procedures, budget constraints, and fixed planning horizons. While time may have equal importance to the planner as it does to the cultural practitioner, its importance is likely to be rooted in vastly different values and expectations. This dissonance presents a challenge to planners in attempting to "fit" TEK into processes, plans, and policies. Indeed, this challenge was felt throughout the development of the ORMP. Despite these conflicts, it is hoped that the effort to acknowledge, honor, and respect traditional knowledge within the Plan update process has served to incrementally expand the state of the practice.

The ORMP invites agencies or partners with responsibilities for coastal health and management to consider the following concepts and principles, which were developed to support the integration of TEK into contemporary planning and the implementation of CZM policies and practices. These suggestions are based on numerous interviews with cultural practitioners and individuals in varied fields and disciplines considered to be ma'a, *knowledgeable*, in the ways of Hawaiian knowing and doing.

RELATIONSHIPS

TEK acknowledges that successful resource management is focused on relationships before transaction, agency partners may need to establish and maintain more meaningful working relationships with practitioners and communities to achieve their respective goals and objectives.

RESPECT

Greater respect should be shown and given to the relationship between practitioners and the resources they care for by acknowledging that TEK is the product of many generations passing on their accumulated experience and knowledge.

RECIPROCITY

Those engaging and interacting with practitioner communities, should consider the benefits of "giving" as much as they "receive" from their interactions, with the intent of leaving people and places whole and not wanting.

RELEVANCE

There needs to be an acknowledgement that not all policies fit all conditions, locales, or practices, especially those governed by natural time and environmental conditions.

REFLEXIVE, REFLECTION & RESPONSIVE(NESS)

Similarly, policies and practices ought to be reflexive and responsive to changing ecological and economic conditions that do not adhere to accounting or administrative practices that are either fixed or inflexible.

REVERENCE VS. REFERENCE

Greater reverence should be shown for the resources and those whose kuleana, *responsibility*, it is to care for them, rather than treating either as reference data in the interest of satisfying programmatic and budgetary constraints.

ACKNOWLEDGEMENTS

In addition to numerous government agencies and nongovernmental organizations providing valuable input into the development of the ORMP, the following individuals provided valuable insight into the traditional ecological knowledge understood and practiced by Native Hawaiians, including:

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DIRECTOR OF AGROFORESTRY.NET

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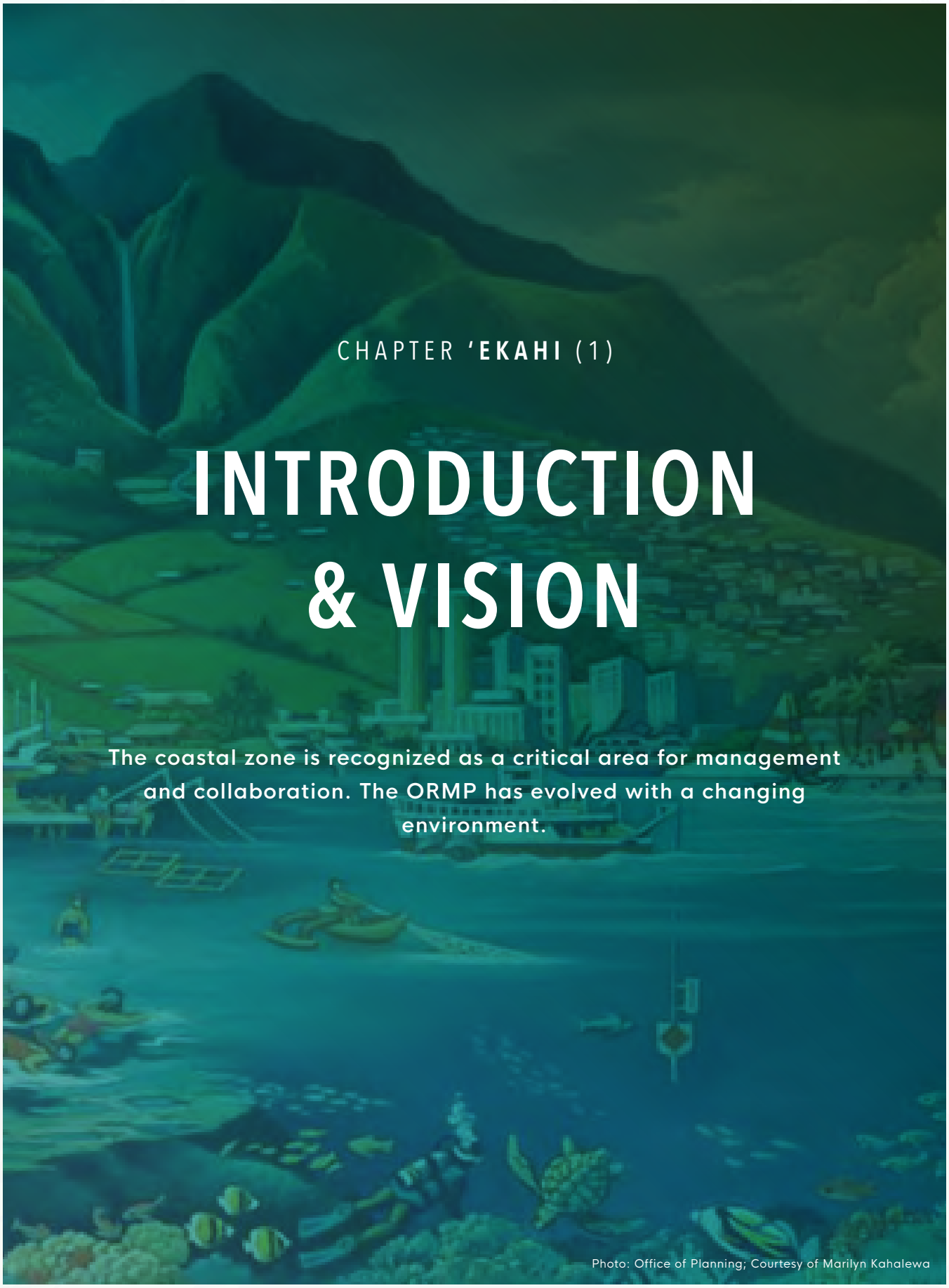
In appreciation and memory of "Uncle Les" Kulolo'io for his leadership and contributions. Mahalo piha for the mana, 'ike, and aloha you have shared with us and so many.

Pua Lehua i ka la lawai'a, *a lehua blossom in fishing (said of an expert fisherman)*
Ōlelo No'eau 2704, Mary Kawena Pukui



CHAPTER **'EKAHI** (1)

INTRODUCTION & VISION

The coastal zone is recognized as a critical area for management and collaboration. The ORMP has evolved with a changing environment.

Photo: Office of Planning; Courtesy of Marilyn Kahalewa

Ka Pae 'Āina o Hawai'i, *the Hawaiian Archipelago*, consists of 132 islands and over a thousand miles of coastline stretching across 1,700 miles in the Pacific Ocean. Consisting of eight (8) major islands, seven (7) of which are inhabited, Hawai'i is the country's only island state, completely surrounded by water. Characterized by mild tropical temperatures, soaring volcanic features, lush green mountain ranges, unique species biodiversity, diverse climate zones, and clear waters, Hawai'i is truly a tropical paradise.

Most often referred to as "land" or "earth", 'Āina may also be translated as "that which feeds". The root word 'ai embraces the principle and practice of "aloha" that act of reciprocity, giving and receiving, as it means both to "feed" as well as to "eat" while also referring to the source of life energy, food.

Underlying the seemingly pristine turquoise waters and lush verdant mountains which appeal to residents and visitors alike, are significant pressures on environmental, societal, and economic levels. State and county agencies are grappling with challenges ranging from invasive species and nearshore coastal water pollution to low housing affordability, high rates of homelessness, competing land uses, and threats to existing development.

Long term planning is one way government entities can combat such pressures. The ORMP, a comprehensive plan mandated by State law, is one such effort. First introduced in 1985, the ORMP was reviewed in 1991, and updated in 2006 and 2013. This 2020 ORMP is the fifth version of the Plan.

The ORMP was one of the first state plans to recognize the traditional Hawaiian ahupua'a concept, the Hawaiian land and ocean tenure system. Since then, most – if not all – natural resource agencies recognize that activities that take place mauka, flow makai, where they impact nearshore waters and the ocean beyond. Natural ecosystems that have co-evolved in isolation for eons have been disrupted by human activity and practices that constrain natural processes, extract resources, and introduce external inputs. Current government constructs lead to entities competing among themselves to address these

An ahupua'a is a traditional Hawaiian land unit and system of land use management, commonly defined by mountain ridges, valley walls, streams or rivers that run from mauka to makai. Its outermost borders were customarily marked by an ahu, *stack of rocks*, upon which a likeness or the skull of a pua'a, *pig*, would be placed where ahupua'a residents could leave offerings and tribute to Lono, the deity of agriculture, and the ali'i, *the high chief*, for access and use of the land.
Photo: Office of Planning; Courtesy of Marilyn Kahalewa

challenges, rather than working in concert with each other. Through the ORMP, its framework, partnerships, and implementation, the State seeks to collectively focus on addressing key environmental challenges facing Hawai'i's natural resources through collaborative governance.

↳ The flow of water from mountains to sea through the modern ahupua'a is impacted by development and human activity.
Photo: Delfi de la Rue via Unsplash

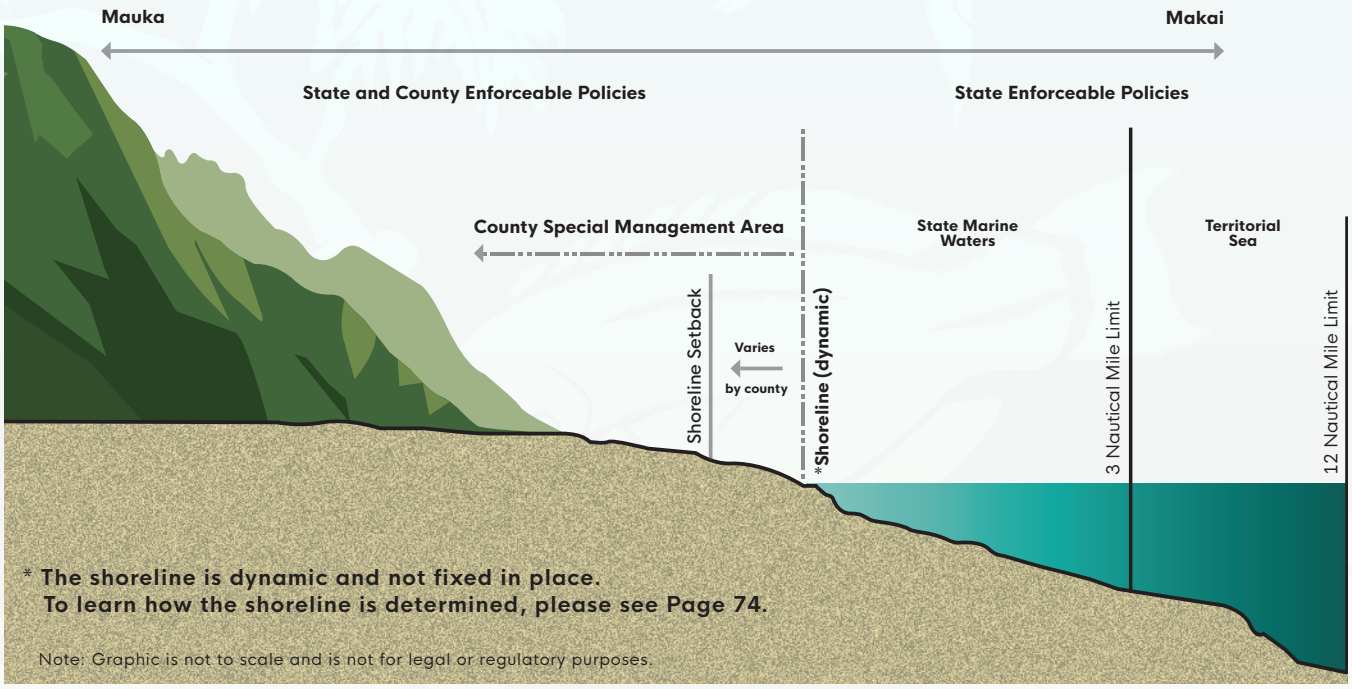
COASTAL ZONE MANAGEMENT

In 1972, the U.S. Congress recognized the need to address the continued growth in the coastal zone through the passage of the Coastal Zone Management Act (CZMA). This act, administered by the National Oceanic and Atmospheric Administration (NOAA) Office for Coastal Management (OCM) provides for the management of the nation's coastal resources, including the Great Lakes. The goal is to "preserve, protect, develop, and where possible, to restore or enhance the resources of the nation's coastal zone." Through the CZMA, NOAA establishes a voluntary partnership with States and territories with approved programs, and disburses funds to support its activities through a cooperative agreement.

In Hawai'i, the Office of Planning's Coastal Zone Management (OP-CZM) Program was enacted into law in 1977 by the Hawai'i State Legislature, which found that the coastal environment is both undermanaged and overregulated; that new mechanisms must not be added onto, but rather combined with the existing systems. Following this act, the OP-CZM Program was submitted to and approved by NOAA in 1978. The CZM Program is appropriately housed in the OP, whose purpose is to (1) provide central direction and cohesion in the allocation of resources and effectuation of state activities and programs, and (2) effectively address current or emerging issues and opportunities (OP 2020).

Through the OP-CZM Program and enactment of CZM law in Hawai'i Revised Statutes (HRS) Chapter 205A, the Legislature established what is described as a network program, whereby the Program works with a network of state agencies and local governments to administer enforceable laws, regulations, and policies that protect the coastal zone. The network is a coordinative device intended to ensure that state and county agencies address coastal management objectives and policies. Thus, the OP-CZM Program is not a singular entity on its own, but a collaborative network of agencies and partners, each of which

Hawai'i Coastal Zone Management



↳ §205A-1 Definition:
"Coastal Zone Management Area" means all lands of the State and the area extending seaward from the shoreline to the limit of the State's police power and management authority, including the United States Territorial Sea.

maintains its existing mandates and responsibilities. The purpose of the Hawai'i OP-CZM Program is to "provide for the effective management, beneficial use, protection, and development of the coastal zone" (HRS 205A 1977)

In the implementation of the network, CZM law requires that the objectives and policies of the Program be binding on all agencies (to include any agency, board, commission, department or officer of a county or state government).

COASTAL ZONE MANAGEMENT AREA

At the national level, the definition of the term "coastal zone" means the coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder), strongly influenced by each other and in proximity to the shorelines of the several coastal states, and includes islands, transitional and intertidal areas, salt marches, wetlands, and beaches. The zone extends inland from the shorelines only to the extent necessary to control shorelands, the uses of which have a direct and significant impact on the coastal waters, and to control those geographical areas which are likely to be affected by or vulnerable to sea level rise (16 United States Code (U.S.C.) § 1453).

The CZMA allowed states to create and exercise their discretion to define their own programs. In Hawai'i, no point in the entire state is more than 29 miles from the shore (OP-CZM 2011). The CZM Program recognized that any action occurring on land will ultimately affect our ocean environment. Therefore, in Hawai'i, the coastal zone management area is defined as: "*all lands of the State and the area extending seaward from the shoreline to the limit of the State's police power and management authority, including the United States territorial sea*," (HRS § 205A-1).

Statutory Mandate & Plan Purpose

The ORMP acknowledges that many of the most challenging issues and pressures affecting Hawai'i's natural environment do not fall neatly within any single governmental agency's kuleana. Thus, the Plan is grounded with the premise that collaboration among agencies for the management of human impacts to the natural environment is instrumental for Hawai'i residents to thrive as well as to sustain the natural beauty that draws visitors to the islands year-round.

The purpose of the ORMP is to serve as a guiding document for agencies with responsibilities relating to marine and coastal zone management. It serves as convening mechanism to improve upon the CZM network's ability to carry out its objectives and policies. The OP-CZM Program leads this initiative to identify management gaps at a statewide level that are presently unaddressed, or insufficiently addressed through existing resources and actions. The ORMP collaboration and resulting initiatives that arise from this Plan are intended to be applied towards strengthening the CZM network by influencing the potential for new or updated enforceable policies, new or updated implementing ordinances and other management actions to achieve CZM objectives and policies.

Primarily a State plan, the legislature specifically identified, but did not limit to, eight state agencies with responsibilities relating to marine and coastal zone management (HRS § 205A-62(3)). Additionally, the County Planning Departments serve as essential partners in land use decisions in their respective counties. Federal partners and other entities also participate in the implementation of this Plan, recognizing potential supporting roles to collaborate with the ORMP and benefits from regular participation in multi-agency and cross-disciplinary discussions.

CHANGING ENVIRONMENT

Growth in Hawai'i's residential population and visitor industry exerts pressures on our natural environments. In 2020, the State residential population is estimated at 1,466,632 and by 2030 it is projected to grow to 1,556,843, approximately a 6% increase (DBEDT 2019a). The visitor industry estimates that 10.7 million visitors will travel to Hawai'i in 2020 (DBEDT 2019c).

↳ Extensive high-density development on the island of O'ahu has transformed the landscape.
Photo: Office of Planning

Sustaining the needs of residents and visitors presently involves importing (by air and sea) an estimated 85-90% of food from off-island sources (HI-OP, HDOA, 2012). Initiatives to increase food production in Hawai'i are ongoing, however maintaining strong working waterfronts to ensure food security and other imports is essential for Hawai'i's vitality.

While the benefits of population growth may contribute towards indications for a stronger economy, such growth also places increased demands on the State's finite natural resources. Since 2013, when the previous version of the ORMP was completed, several events have helped to localize issues which may have been regarded as abstract or global in scale and concern. These events include coral bleaching, a significant reduction in coral cover, declines in the health of coral reefs and nearshore marine ecosystems, and loss of the natural infrastructure that protects beaches from erosion.

In 2014-2015, elevated ocean temperatures resulted in extreme coral bleaching, occurring particularly in west Hawai'i and Maui. Overall, average coral cover declined by 49.7% and 20-40% for these areas, respectively (DLNR-DAR 2017).

Between 2014-2019, an unprecedented three separate coral bleaching events have occurred for this critical island resource, for which declining coral health has implications that result in cascading negative effects. Among them: reducing habitat for nearshore marine ecosystems, impacting tourism snorkeling experiences, and reducing the coastal protection ecosystem services that coral provides by dissipating wave energy.

↳ Erosion on Kā'anapali Beach reduces public access in a popular resort district.
Photo: Office of Planning

Past and current development patterns and other historic and present land use activities have altered conditions with resulting impacts on land and in water systems. Shoreline development and subsequent

protection of these structures are increasingly impacting Public Trust resources and public access.

In 2017, the State issued the *Hawai'i Sea Level Rise Vulnerability & Adaptation Report* which identified the extensive vulnerability of Hawai'i's shoreline infrastructure, amounting to an estimated 38 miles of major roadways, 6,500 structures, and 500 cultural sites inundated with 3.2 feet of sea level rise. These impacts could displace nearly 20,000 people within the State's coastal zone (Hawai'i Climate Change Mitigation and Adaptation Commission 2017).

In 2019, the National Weather Service recorded 281 record high temperatures in the State which scientists attribute to a marine heat wave potentially linked to climate change. Scientific studies and community-led historical observations continue to study the impacts from dramatic weather shifts, some of which recent documented effects of which include: increased wildfire frequencies, fish kills in Kāne'ohe Bay, and an April 2018 "rain bomb" over Kaua'i (which resulted in 49.7 inches over a 24 hour period flooding the area of Hanalei and Hā'ena) (McCoy, et al. 2017).

Indeed, it is our kuleana, to huli, *return or shift*, the balance and ensure that the health of our environment is incorporated and prioritized. Management actions for human behaviors will have to be considered hand in hand with efforts to sustain and grow the economy. In response to these changes and ongoing concerns in the coming decade, the ORMP will guide the work of multiple stakeholders to implement its vision and mission:

VISION

The vision for Hawai'i's resources is a healthy island ecosystem that fosters social and economic sustainability through the preservation and restoration of Hawai'i's unique cultural and environmental values.

MISSION

The ORMP supports collaboration to address Hawai'i's resource management issues and encourages holistic stewardship from land to sea.

Huli means to return, repeat, change, reverse or turn over. It can also refer to the shoot or top of a taro plant which is "replanted" or "returned" to the soil to produce the next generation of taro.

Kuleana also refers to rights and privileges associated with living up to responsibilities and obligations. It also refers to a smaller land division within an ahupua'a or 'ili, *land section, usually a subdivision of an ahupua'a.*

A vibrant and healthy ocean environment is essential to the quality of life in Hawai'i. One of Hawai'i's greatest natural resources, the ocean provides economic vitality, sustenance, and world-class recreational ocean activities. In 2015, the ocean economy supported 116,742 jobs, provided $4.2 Billion in wages, and contributed $8.2 Billion towards Hawai'i's gross domestic product. Indeed, the ocean is a significant contributor to the State's livelihood.

Ocean sector jobs include positions related to: living resources (i.e. commercial fishing, fish hatcheries, aquaculture, seafood processing, and seafood markets), marine construction (i.e. beach nourishment and harbor dredging), ship and boat building (building and repairs), marine transportation (deep sea freight, marine passenger transportation, pipeline transportation, marine transportation services, search and navigation equipment, and warehousing), offshore mineral extraction (sand and gravel mining), and the highest contributor to the total ocean economy, tourism and recreation (eating and drinking establishments, hotels, marinas, boat dealers and charters, campsites, scenic water tours, manufacture of sporting goods, amusement and recreation services, recreational fishing, zoos, and aquariums).

The statewide system of commercial harbors consists of ten harbors on six islands. This system serves a vital role in Hawai'i's economy as the ports are the primary means for goods to enter and exit the State. Given its isolated location, Hawai'i imports approximately 80% of what it consumes, the majority of which enters the State though the commercial harbors system. The State relies upon the ocean for safe transport of goods which support consumer needs for both the ~1.4 million residents and the ~10 million persons/year visitor industry. Additionally, within the ~10 million visitors,

are approximately 230,000 passengers that arrive via cruise ships – an industry completely reliant upon the ocean.

Although much of our consumer goods are imported, the ocean also provides a local food resource, which may be particularly essential for "neighbor islands" which require additional local shipping to continue to distribute goods past the main commercial port on O'ahu – thereby further increasing costs of goods. Presently, there is no consistent data source, i.e., fishing registry, license, or permit program for non-commercial fisheries, however estimates that non-commercial fisheries make up about 84% of total nearshore catch. While this may not be recorded as an economic value, these non-commercial fisheries are an important component in Hawaiian traditional cultural practices and food security. For example on the island of Moloka'i 24.1% of households engage in fishing per 2-month period, in comparison to O'ahu where that is 5.6% (McCoy, et al. 2018).

In order to continue to enjoy the economic and social benefits described, the State must commit to preserve ocean health and to enhance Hawai'i's ocean resources in the face of impacts. As a State, we must mālama, *protect, nurture, and care for*, ocean resources that provide so much for us. There must be regular, meaningful, stakeholder engagement to achieve the ORMP Vision and significant investments of financial and human capital dedicated to furthering its Mission. The ORMP sustains this commitment through a shared framework of purposeful actions, guided by core principles that are intended permeate the activities carried out through this Plan. The ORMP will operate through a framework of Perspectives that will set the foundation for how the Plan is implemented.

Mālama is a key guiding principle grounded in service to and for the wellbeing of future generations, and a commitment to care for, maintain, sustain, protect and preserve natural resources for the benefit of the "we" and not just the "me".

↳ As seas rise, all coastal infrastructure will require adaptation. Here, the He'eia loko i'a, *fishpond*, kuapā, *wall*, and mākahā, *sluice gate* are overwhelmed by rising tides.
Photo: Hawai'i Sea Grant King Tides Project

FOUR GUIDING PERSPECTIVES

The ORMP's Perspectives are intended to be referenced as guiding principles. They serve to promote the consistent inclusion of land-sea connections, traditional ecological knowledge, multi-agency collaboration, and adaptation to global climate change into all ORMP-led initiatives. The OP-CZM Program encourages application of the Perspectives in all efforts led by the partners that compose Hawai'i's Coastal Zone Management Network.

1. CONNECT LAND AND SEA

Incorporate the interconnectedness of island ecosystems into decision-making. Alleviate pressures on and prioritize environmental health from mauka to makai.

2. PRESERVE OUR OCEAN HERITAGE

Promote respect towards native Hawaiian traditional ecological knowledge. Acknowledge the unified fates of human and environmental health, both for the wellbeing of current and future generations.

3. PROMOTE COLLABORATION AND STEWARDSHIP

Work together to share knowledge, experience, and resources. Create and sustain a diverse network of stakeholders.

4. ADAPT TO CHANGING CONDITIONS

Mitigate the projected impacts of global climate change by reducing the vulnerability of the built and natural environments to rising sea levels and extreme weather.

WHAT HAS CHANGED IN THE 2020 OCEAN RESOURCES MANAGEMENT PLAN

Through a collaborative outreach process involving both agency partners and public stakeholders, Focus Areas have been identified as priorities for the allocation of resources during the Focused Implementation phase (2020-2030). Focus Areas for this phase were selected based on consideration of the Plan's unique mandate, place-based observations of coastal issues reported by stakeholders and community members, and the priorities and capacity of the Coastal Zone Management Network.

Many Management Priorities identified by the 2013 ORMP remain important to the comprehensive health of Hawai'i's environmental, social, cultural, and economic wellbeing. The Management Priorities generally mirror CZM's objectives and policies as stated in HRS § 205A-2 and serve as one way to monitor agency compliance and document ongoing actions that demonstrate consistency to further this management framework. Metrics are used to measure the status of agency activities related to each Priority area. Each metric is attributed directly to an agency.

The ORMP builds upon previous versions of the Plan, which has evolved since its origins in 1985 from a focus on individualized, sector-based responsibilities towards promoting collaborative management among multiple agencies and levels of jurisdiction. Starting in 2006, emphasis on measures and government accountability incorporated goals and metrics under categories described as "management priorities" with progress on how agency actions (metrics) contributed to accomplishing goals. Over time, the vast number of metrics – 113 in 2006 and 84 in 2013 – proved to be difficult to track and minimally effective in demonstrating how the individual agency actions were contributing collectively towards furthering an overarching Management Priority.

State law requires the Plan to be updated periodically but does not prescribe the frequency of its updates. Recent ORMP updates have occurred every five years through a process that involves statewide public input and government feedback. In revisiting this frequency and the magnitude of the issues to be addressed within this Plan, it is proposed that ORMP funding is focused on implementation of the Plan, rather than the update of its contents. Therefore, in five years, the ORMP will be revisited, but may not undergo a wholesale update process.

In this version of the ORMP, these Management Priorities will be maintained, and metrics will continue to be tracked as agencies carry out their responsibilities. However, the 2020 ORMP places an emphasis on making more impactful progress by refining areas within the management priorities and identifying Focus Areas. Identification of the Focus Areas is a result from statewide public input, stakeholder vetting, and compatibility with CZM priorities and direction.

BRIEF INTRODUCTION TO FOCUS AREAS AND ACTION TEAMS

Within the ORMP, those emerging issues and long-standing challenges are identified as the following Focus Areas which will be discussed in-depth in Chapter 3:

I. Development and Coastal Hazards;

II. Land-Based Pollution; and,

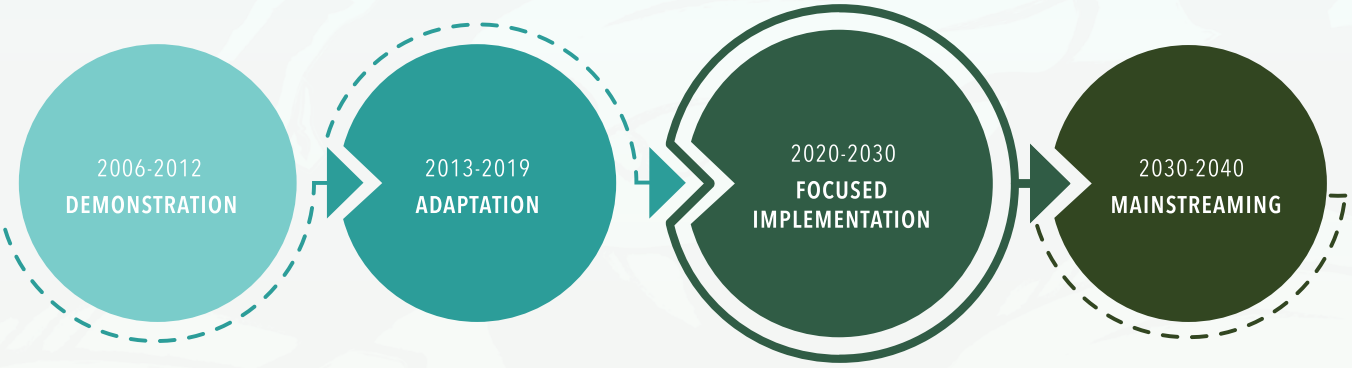
III. Marine Ecosystems.

ORMP PHASING APPROACH

The ORMP represents Hawai'i's contemporary take on coastal management. Since 1985, each successive Plan update has underscored the need to evaluate effectiveness and integrate Hawai'i's evolving conditions.

The 2020 ORMP is the Plan's fifth iteration. Its recent evolution is most pronounced in its focused approach to implementation. The Adaptation phase (2013-2019) encouraged broad actions in many areas of coastal need. Recent assessments have found that this wide-reaching approach overextended the implementation capacity of the Plan's partner agencies. The breadth of the Adaptation phases' goals, combined with a lack of personnel and funding resources for implementation, left many Plan priorities unaddressed at the end of the 5-year plan horizon.

These valuable lessons helped to craft the Focused Implementation phase (2020-2030). The Focused Implementation approach elevates select topic areas from a wide spectrum of issues in order to encourage demonstrable progress in areas determined through a collaborative and iterative outreach process. This phase will also have an extended planning horizon to accommodate the long-term implementation efforts identified as needs in the 2020 Plan. After approximately 5 years, a check-in will provide an assessment of progress for Plan Partners and members of the public. Following Focused Implementation, the Mainstreaming phase (2030-2040) will seek to build upon the successes of the previous phases' work and add, if capacity allows, collective action in newly-assessed areas of need.



CZM'S VISION TO CATALYZE LEVERAGED RESOURCES

Further refinement among the previous eleven (11) Management Priorities to advance specific Focus Areas fulfills both a State mandate to identify management gaps in coastal zone management and direct funding resources towards developing policies and guidelines (HRS § 205A-3(7)) and provides federal opportunities to address emerging issues and long-standing challenges through resources from the CZMA Section 309 Coastal Zone Enhancement Program.

Implementation of the Focus Areas will be initially catalyzed by OP-CZM Program resources and concerted application in response to federal funding opportunities. Ultimately, it is recognized that agencies with the mandate, express authorities, and technical expertise will be the entities that further carry out later project stages to improve upon their practices in carrying out obligations for implementation of objectives, policies, and guidelines of HRS 205A. OP-CZM Program federal funding is intended to achieve policies of the CZMA and in part may be used for work products such as feasibility studies and preliminary engineering reports. CZM-funded studies and reports serve to lay the groundwork for understanding the impacts of an issue, and may lead to in-ground capital improvement projects. Therefore, it is envisioned that state and county resources will be required to leverage initial CZM seed funding to build upon initial progress accomplished through the ORMP.

Thus, sustained participation in ORMP governance at staff, management, and departmental leadership levels is critical to successful implementation of this Plan. This is further discussed in Chapter 2.

↳ State, County, and Federal agencies discuss ocean resource management gaps identified by members of the public as priorities for Plan action.
Photo: Office of Planning

CHAPTER **'ELUA (2)**

ORMP GOVERNANCE

The ORMP seeks to foster collaboration among agencies with ocean and coastal resource management responsibilities. By collaborating and sharing our individual and collective visions, we can find gaps and address them together.

Photo: Greg Rakozy via Unsplash

OP-CZM | ROLE & OBJECTIVES

The role of the OP and the CZM Program is to work collaboratively among its stakeholders and agency partners to develop the strategic direction to address environmental management gaps, taking into consideration a balance for economic use and livelihood, through policy and guidance.

OP-CZM serves as a convening and coordinating entity to ensure that the implementation actions within the State are consistent with the national CZMA and HRS Chapter 205A and is charged with periodically updating the Plan (HRS § 205A-62). Facilitation of these discussions among agencies and interests is essential to identify opportunities for alignments that may create future opportunities, as well as agency misalignments that require further compromise to accomplish broader State outcomes.

In 2013, recognizing the critical nature of the need to sustain relationships among agencies for the implementation of long-term vision, the OP-CZM Program formalized ORMP governance through the Hawai'i Ocean Partnership Agreement. The agreement identifies the roles of staff, management, and departmental leadership, and describes the intentions for how the Partnership will interact, which is described briefly as follows:

COUNCIL ON OCEAN RESOURCES (COUNCIL)

The Council is responsible for 1) setting Partnership priorities and 2) providing leadership and direction to the Coordinate Working Group (CWG) on implementing the ORMP. The Council shall have the authority to collectively establish, dissolve, or modify Action Teams (ACTs).

COORDINATED WORKING GROUP (CWG)

The CWG is responsible for identifying resources and recommending ORMP implementation strategies to the Council; reporting the progress of ORMP implementation to the Council; and serving as the principal venue to communicate, coordinate, and integrate implementation activities across the Action Teams. The CWG shall evaluate Action Team progress and recommend Action Team modifications to the Council.

ACTION TEAMS (ACTs)

ACTs serve as multi-agency groups to implement specific priorities, goals, or actions in the ORMP. An ACT is responsible for developing and executing work plans, tracking metrics, and reporting accomplishments to the CWG.

↳ The Council on Ocean Resources convening to discuss the ORMP update process.
Photo: Office of Planning

MARINE & COASTAL ZONE ADVOCACY COUNCIL (MACZAC)

In 2001, the State Legislature passed Act 169, which became HRS § 205A-3.5. This law clarifies OP-CZM's responsibility to maintain a public advisory body and defines its membership. The twelve advisory members of the Marine & Coastal Zone Advocacy Council (MACZAC) are recruited from the islands of Kaua'i, O'ahu, Maui, Moloka'i, Lāna'i, and Hawai'i, and have diverse professional and community backgrounds. MACZAC's mission statement is, "Advocate for a comprehensive management system which restores, preserves, and protects Hawai'i's marine and coastal environment." The MACZAC meets quarterly.

PAST, PRESENT, & FUTURE

The ORMP's origin dates to the mid-1980's, encompassing several iterations, as illustrated below.

1978

Establishment of Hawai'i Coastal Zone Management Program.

1985

Hawai'i's first Ocean Resources Management Plan published, takes sectoral approach to agency responsibilities for coastal management.

1991

Plan update encourages comprehensive management approach.

2006

Plan update includes an ahupua'a approach to ecosystem management and begins tracking metrics of partner agency efforts.

2013

Plan update identifies 11 Management Priorities and encourages inter-agency collaboration.

2020

Plan update identifies 3 Focus Areas as priorities for implementation action.

ORMP AGENCY PARTNERS

Many government agencies and authorities participate in the management of ocean and coastal resources, each with their own roles and responsibilities. The following table lists agencies that commonly participate as ORMP Partners. It is organized by State, County, University, or Federal affiliation, and alphabetized within each category. This table serves to highlight the diverse and complementary contributions of ORMP Partners to resource management in the Hawaiian Islands.

STATE PARTNERS

OFFICE OF PLANNING - COASTAL ZONE MANAGEMENT PROGRAM (OP-CZM)

MANDATE OR MISSION

To provide for the effective management, beneficial use, protection, and development of the coastal zone.

ORMP - RELATED WORK AREAS

OP-CZM is statutorily tasked with updating and implementing the ORMP. OP-CZM provides legislative and administrative policy proposals to improve natural resource management and plan for climate change. OP-CZM administers the Special Management Area (SMA) permit system and co-administers the Coastal Nonpoint Pollution Control Program (CNPCP) in partnership with DOH.

DEPARTMENT OF HAWAIIAN HOME LANDS (DHHL)

MANDATE OR MISSION

DHHL's mission is to manage the Hawaiian Home Lands trust effectively and to develop and deliver lands to native Hawaiians.

ORMP - RELATED WORK AREAS

DHHL serves its beneficiaries and manages its extensive land trust. The trust lands consist of over 200,000 acres on the islands of Hawai'i Maui, Moloka'i, Lāna'i, O'ahu and Kaua'i. DHHL considers social and environmental health in decision-making, including the vulnerability of beneficiaries and lands to coastal hazards and the impacts of global climate change.

DEPARTMENT OF HEALTH –
1. CLEAN WATER BRANCH (DOH-CWB)
2. WASTEWATER BRANCH (DOH-WWB)

MANDATE OR MISSION

1. *Administers and enforces statewide water pollution laws and rules. This is achieved through permitting of point sources, compliance monitoring, inspections, investigations of complaints, and ambient water quality monitoring.*
2. *Responsible for regulatory and financing issues relating to wastewater. Responsible to implement the construction of county wastewater facilities with federal and state financing by low interest loans from the State Revolving Fund.*

ORMP - RELATED WORK AREAS

DOH develops appropriate water quality standards, conducts water quality monitoring, identifies and restores impaired water bodies, and administers of the National Pollutant Discharge Elimination System (NPDES) permit program. DOH co-administers the CNPCP with OP-CZM.

STATE PARTNERS

DEPARTMENT OF LAND & NATURAL RESOURCES – DIVISION OF AQUATIC RESOURCES (DLNR-DAR)

MANDATE OR MISSION

DLNR-DAR's core responsibilities include in the management of marine, estuarine and anchialine resources in Marine Managed Areas (MMAs) and Marine Life Conservation Districts (MLCDs), the Aquatic Invasive Species program, and other regulatory activities such as permits and licensing.

ORMP - RELATED WORK AREAS

DAR supports Focus Area III: Marine Ecosystems through implementation of the Coral Reef Strategy, through its core responsibilities in the management of marine, estuarine and anchialine resources in Marine Managed Areas (MMAs) and Marine Life Conservation Districts (MLCDs), the Invasive Species program, and other regulatory activities such as permits and licensing.

DEPARTMENT OF LAND & NATURAL RESOURCES – DIVISION OF BOATING AND OCEAN RECREATION (DLNR-DOBOR)

MANDATE OR MISSION

Responsible for the management and administration of statewide ocean recreation and coastal areas programs pertaining to the ocean waters and navigable streams of the State.

ORMP - RELATED WORK AREAS

DLNR-DOBOR enforces state legislation and administrative rules regulating boating facilities and recreational use of state waters. DLNR-DOBOR is also responsible for ensuring equal public access to beach and ocean resources through the management of small boat harbors, wharves, and all associated harbor infrastructure, as well as the services and equipment for maintaining waste management at public beaches.

DEPARTMENT OF LAND & NATURAL RESOURCES – DIVISION OF CONSERVATION AND RESOURCES ENFORCEMENT (DLNR-DOCARE)

MANDATE OR MISSION

Effectively upholds the laws that serve to 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 visitors and the people of Hawai'i nei.

ORMP - RELATED WORK AREAS

DLNR-DOCARE provides community education and promotes awareness through programs including training for resource officers and the Makai Watch program to promote user compliance for marine resource management.

DEPARTMENT OF LAND & NATURAL RESOURCES – DIVISION OF FORESTRY AND WILDLIFE (DLNR-DOFAW)

MANDATE OR MISSION

Responsibly manage and protect watersheds, native ecosystems, and cultural resources and provide outdoor recreation and sustainable forest products opportunities, while facilitating partnerships, community involvement and education.

ORMP - RELATED WORK AREAS

DLNR-DOFAW supports comprehensive watershed management through Forest Reserve Management Plans, soil erosion reduction and upland forest conservation, management of the Natural Area Reserves System (NARS), and support of the Hawai'i Association of Watershed Partnerships. These efforts often involve community-based implementation and/or the collaboration of many landowners.

DEPARTMENT OF LAND & NATURAL RESOURCES – OFFICE OF COASTAL AND CONSERVATION LANDS (DLNR-OCCL)

MANDATE OR MISSION

Maintain balance between conserving coastal resources and responsible development in coastal areas.

ORMP - RELATED WORK AREAS

DLNR-OCCL oversees beach and marine lands out to the seaward extent of the State's jurisdiction. The Coastal Lands Program supports beach restoration and other nature-based alternatives for coastal erosion management. DLNR-OCCL contributes to Hawai'i's climate change adaptation efforts through the agency's administration of the Hawai'i Climate Change Mitigation and Adaptation Commission and authorship of the *Hawai'i Sea Level Rise Vulnerability and Adaptation Report (2017).*

DEPARTMENT OF TRANSPORTATION - HARBORS DIVISION (DOT-HARBORS)

MANDATE OR MISSION

To ensure the continuous and effective management and operation of a statewide commercial harbors system that cost-effectively facilitates the efficient movement of people and goods to, from, and between the Hawaiian Islands.

ORMP - RELATED WORK AREAS

DOT-HARBORS manages the State's 10 commercial harbors, including harbor modernization, stormwater runoff mitigation, and adaptation of facilities to sea level rise.

STATE PARTNERS

HAWAI'I DEPARTMENT OF AGRICULTURE (HDOA)

MANDATE OR MISSION

To develop a sustainable and profitable commercial aquaculture industry by encouraging a diversity of products, improving management practices and technologies, and providing direct assistance with regulations, disease, marketing and new business development.

ORMP - RELATED WORK AREAS

HDOA plans and develops activities for sustainable commercial aquaculture. HDOA also supports responsible agricultural practices that mitigate land-based pollution and works to prevent the introduction of harmful plants, animals, and diseases to the State.

HAWAI'I EMERGENCY MANAGEMENT AGENCY (HI-EMA)

MANDATE OR MISSION

The agency shall perform emergency management functions within the territorial limits of the State (HRS §127A-3).

ORMP - RELATED WORK AREAS

HI-EMA is the State's lead in planning for an emergency or disaster. HI-EMA coordinates with the four county civil defense agencies to provide specialized or supplemental resources, technical assistance, or other support needed to protect human lives and property.

HAWAI'I STATE ENERGY OFFICE (HSEO)

MANDATE OR MISSION

The HSEO is committed to promoting energy efficiency, renewable energy, and clean transportation to help achieve a resilient, clean energy, decarbonized economy.

ORMP - RELATED WORK AREAS

HSEO works to ensure the appropriate placement and application of energy technologies and seeks to balance considerations of economic development and technological advancement with environmental impact, including vulnerability to coastal hazards. Within HSEO, the Hawai'i Green Business Program (HGBP) reduces the pressures of development on Hawai'i's environment by assisting offices, retailers, hotels, restaurants, and events to integrate green, clean, and sustainable practices into their organizations.

STATE PARTNERS

OFFICE OF HAWAIIAN AFFAIRS (OHA)

MANDATE OR MISSION

To improve the conditions of Native Hawaiians across six areas: 'Āina, Culture, Economic Self-Sufficiency, Education, Governance, and Health.

ORMP - RELATED WORK AREAS

OHA's traditional knowledge help other agencies to connect to the cultural heritage of the ocean. OHA is a joint manager of the Papahānaumokuākea Marine National Monument with DLNR, USFWS, and NOAA-National Marine Sanctuaries program.

COUNTY PARTNERS

CITY AND COUNTY OF HONOLULU - DEPARTMENT OF PLANNING AND PERMITTING (DPP)

MANDATE OR MISSION

Responsible for Honolulu's long-range and community planning efforts, administration and enforcement of ordinances, and regulations governing the development and use of land.

ORMP - RELATED WORK AREAS

DPP addresses life and safety, coastal development, and coastal hazards through adoption and implementation of its plans and ordinances. County planning staff convene with OP-CZM staff on a monthly basis to collaborate on ORMP-related initiatives.

COUNTY OF HAWAI'I - PLANNING DEPARTMENT

MANDATE OR MISSION

To manage growth in a sustainable manner that balances the County of Hawai'i's economy, culture and the environment.

ORMP - RELATED WORK AREAS

The County of Hawai'i addresses life and safety, coastal development, and coastal hazards through adoption and implementation of its plans and ordinances. County planning staff convene with OP-CZM staff on a monthly basis to collaborate on ORMP-related initiatives.

COUNTY PARTNERS

COUNTY OF KAUA'I - PLANNING DEPARTMENT

MANDATE OR MISSION

Administers the County's planning program and is responsible for the development, maintenance and implementation of the Kaua'i County General Plan and other related plans and projects.

ORMP - RELATED WORK AREAS

The County of Kaua'i addresses life and safety, coastal development, and coastal hazards through adoption and implementation of its plans and ordinances. County planning staff convene with OP-CZM staff on a monthly basis to collaborate on ORMP-related initiatives.

COUNTY OF MAUI - PLANNING DEPARTMENT

MANDATE OR MISSION

Offers technical advice to the Mayor, County Council and commissions; proposes zoning legislation; drafts updates to the General Plan, Maui Island Plan and Community Plans; presents reports and recommendations on development proposals; and oversees programs on cultural resources, census and geographic information, flood plain permits and other special projects and permits.

ORMP - RELATED WORK AREAS

The County of Maui addresses life and safety, coastal development, and coastal hazards through adoption and implementation of its plans and ordinances. County planning staff convene with OP-CZM staff on a monthly basis to collaborate on ORMP-related initiatives.

HONOLULU BOARD OF WATER SUPPLY (BWS)

MANDATE OR MISSION

Carrying out the vision, ka wai ola, water is life, the BWS is charged with providing the people of O'ahu with safe, dependable, and affordable water now and into the future.

ORMP - RELATED WORK AREAS

BWS is charged with providing safe, dependable, and affordable water to the people of O'ahu, Hawai'i's most populous island. To ensure delivery now and into the future, the BWS exerts considerable effort toward water conservation, including system improvements, water recycling, and use reduction education as well as watershed planning efforts to ensure O'ahu's groundwater supply are recharged with drinkable water.

UNIVERSITY PARTNERS

PACIFIC ISLANDS OCEAN OBSERVING SYSTEM (PacIOOS)

MANDATE OR MISSION

Empowers ocean users and stakeholders in the Pacific Islands by providing accurate and reliable coastal and ocean information, tools, and services that are easy to access and use.

ORMP - RELATED WORK AREAS

PacIOOS collects data, generates forecasts, and develops user-friendly tools related to waves, currents, weather, water characteristics, ocean species, and shoreline impacts. Through data collection and dissemination, PacIOOS contributes to the state of science as well as public education and community collaboration.

UNIVERSITY OF HAWAI'I - SEA GRANT COLLEGE PROGRAM (HAWAI'I SEA GRANT)

MANDATE OR MISSION

Conduct an innovative program of research, outreach, and education services toward the improved understanding and stewardship of coastal and marine resources of the state, region, and nation.

ORMP - RELATED WORK AREAS

Hawai'i Sea Grant contributes research, analysis, and subject matter expertise towards the development and refinement of management actions for ocean and coastal health.

UNIVERSITY OF HAWAI'I - SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY (UH SOEST)

MANDATE OR MISSION

Dedicated to serving society through the acquisition and dissemination of new knowledge about the ocean, Earth, and planets, and to enhancing the quality of life in the State of Hawai'i by providing world-class education, contributing to a high-tech economy, and promoting sustainable use of the environment.

ORMP - RELATED WORK AREAS

UH SOEST conducts data collection, research, and analysis pertaining to water quality monitoring, climate change, shoreline erosion, beach loss mitigation, and marine alien/invasive species.

FEDERAL PARTNERS

COMMANDER NAVY REGION HAWAI'I - ENVIRONMENTAL PROGRAM

MANDATE OR MISSION

To provide, maintain and modernize shore infrastructure and service support to enable Navy and Air Force operations in the Hawai'i area of responsibility in a protective manner and compliant with environmental regulations.

ORMP - RELATED WORK AREAS

Demonstrating environmental stewardship by complying with environmental requirements, limiting and conserving resources, and reducing our overall impact on the environment;

- Complying with environmental laws, regulations, and other applicable requirements by utilizing the Environmental Management System (EMS) as a tool to communicate environmental responsibilities, and to establish and track environmental objectives and targets;
- Achieving improvements in the compliance program and hazardous waste management;
- Continuing prudent shore-side infrastructure improvements and modernization to reduce environmental impact;

Preventing or minimizing pollution at its source to reduce the generation of waste; and

Providing continual improvement of our environmental performance to strengthen community trust while applying prudent business principles.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

MANDATE OR MISSION

To understand and predict changes in climate, weather, oceans, and coasts, to share that knowledge and information with others, and to conserve and manage coastal and marine ecosystems and resources. Provide science-based solutions through collaborative partnerships with the private sector, academic, and research entities on nine mission areas.

ORMP - RELATED WORK AREAS

NOAA contributes to the collection, analysis, and distribution of data. NOAA furthers public awareness and education around ocean resources.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION - CORAL REEF CONSERVATION PROGRAM (NOAA-CRCP)

MANDATE OR MISSION

To protect, conserve, and restore the nation's coral reefs by maintaining healthy ecosystem function.

ORMP - RELATED WORK AREAS

NOAA-CRCP supports coral reef health by increasing resilience to climate change, reducing land-based sources of pollution, improving fisheries' sustainability, and restoring viable coral populations.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION - MARINE DEBRIS PROGRAM (NOAA-MDP)

MANDATE OR MISSION

To investigate and prevent the adverse impacts of marine debris.

ORMP - RELATED WORK AREAS

NOAA-MDP works with local partners to prevent, remove, and research the impacts of marine debris. NOAA-MDP provides coordination and emergency response to storms and natural disasters across the nation.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION - FISHERIES (NOAA-Fisheries)

MANDATE OR MISSION

To ensure the productivity and sustainability of fisheries and fishing communities through science-based decision-making and compliance with regulations, and to recover and conserve protected resources including whales, turtles, and salmon.

ORMP - RELATED WORK AREAS

NOAA-Fisheries uses scientifically-sound, ecosystem-based approach to fisheries management. NOAA Fisheries collaborates with the eight U.S. Regional Fisheries Management Councils, including the Western Pacific Regional Fishery Management Council.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION - NATIONAL MARINE SANCTUARIES PACIFIC ISLANDS REGION (NOAA-NMS)

MANDATE OR MISSION

To identify, designate, protect and manage the ecological, recreational, research, educational, historical, and aesthetic resources and qualities of nationally significant coastal and marine areas.

ORMP - RELATED WORK AREAS

NOAA-NMS is a joint manager of the Papahānaumokuākea Marine National Monument with DLNR, USFWS, and OHA. NOAA-NMS co-manages the Hawaiian Islands Humpback Whale National Marine Sanctuary with DLNR.

FEDERAL PARTNERS

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION - OFFICE FOR COASTAL MANAGEMENT (NOAA-OCM)

MANDATE OR MISSION

To preserve, protect, develop, and where possible, restore or enhance the resources of the nation's coastal zone by overseeing implementation and providing technical assistance to federally approved state programs.

ORMP - RELATED WORK AREAS

NOAA-OCM is the nation's coastal management agency and works to maintain balance between the natural and environment, quality of life, and economic prosperity in coastal areas. NOAA-OCM is composed of four programs: the National CZM Program, National Estuarine Research Reserves, NOAA CRCP, and Digital Coast.

UNITED STATES ARMY CORPS OF ENGINEERS (USACE)

MANDATE OR MISSION

1. *Provides safe commercial and recreational navigation improvements, hurricane and storm risk management projects, and ecosystem restoration.*
2. *Protects the Nation's waters for current and future generations while allowing for reasonable economic development.*
3. *Restores degraded ecosystem structure, function and dynamic processes to a more natural condition through large-scale ecosystem restoration projects.*

ORMP - RELATED WORK AREAS

USACE reviews permits for construction activities affecting aquatic resources. It also assists in hurricane and storm risk management, including coastal damage reduction, and in improving navigation and maintenance of marine transport systems.

UNITED STATES COAST GUARD (USCG)

MANDATE OR MISSION

Charged with enforcing all U.S. maritime law.

ORMP - RELATED WORK AREAS

USCG issues permits for structures in navigable waters, enforces maritime law, and provides data and resources. USCG is involved with the management of vessel ballast water in partnership with DLNR-DAR.

UNITED STATES FISH AND WILDLIFE SERVICE (USFWS)

MANDATE OR MISSION

To conserve, protect and enhance fish, wildlife and plants and their habitats for the continuing benefit of the American people.

ORMP - RELATED WORK AREAS

USFWS is the principal federal partner responsible for administering the Endangered Species Act (ESA).

UNITED STATES GEOLOGICAL SERVICE (USGS)

MANDATE OR MISSION

Serves the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.

ORMP - RELATED WORK AREAS

USGS collects, monitors, analyzes, and provides science about natural resource conditions, issues, and problems.

The USGS Pacific Islands Climate Adaptation Science Center is a USGS - University of Hawai'i - University of Guam partnership providing natural resource managers and cultural stewards in federal, state, and local agencies access to the best science available on climate change and other landscape-scale stressors that are impacting natural and cultural resources.

The USGS Pacific Islands Water Science Center collects, analyzes, and publishes objective hydrologic data and information needed to make informed decisions about water resources.

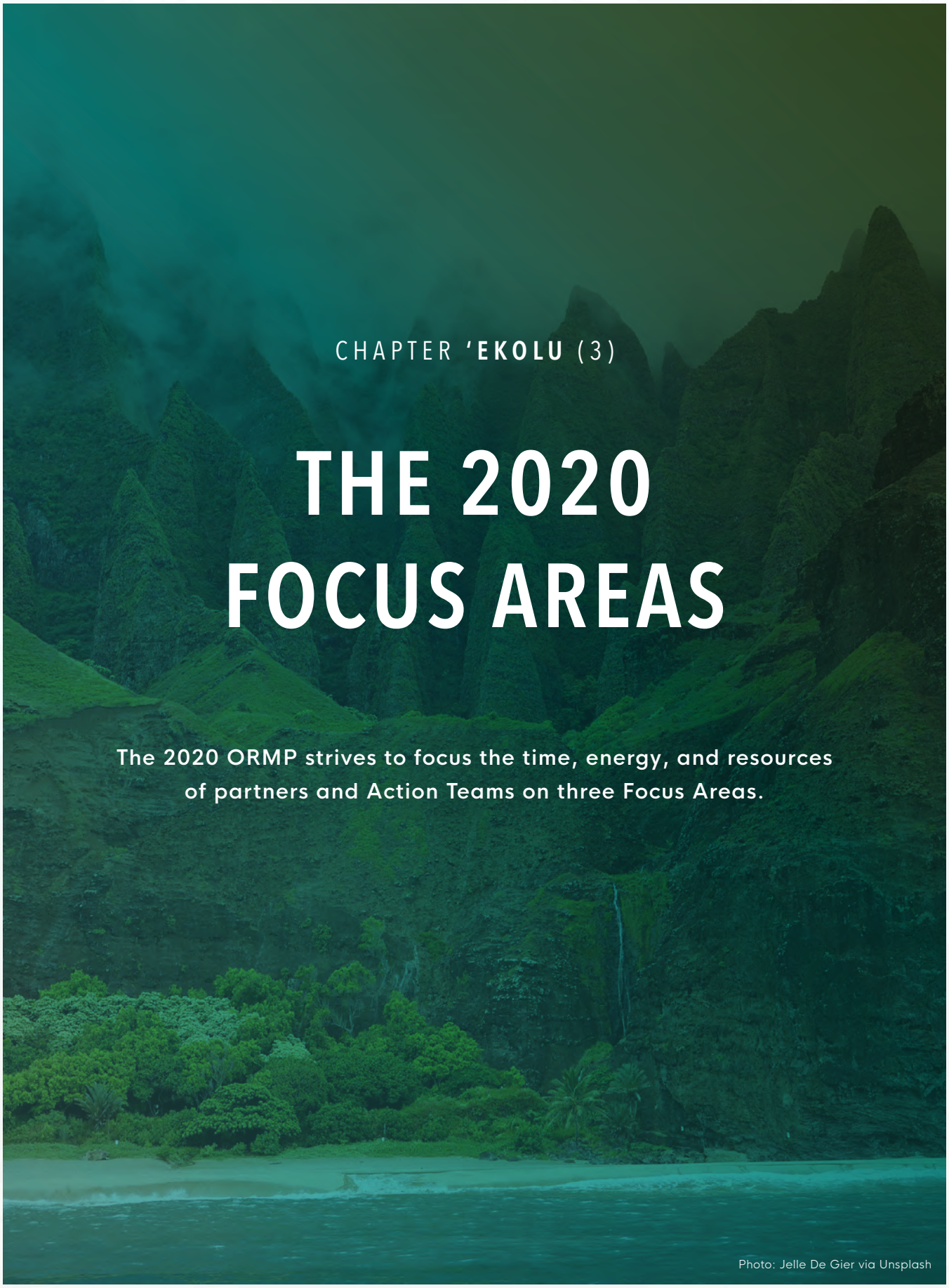
WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL (WPRFMC)

MANDATE OR MISSION

One of eight regional fishery management councils to manage national marine fishery resources.

ORMP - RELATED WORK AREAS

WPRFMC serves as a liaison to the Protected Species Advisory Committee and develops management plans for fisheries beyond the State's jurisdiction.



CHAPTER **'EKOLU** (3)

THE 2020 FOCUS AREAS

The 2020 ORMP strives to focus the time, energy, and resources of partners and Action Teams on three Focus Areas.

Photo: Jelle De Gier via Unsplash

INTRODUCTION TO THE FOCUS AREAS

The 2013 ORMP contained 11 Management Priorities, each with multiple goals, and metrics indicating supportive state and county agency actions. Progress across the 11 Management Priorities was limited by their broad scope, limited devoted funding and personnel resources for action, and short planning horizon of five years between plan update processes.

The 2020 ORMP strives to focus the time, energy, and resources of OP-CZM staff, partners, and Action Teams on three Focus Areas outlined in this chapter. The three Focus Areas were developed out of the 2013 ORMP Management Priorities, as identified based on input from the public and agencies. Narrowing the Plan's implementation actions to three subjects and specific actions within those subjects (the Focus Areas) required consideration of management gaps, synergies and conflicts with other efforts, extent of the issue across the state, and need for collaboration. In recognition of their equivalent importance to the ORMP Focus Areas, additional but complementary Management Priorities are detailed in Chapter 4.

FOCUS AREA SELECTION CRITERIA

To assist in narrowing from the many Management Priorities of the prior ORMP Update, the OP-CZM Program identified the following criteria for the selection of the 2020 Focus Areas.

IS THERE A MANAGEMENT GAP?

No agency or organization is working on the issue, or they cannot address it due to lack of funds or capacity.

IS IT A STATEWIDE ISSUE?

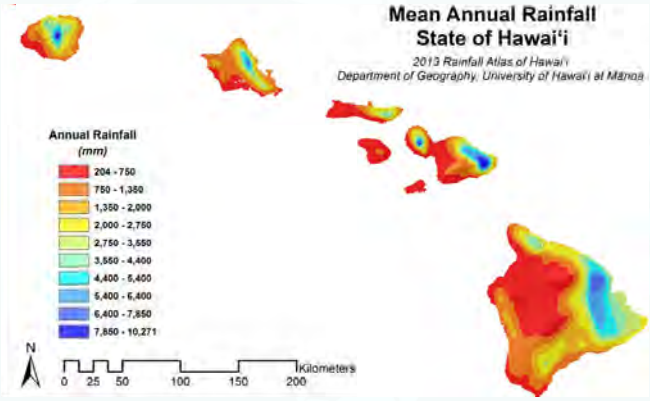
The topic area impacts multiple communities on multiple islands, and a potential solution would benefit people throughout the state.

IS IT A MULTI-AGENCY CONCERN OR REQUIRE COLLABORATION ACROSS AGENCIES?

The topic area requires collaboration between more than two agencies.

IS THE ISSUE DISTINCT FROM OTHER EFFORTS?

This issue is not duplicative of another agency's efforts, and is complementary to agency and State initiatives.



↳ Flexibility: Contemporary maps illustrate that the Hawaiian Islands contain many microclimates, requiring tailored implementation. Local ecological knowledge may reveal additional environmental nuances particular to a place.
Photo: UH Department of Geography (SOEST)

↳ Collaborative relationships: The importance of public consultation is well-recognized by the ORMP update process, and is codified in HRS § 205A. Agencies can maintain relationships through ongoing information exchange on a consistent basis.
Photo: Office of Planning

↳ Consider Native Hawaiian traditional practices and knowledge: The Pueo – the Hawaiian short-eared owl – is one of the more famous versions of the traditional Hawaiian 'aumākua, *ancestor spirits*, that provide traditional ways of knowing through consultation that involves observation. Planners and decision-makers can incorporate observation (listening before telling) methods by identifying individuals with kuleana to a place, practice, or resource and consulting with those individuals at regular intervals through a planning process.
Photo: DLNR - DOFAW

HOW DID TRADITIONAL ECOLOGICAL KNOWLEDGE INFORM THE FOCUS AREAS?

The Focus Areas are framed to the extent possible with the principles of Traditional Ecological Knowledge in mind. Generally speaking, the goals in each Focus Area are intended to:

Design a level of flexibility into policies that allows translation into place-based management strategies and programs.

Consider ways of knowing that enabled kānaka maoli to adapt and live in harmony with the natural world by holding space for consideration and accommodation of local characteristics such as the unique resources, weather, and demographics of each place. This principle also encourages state-wide policies to adopt the flexibility necessary for managing agencies to adapt to the widely variable and quickly changing conditions of climate change and sea level rise.

Develop long-term collaborative relationships between government and communities.

Create opportunities to connect with traditional knowledge that enabled communities to thrive in Hawai'i long before Western contact, to enhance the effective management of natural and cultural resources through local knowledge sharing.

Incorporate systematic processes and methods for regular and consistent consideration of Native Hawaiian traditional practices and knowledge.

Consistently include traditional knowledge, especially in place-based management strategies and programs, but also within larger decision-making processes.

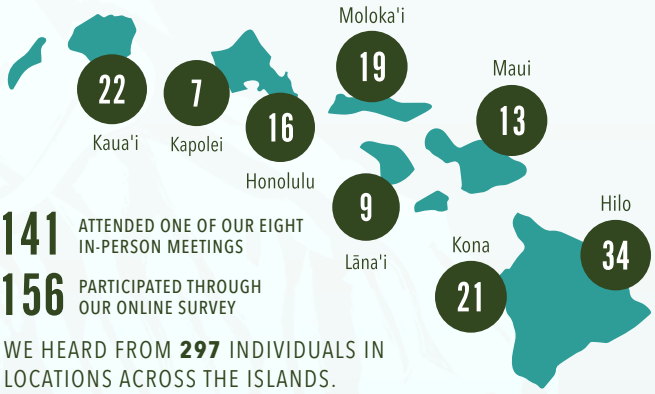
PUBLIC AND PLAN PARTNER INPUT

A primary consideration of the update process was connecting community concerns and lived experiences to the Focus Areas. To facilitate an exchange of information between the Coastal Zone Management Program and the public, Information Sharing Sessions were held around the state and on-line.

Eight Information Sharing Sessions were held between August 19th and 30th, 2019. Two meetings were held on each of the islands of O'ahu and Hawai'i, and one meeting was held on each of the islands of Kaua'i, Maui, Moloka'i, and Lāna'i. In total, 141 people attended the Information Sharing Sessions. An additional 156 people remotely provided input through an online survey.

The issues voiced by the public in the Information Sharing Sessions and on-line surveys were then shared with agency partners to look for synergies between public interest and agency initiatives. They were also examined for opportunities to apply Traditional Ecological Knowledge to problems. Publicly voiced issues were also evaluated against Focus Area Selection Criteria (Page 41) for the OP-CZM Program.

Upon completion of the Information Sharing Sessions, interviews were conducted with Plan Partners, primarily State agencies that regularly participate in the Coordinated Working Group on ORMP Management Priorities. Plan Partner responses reveal that sentiments expressed frequently by the public are also of agency concern and the subject of ongoing agency action. The interviews affirmed working relationships and collaborations that have been forged inside the ORMP structure through the Coordinated Working Group and Action Teams and revealed opportunities for future partnerships.

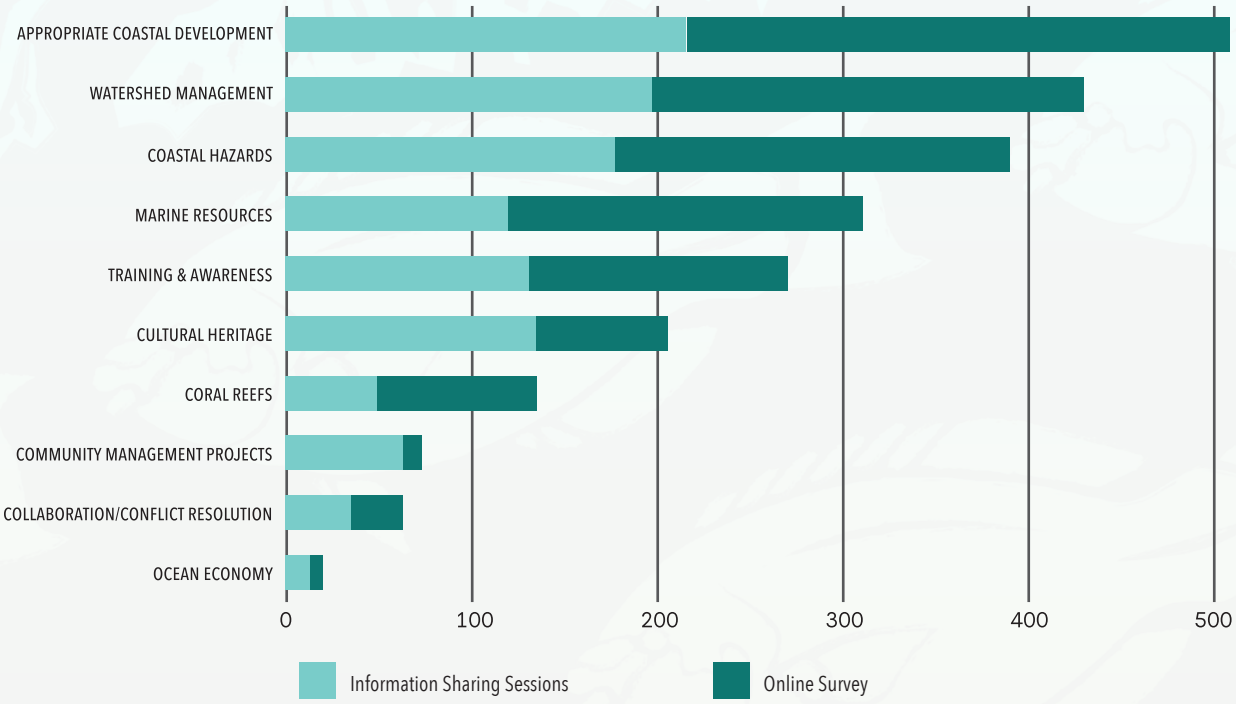


141 ATTENDED ONE OF OUR EIGHT IN-PERSON MEETINGS

156 PARTICIPATED THROUGH OUR ONLINE SURVEY

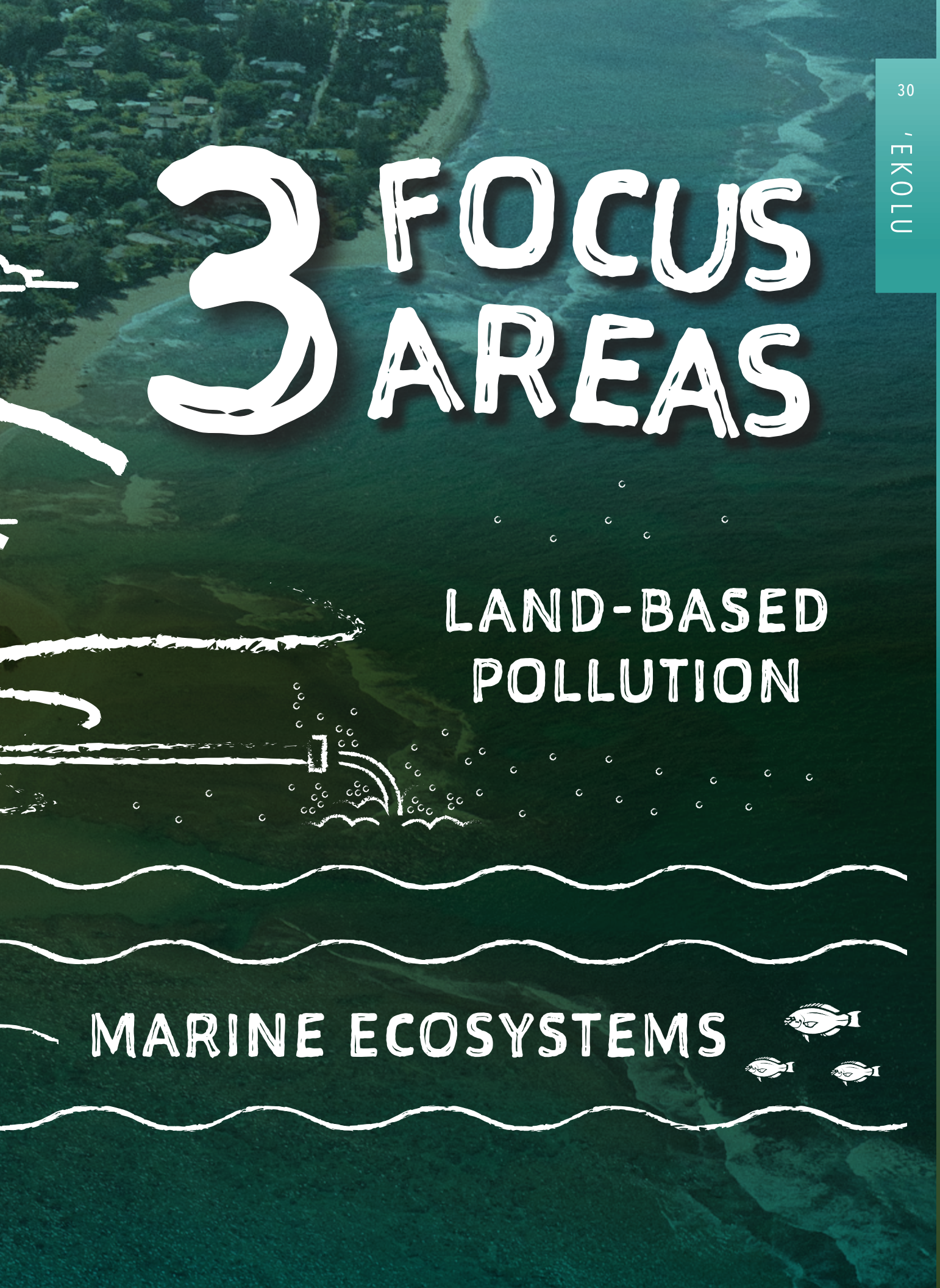
WE HEARD FROM **297** INDIVIDUALS IN LOCATIONS ACROSS THE ISLANDS.

Ocean Resource Management Priorities Expressed by the Public in August, 2019



DEVELOPMENT & COASTAL HAZARDS

3 FOCUS AREAS



FOCUS AREA I: DEVELOPMENT & COASTAL HAZARDS

When the ocean interacts with the built environment, threatening coastal structures and community safety, coastal processes become coastal hazards. Because much of the urbanization in Hawai'i has occurred in close proximity to the shoreline, management in our island state cannot address development and coastal hazards separately. Thus, the 2013 ORMP Management Priorities of Appropriate Coastal Development and Management of Coastal Hazards have been combined in recognition of this dynamic.

The Development and Coastal Hazards Focus Area encompasses the linkage of planning decisions relating to development in the coastal zone with planning for adaptation according to the best available science on coastal hazards. This Focus Area is grounded in all four of the ORMP Perspectives; it requires collaboration and stewardship in the careful and appropriate use of the land to maintain the wide array of benefits derived from coastal lands and ocean assets, preservation and restoration of heritage traditions and resources for future generations, and response to the dynamic environmental conditions of Hawai'i in the age of climate change.

WHY FOCUS ON DEVELOPMENT & COASTAL HAZARDS?

All of Hawai'i's counties have lands that face impacts from coastal hazards and every state, county, and federal agency that operates in Hawai'i will need to consider and take steps to address the projected impacts of climate change on their community assets. In this regard, this Focus Area is both distinct and complementary to other agency efforts. Challenges such as beach erosion, wetland loss, sinkhole formation, and structure damage have already changed the character of Hawai'i's shorelines, and many management gaps related to Development and Coastal Hazards remain to be addressed. A perceptible rise in public awareness of shoreline impacts resulting from widely published science, mapping, outreach efforts, and community experiences has created a social environment ready for change. Public participants in the Information Sharing Sessions expressed considerable alarm at the rate of change witnessed to their favorite beachfront parks, homes, and public infrastructure.

*"...developers need to understand that if they build right next to the beach, they are affecting natural coastal processes and will lose the sand eventually... **we need more awareness of sea level rise and the fact that the coastline needs to be able to move backwards...** yet we are still allowing building right on the shore."*

– 2019 ORMP UPDATE INFORMATION SHARING SESSION PARTICIPANT

Furthermore, when agency partners were asked if there are any new or contemporary issues that have affected their work programs, the nearly unanimous response was, "sea level rise." Correspondingly, capital improvement budgets and political sentiment are aligning to acknowledge the changing climate and its effects on coastal communities. In the last five years, the State has created a Hawai'i Climate Change Mitigation and Adaptation Commission and the City and County of Honolulu has established both their own Climate Commission as well as the Office of Climate Change, Sustainability, and Resiliency. Several counties are working on their own adaptation plans and policies at both the island and community development plan scales. Despite these positive developments, much uncertainty remains as science continually develops

data and analysis-based knowledge, and models projections for climate change and sea level rise. Thus, a focus on Development and Coastal Hazards is ripe for continued advancement.

Augmenting shoreline management across the State is one way to address the impacts of sea level rise on Hawai'i's communities. There is recognition that development patterns that site buildings and infrastructure along the shoreline create a built environment vulnerable to multiple hazards and degrade coastal landforms (beaches, dunes, etc.) which would otherwise serve to protect back-shore infrastructure. These development patterns literally erode an island's resiliency, damaging resources and creating risk of harm to homes, infrastructure, and the people they are meant to serve. Implementing actions from the 2013 ORMP include:

i. the review and update for shoreline erosion maps for Kaua'i, Maui, and O'ahu

ii. the development of guidance on how to integrate climate change policy into County Development/Sustainable Community Plans (Courtney, C. A.; Romine, B. M.; Lander, M.; Hintzen, K. D.; Owens, T. M. 2019), and

iii. assessing the adaptation strategy of managed retreat in a Hawai'i context (OP-CZM 2019a).

Shoreline erosion map updates (UH SOEST Coastal Geology Group for OP 2020) help to inform key policies that site new development away from the shoreline and inform communities about the inherent risks associated with living adjacent to ocean waters. However, these shoreline setback policies primarily address new development rather than existing development that may already be in harm's way. Similarly, developing guidance that integrates sea level rise risks into county planning frameworks is a key component for the integration of mid- and long-term strategies for appropriate land use. However, these strategies mainly inform our vision of future growth and development. For existing development, shoreline management may include the challenging discussions of managed retreat, or shifting existing development away from the shoreline, which was addressed in the CZM report, *"Assessing the Feasibility and Implications of Managed Retreat Strategies for Vulnerable Coastal Areas in Hawai'i"* (OP-CZM 2019a).

While progress has been made within this Action Team and among key entities at county and state levels, there remains a statewide challenge to address development siting in a way that is deemed fair and consistent, while allowing for variation and

A phenomenon known as 'flanking' often occurs when a shoreline structure such as a vertical sea wall is located adjacent to an unarmored sandy shoreline. Here, reflected wave energy erodes a beach area during king tide conditions at Kapa'a Beach Park, Kaua'i.
Photo: Hawai'i Sea Grant King Tides Project

The construction of a 95-foot-long sandbag groin stabilizes sand on the east end of Kūhiō Beach Park in Waikīkī. In the foreground, the foundation of the old Waikīkī Tavern (CA. 1930's) is exposed, presenting a hazard to beachgoers.
Photo: Office of Planning

Historic rainfall rerouted waterways on the north shore of Kaua'i in April 2018. From Hanalei to Hā'ena homes, farms, and businesses experienced catastrophic damage.
Photo: Hawai'i Sea Grant

Hawai'i's harbors and working shorelines are critical to the State's economic health.
Photo: DOT-Harbors

responsiveness to local conditions. Decisions to protect the built environment must first consider and incorporate adaptation strategies to reduce pressures on public trust resources and nearshore ecosystems. A lack of proactive, proven and cost-effective options put both the property of private landowners, as well as public assets such as infrastructure and beach parks, at risk. A step toward coastal resilience is to support shifts away from shoreline hardening and move towards the use of natural infrastructure, such as cost-effective beach nourishment projects, dune management, and the planting of native coastal species to reduce shoreline erosion. A statewide, comprehensive understanding of infrastructure vulnerability and a plan for which facilities should be hardened, adapted, and retreated is needed. One shoreline management action that could provide greater consistency statewide is broad use of the Sea Level Rise Exposure Area (SLR-XA) as identified by the *Hawai'i Sea Level Rise Vulnerability and Adaptation Report* (Hawai'i Climate Change Mitigation and Adaptation Commission 2017) and depicted on an online viewer (PacIOOS for Hawai'i Sea Grant 2019) as a state-wide vulnerability zone. The use of this overlay is evolving, but in the future this information could be integrated within agency planning, programing, and capital improvement decisions. There is an ongoing need for the best available science and research to inform appropriate adaptation to coastal hazard risks and their impacts on Hawai'i's land use.

Increased state and county agency collaboration is imperative to develop and implement land use policies, hazard mitigation actions, and design and construction standards that mitigate and adapt to the impacts of climate change and sea level rise. Monthly convening of state coastal zone management planners and county shoreline planners facilitate some of these discussions, but there is a recognition that further outreach to engage facilities management, park services, and many other agencies will be a key component to successful adaptation.

OPPORTUNITIES FOR COMMUNITY ACTION!

BECOME A CITIZEN SCIENTIST!
Photograph the impacts of king tides, high tides that indicate how future sea level rise may affect our coastline. Submit your images to the Hawai'i Sea Grant Program's *Hawai'i and Pacific Islands King Tides Project* and contribute to community efforts to understand and adapt to rising seas [1].

HOW HIGH IS THE WATER RISING?
View the extent of 0.5-foot to 3.2-foot sea level rise projections on Hawai'i's coastal zone. Visit the Hawai'i Sea Level Rise Viewer to explore potential economic loss, flooded highways, flood hazard zones and beaches vulnerable to coastal erosion [2].

YOUR HOME IS YOUR CASTLE – PROTECT IT.
Learn how to protect your property and keep your 'ohana safe during and after a natural disaster. Download the Hawai'i Sea Grant Program's Hawai'i Homeowner's Handbook to Prepare for Natural Disasters for step-by-step guidance [3].

TAKE A LEADERSHIP ROLE IN YOUR NEIGHBORHOOD.
There are times when communities must be self-reliant. Get trained in basic disaster response skills, team organization, and disaster medical operations. Contact your county emergency management agency to learn how to get Community Emergency Response Team (CERT) Certified [4, 5, 6, 7].

1. http://seagrant.soest.hawaii.edu/coastal-and-climate-science-and-resilience/ccs-projects/how-to-participate/
2. http://www.hawaiisealevelriseviewer.org
3. http://seagrant.soest.hawaii.edu/wp-content/uploads/2019/12/Hawaii-Homeowners-Handbook-Fourth-Ed.-final1.pdf
4. https://www.ready.gov/cert
5. https://www.mauicounty.gov/1899/Community-Emergency-Response-Team
6. https://www.hawaiicert.org/
7. https://www.kauai.gov/CERT

FOCUS AREA GOALS

DEVELOPMENT & COASTAL HAZARDS

GOAL: DEVELOP A STATEWIDE INTEGRATED SHORELINE MANAGEMENT STRATEGY TO ADDRESS THE COMPOUNDING IMPACTS TO HAWAI'I'S SHORELINES OF COASTAL DEVELOPMENT, CLIMATE CHANGE AND SEA LEVEL RISE, EROSION, AND OTHER CHRONIC COASTAL HAZARDS.

THE ACTION TEAMS OUTLINED BELOW ARE LISTED ALPHABETICALLY, AND IN THE FOLLOWING JURISDICTIONAL ORDER: STATE, COUNTY, UNIVERSITY, AND FEDERAL.

CONVENE DEVELOPMENT AND COASTAL HAZARD ACTION TEAM:

- Office of Planning-Coastal Zone Management Program (OP-CZM) (lead)
- Department of Hawaiian Home Lands (DHHL)
- Department of Land and Natural Resources – Office of Coastal and Conservation Lands (DLNR-OCCL)
- Department of Transportation (DOT)
- Hawai'i Emergency Management Agency (HI-EMA)
- Marine and Coastal Zone Advocacy Councils Representative (MACZAC) (advisory)

- Honolulu Department of Planning and Permitting (DPP)
- County of Hawai'i Planning Department
- County of Kaua'i Planning Department
- County of Maui Planning Department
- Board of Water Supply (BWS)

- University of Hawai'i - Sea Grant College Program (Hawai'i Sea Grant)

RECOMMENDED CONSULTATION AS NEEDED WITH:

- City and County of Honolulu Office of Climate Change, Sustainability and Resiliency
- County Departments, including Facility Maintenance, Water and Wastewater, Parks and Recreation, and Public Works

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- National Oceanic and Atmospheric Administration-Office for Coastal Management (NOAA-OCM)
- United States Army Corps of Engineers (USACE)

- Community Organizations

- Industry Professionals, including insurance and real estate agents

PROPOSED COMPONENTS FOR GOAL SUCCESS:

Knowledge or management gaps related to Development and Coastal Hazards have been identified during the ORMP update process. The following projects and initiatives are proposed actions to be considered by the Focus Area 1 Action Team as well as the Hawai'i Climate Change Mitigation & Adaptation Commission and may be further refined. These components are not ordered or prioritized unless otherwise noted.

- Inventory and analyze critical infrastructure assets along the shoreline threatened by chronic and episodic coastal hazards and future sea level rise projections. Conduct vulnerability assessments and assess options for protection, accommodation, and retreat of public infrastructure as sea levels rise.

- Identify suitable geographic scale for shoreline adaptation planning based on coastal processes.

- Determine barriers to proactive shoreline adaptation and actionable policy strategies to surmount them.

- Examine barriers to beach nourishment, including impacts to coastal habitats (offshore sand sources, sandy beach ecosystems), cost, and regulatory requirements (i.e. dewatering of sand).

- Study the feasibility of utilizing 'nature-based solutions' on Hawai'i's high-energy shorelines to manage and mitigate erosion.

- Study the impacts of sea level rise projections on cultural and archeological resources, such as gathering sites, loko i'a, *fishponds or fish traps*, heiau, *place of worship*, *shrine*, and ki'i pohaku, *petroglyphs*.

- Incorporate a managed retreat or strategic relocation analysis in all action team projects/studies to help develop criteria for this adaptation strategy as identified in *Assessing the Feasibility and Implications of Managed Retreat Strategies for Vulnerable Coastal Areas in Hawai'i* (OP-CZM 2019a).

FOCUS AREA II: LAND-BASED POLLUTION

This Focus Area is a refinement of the 2013 ORMP Management Priority 'Watershed Management', which viewed the mauka areas of Hawai'i's watersheds as primarily protecting aquifer recharge and the makai areas as most directly impacting coastal water quality. The selection of Land-Based Pollution as a 2020 Focus Area highlights polluted stormwater runoff as a pervasive and widespread issue within Hawai'i's watersheds. This issue does not occur solely in Hawai'i but does impact the State uniquely. As an island state, Hawai'i is reliant upon robust freshwater resources and healthy nearshore ecosystems, and its highly permeable geography creates an unusually fast transfer of pollutants to groundwater. Land-based pollution degrades irreplaceable coastal habitats, threatens human health, limits cultural practices, reduces local sustainability and self-sufficiency, and reduces visitor appeal, an issue tied to the health of the State's tourism-dependent economy. There is perhaps no single issue that better encapsulates the truly indelible relationship between land and sea than that of land-based pollution.

WHY FOCUS ON LAND-BASED POLLUTION?

Land-based pollution largely originates from nonpoint sources, meaning there is no one point of origin that can be addressed or remediated to stop the flow of polluted waters. The force of flowing water picks up sediment, nutrients, bacteria, toxic chemicals, oil, and trash at which point freshwater becomes polluted stormwater runoff (DOH-CWB 2018). As water flows across altered areas known as the built environment it carries pollution through natural waterways, channelized streams, and storm drains. In Hawai'i, untreated stormwater runoff is deposited directly into nearshore waters without treatment or filtration. The *State of Hawai'i Water Quality and Assessment Report* found that of 108 marine water bodies assessed, 88 (81%) did not meet water quality standards for one or more pollutants (DOH 2019). The report cites turbidity as the leading cause of coastal water quality degradation and attributes this finding to polluted runoff from land-based sources. Over half of marine assessments also identified excess nutrients present in coastal waters. 'Brown water' a term for the possible presence of sewage, pathogens, debris, and other health risks in ocean waters, has become part of Hawai'i residents' lexicon. Brown water advisories issued by the DOH explicitly warn that if it has recently rained, swimming in streams or the ocean is inadvisable.

"Rain has resulted in stormwater runoff entering into coastal waters. ***The public is advised to stay out of flood waters and storm water runoff due to possible overflowing cesspools, sewer, manholes, pesticides, animal fecal matter, dead animals, pathogens, chemicals, and associated flood debris.*** *Not all coastal areas may be impacted by runoff, however, if the water is brown stay out."*

- DOH BROWN WATER ADVISORY, 2020

Input from members of the public during the Information Sharing Sessions and corresponding online survey indicated that polluted stormwater runoff, specifically from the most intensely developed areas of Hawai'i's coastline, was a ubiquitous concern statewide. In fact, nonpoint source pollution's impact on freshwater

The DOH-CWB conducts water quality monitoring in He'eia, O'ahu during alien mangrove removal. The restoration of native species in Hawai'i's coastal ecosystems supports improved water quality.
Photo: DOH-CWB

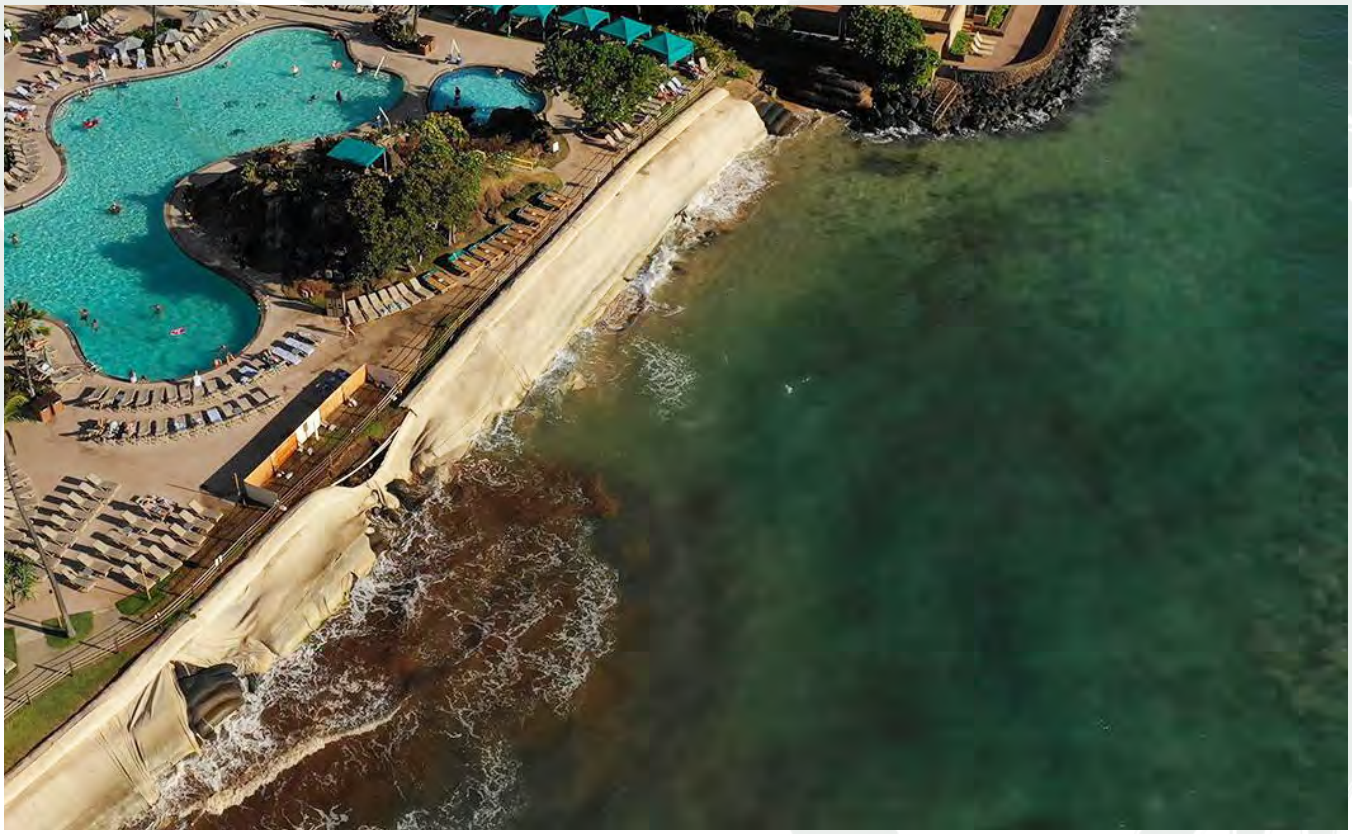
Plastic debris demarcates the high tide line at Bellows Beach Park, O'ahu.
Photo: Office of Planning

resources and nearshore ecosystems was the most frequently voiced concern during public outreach, indicating a keen awareness of the impact of human activities and development practices on coastal resource health.

In Hawai'i, the DOH-CWB Polluted Runoff Control Program's mission is to prevent and reduce nonpoint source pollution. At the county level, prevention is enforced through rules and ordinances and by implementing nonpoint source pollution control projects that aim to improve water quality. Monitoring is a fragmentary effort composed of data collection by the USGS, DOH-CWB, counties, private companies and consultants, non-profits, and academic institutions that meet the DOH-CWB's Quality Assurance/Quality Control (QA/QC) requirements. Though the DOH is required by the Clean Water Act to report select monitoring data every two years, the report's data comes from a variety of sources, leaving the State vulnerable to changes in federal and institutional funding and priorities.

The DOH-CWB Monitoring and Analysis Section checks for bacterial contamination at beaches around the State, however a significant lack of regulatory and monitoring capacity has inhibited the State's ability to frequently, expansively, and consistently monitor water quality elsewhere. Until 2020, Hawai'i Island's coastal water quality was monitored by a single individual. DOH-CWB monitoring focuses on protecting human health and enhancing the quality of the State's waters. It does not directly assess pollutant impacts on coastal ecosystem impacts, but outsources stream water quality data collection. The lack of essential resources for coastal and stream water quality monitoring has resulted in better cooperation between the State and citizen science groups. In doing so, State residents have demonstrated the importance of both individual and collective action as well as their urgent desire for information.

Data is incredibly important for enforcement, analysis, and decision-making; however, monitoring does not inherently improve coastal water quality. A critical gap exists between establishing regulations and



King tide conditions compromise a sandbag revetment in Kahana, Maui, exposing nearshore waters to sediment. Photo: Hawai'i Sea Grant King Tides Project

monitoring outcomes—the proactive mitigation and reduction of land-based pollution. Because nonpoint source runoff does not have a point of origin, there is no one agency that is solely responsible for mitigating its impacts. In seeking an example of how to improve land-based pollution originating in the makai portion of urbanized watersheds we need not look far for inspiration. In the mauka portion of Hawai'i's watersheds proactive programs and partners have been actively collaborating for several decades to promote the health and regeneration of native forests. The Hawai'i Association of Watershed Partnerships, a voluntary alliance, includes more than 70 public and private landowners protecting upwards of 2 million acres of upper watershed lands (Hawai'i Association of Watershed Partnerships 2020). Ongoing cooperation between DLNR-DOFAW and DLNR-DAR promotes a shared understanding of upper watershed and coastal ecosystem issues as well as opportunities for cooperative action (Chapter 4, Management Priorities, includes several ongoing initiatives of DLNR-DOFAW and DLNR-DAR related to Focus Area II).

Makai watersheds lack the same concerted efforts to reduce land-based threats to nearshore ecosystems. Controlling the many sources of land-based pollution across public and privately owned urban, rural, and agricultural landscapes can only be addressed through wide-spread collaboration. Likewise, mauka, makai, and nearshore watershed stewards must understand and support each other's efforts.

The selection of Land-Based Pollution as a Focus Area is an acknowledgment of the need to concurrently modify the societal practices that contribute to water quality issues while enhancing and restoring the natural processes that mitigate the impacts of land-based pollution. Future action in this subject-matter area should seek opportunities to convene diverse stakeholders, remediate lost ecosystem services, and improve upon current practices and hotspots that contribute to polluted runoff, including cesspools, fallow lands, concrete-lined waterways, extensive paving, and the unregulated removal of beneficial tree canopy cover and native vegetation. Mutually beneficial

The "recycled water" sign reminds residents to refrain from drinking the water used for irrigation.
Photo: Office of Planning

outcomes should also motivate collaboration. For example, State goals to reduce carbon emissions from the transportation sector encourages a transition to electric vehicles which would also reduce gas, diesel, and petroleum oils running off roadways and into surface and groundwater systems. The opportunities to affect change are many, including the establishment of 'makai watershed partnership networks', supporting and expanding successful education and outreach campaigns among youth and adults, and researching and evaluating best management practices appropriate for application in Hawai'i. Land-based pollution is a long-standing and chronic issue which will never be completely resolved. However, it is critical that Hawai'i invest in the mitigation of the most harmful impacts of degraded water quality urgently, with a long-term vision to restore ecological balance in the islands' future.

OPPORTUNITIES FOR COMMUNITY ACTION!

SUPPORT HAWAI'I'S WATERSHED PARTNERSHIPS.
Join a local a watershed partnership in your area for opportunities to volunteer and restore native forests. You can also support watershed restoration through local water quality monitoring groups like Hui O Ka Wai Ola on Maui [1].

TAKE SMALL STEPS TO MAKE A BIG CHANGE.
Minimize water loss and stop household pollutants from entering water resources. If you are ready to help prevent stormwater pollution, visit the Mālama I Ka Wai website for tips [2].

DON'T TRASH OUR WAVES.
Prevent toxins and bacteria from entering waters by picking up pet waste, using low or no-phosphate dishwashing and laundry detergent, and applying organic fertilizers to your lawn. Find out what you can do to keep ocean waters clean on the DOH-CWB website [3].

INSTALL A RAIN BARREL AND TAP INTO NATURAL IRRIGATION.
Save rainwater from picking up land-based pollution and flowing to the storm sewers, streams and the ocean by installing a rain barrel. Rain barrel catchment water can be used to water your lawn and garden where it can infiltrate to aquifers, naturally. To purchase a rain barrel or learn how to build and install your own, attend a Honolulu Board of Water Supply (BWS) workshop, or download their Rain Barrel DIY resources [4].

1. https://www.huiokawaiola.com/join-us.html
2. https://www.stormwaterhawaii.com/resources/baby-steps/
3. https://health.hawaii.gov/cwb/clean-water-branch-home-page/polluted-runoff-control-program/what-you-can-do/
4. https://www.boardofwatersupply.com/conservation/rain-barrel-catchment

FOCUS AREA GOALS

LAND-BASED POLLUTION

GOAL: DESIGN MANAGEMENT STRATEGIES AND PROGRAMS TO RECOGNIZE AND INCORPORATE THE CONNECTION OF LAND AND SEA, FACILITATING THE BROAD ADOPTION OF GREEN INFRASTRUCTURE PRACTICES TO REDUCE POLLUTED RUNOFF FROM WITHIN WATERSHEDS.

THE ACTION TEAMS OUTLINED BELOW ARE LISTED ALPHABETICALLY, AND IN THE FOLLOWING JURISDICTIONAL ORDER: STATE, COUNTY, UNIVERSITY, AND FEDERAL.

CONVENE LAND BASED POLLUTION ACTION TEAM:

- Office of Planning-Coastal Zone Management Program (OP-CZM) (lead)
- Department of Hawaiian Home Lands (DHHL)
- Department of Health - Clean Water Brach (DOH-CWB)
- Department of Health - Wastewater Brach (DOH-WWB)
- Marine and Coastal Zone Advocacy Councils Representative (MACZAC) (advisory)

- Honolulu Department of Planning & Permitting (DPP)
- County of Hawai'i Planning Department
- County of Kaua'i Planning Department
- County of Maui Planning Department

- University of Hawai'i - Sea Grant College Program (Hawai'i Sea Grant)
- Pacific Islands Ocean Observing System (PacIOOS)

RECOMMENDED CONSULTATION AS NEEDED WITH:

- City and County of Honolulu Office of Climate Change, Sustainability and Resiliency
- County Departments, including Facility Maintenance, Water and Wastewater, Parks and Department of Land and Natural Resources (DLNR)
- Department of Land and Natural Resources – Commission on Water Resource Management (DLNR-CWRM)
- Department of Land and Natural Resources - Division of Aquatic Resources (DLNR-DAR)
- Department of Land and Natural Resources - Division of Forestry and Wildlife (DLNR-DOFAW)
- Hawai'i Association of Watershed Partnerships
- Hawai'i Department of Agriculture (HDOA)
- Hawai'i State Energy Office-Green Business Program (HSEO-HGBP)
- Honolulu Board of Water Supply (BWS)

- National Oceanic and Atmospheric Administration-Marine Debris Program (NOAA-MDP)
- National Oceanic and Atmospheric Administration-Office of National Marine Sanctuaries (NOAA-ONMS)
- National Oceanic and Atmospheric Administration-Fisheries (NOAA Fisheries)
- United States Geological Survey, Pacific Islands Water Science Center

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- Community Organizations

- Industry Professionals, including landscape architects, ecologists, and real estate agents

PROPOSED COMPONENTS FOR GOAL SUCCESS:

Knowledge or management gaps related to Land-Based Pollution have been identified during the ORMP update process. The following projects and initiatives are proposed actions to be considered by the Focus Area II Action Team and may be further refined. These components are not ordered or prioritized unless otherwise noted.

- Increase the shared understanding of green stormwater infrastructure among homeowners, government officials, practitioners, and private industry, through continuing outreach efforts.

- Sponsor symposia and trainings on green stormwater infrastructure installation and maintenance for professionals, homeowners, and advocates.

- Identify adaptations needed to implement green stormwater infrastructure successfully in Hawai'i's unique conditions (topography, climate, soils, development patterns).

- Compare and contrast the efficacy, cost, and lifespan of green stormwater infrastructure, and traditional water management techniques (through such process as phytoremediation and filtration) compared to the 'grey' infrastructure (engineered assets) currently utilized in Hawai'i in order to dispel misconceptions about green options.

- Evaluate the use of green stormwater infrastructure along Hawai'i's shoreline and throughout the coastal zone, with the dual-benefit of controlling erosion and other shoreline processes while mitigating the impacts of land-based pollution and inland flooding.

- Expand use of NOAA's Coastal Change Analysis Program (C-CAP) sea level rise and land cover data in conducting stormwater assessments and modeling.

FOCUS AREA III: MARINE ECOSYSTEMS

This Focus Area continues the work from the 2013 ORMP Action Team for the former Management Priorities "Coral Reef" and "Marine Resources." The Focus Area is led by the DLNR-DAR, Hawai'i's lead state agency working to manage, conserve, and restore aquatic resources and ecosystems. Through this Focus Area, the ORMP will support the State's path towards effective management of Hawai'i's nearshore waters for healthy reefs, fish, and communities. DLNR-DAR is seeking to accomplish this through the effective management of at least 30% of nearshore waters around each main Hawaiian Island by 2030.

WHY FOCUS ON MARINE ECOSYSTEMS?

The health and abundance of Hawai'i's marine ecosystems are affected by many stressors that are negatively affecting marine ecosystems. Among many things, development and land-based activities contribute surface runoff of pollutants and sediment which lead to compromised nearshore water quality. Beaches and warm tropical waters draw scores of residents and tourists for a multitude of activities, all of which result in a wide range of impacts including: marine debris, damage/trampling of coral reef, introduction of aquatic alien species, and decline in nearshore fishery stocks.

Meanwhile, ocean warming has led to multi-year, statewide coral bleaching events and ocean acidification may also contribute to increased degradation. These declines in marine ecosystem health not only have direct impacts on ecosystem health, but also diminish the protection coral reefs provide to our coastal infrastructure and may lead to long-term declines in visitor interest in Hawai'i, a fundamental tenant of the State's economy. It is the lure of the ocean as a vast resource for sustenance and recreation that reinforces the need to sustain and improve upon marine ecosystem health for current and future generations.

Many participants in the Information Sharing Sessions and on-line survey voiced concern toward the health of Hawai'i's marine ecosystems. Participants were particularly interested in the carrying capacity of

Alien seaweed and algae can smother slower growing corals, but herbaceous fish like the convict tang (*Acanthurus triostegus*) keep the ecosystem in balance by grazing and controlling the seaweed populations.
Photo: DLNR-DAR

nearshore areas, considering the many pressures and extractive uses they face.

"It [the ocean] is our livelihood, our cultural practice, our refrigerator, our bread and butter, ***this is how we feed our family and in return we take care of it,*** *so that it is abundant for all generations."*

- ORMP 2019 INFORMATION UPDATE SHARING SESSION PARTICIPANT

DLNR-DAR is currently adjusting its management strategies to the threats of warming ocean temperatures, ocean acidification, sea level rise, and storm events of increasing intensity. The Division's approach is one that looks to place-based planning to build a network of marine managed areas, which minimize damage to fragile ecosystems and restore areas in need. The Division is also investing in education with respect to fishing practices and the prevention of aquatic alien species. Documenting change and success is part of multi-faceted efforts to monitor marine resources (DLNR-DAR 2020).

Collaboration through the ORMP can raise awareness of the need for expanded programs to stem the introduction of aquatic alien species, such as a program to conduct biofouling risk assessments to reduce threats from the introduction of aquatic alien species.

The ORMP's mauka to makai perspective is reflected in the interconnectedness of the three Focus Areas. There is a need to address land-based pollution and sediment runoff, especially in watersheds that include networks of healthy coral reef in their nearshore waters. In turn, healthy reefs serve to protect coastlines from coastal hazards such as storm surge.

OPPORTUNITIES FOR COMMUNITY ACTION!

TAKE THE CORAL PLEDGE!
Commit to protecting Hawai'i's coral reefs by visiting the DLNR-DAR website and taking the voluntary 'Coral Pledge' [1].

THERE'S HELP WHEN IT GETS HEAVY.
If you find marine debris drifting in state waters or washed up on the shoreline that you cannot remove by yourself, report it through the Marine Debris Response and Removal Reporting DLNR-DOBOR website [2].

STOP AQUATIC HITCHIKERS.
Ensure your boating and fishing gear are not giving harmful aquatic alien species a free ride to spread around your island. Learn the clean, drain, and dry procedure to be a good steward of your local waters [3].

THERE'S AN APP FOR THAT.
Protect the natural resources in your community by sharing anonymous tips with State Conservation Officers. Report potential hunting, fishing, alien species, and other natural resource protection violations. Download the DLNR-DOCARE DLNRtip App, available for free on the Apple iTunes store or Google Play. Don't have a smartphone? Call the DLNR Enforcement Hotline, (808) 643-DLNR [4,5].

1. https://dlnr.hawaii.gov/dar/coral-pledge/
2. https://dlnr.hawaii.gov/dobor/reportmarinedebrishawaii/.
3. http://stopaquatichitchhikers.org/
4. https://apps.apple.com/us/app/dlnrtip/id1235692976?ls=1
5. https://play.google.com/store/apps/details?id=com.citizenobserver.dlnrtip&hl=en_US

FOCUS AREA GOALS

MARINE ECOSYSTEMS

GOAL: PROMOTE FISHING PRACTICES THAT ADOPT THE WISDOM OF BOTH TRADITIONAL ECOLOGICAL KNOWLEDGE AND SCIENTIFIC ECOLOGICAL KNOWLEDGE TO IMPROVE FISH STOCKS.

GOAL: EFFECTIVELY MANAGE NETWORKS OF HEALTHY CORAL REEFS WHILE IMPROVING THE HEALTH OF REEF ECOSYSTEMS AT PRIORITY SITES IDENTIFIED BY THE STATE OF HAWAI'I CORAL PROGRAM.

GOAL: MINIMIZE THE LIKELIHOOD OF AQUATIC ALIEN SPECIES INTRODUCTION AND SPREAD INTO AND WITHIN HAWAI'I FROM SOURCES ASSOCIATED WITH VESSELS.

THE ACTION TEAMS OUTLINED BELOW ARE LISTED ALPHABETICALLY, AND IN THE FOLLOWING JURISDICTIONAL ORDER: STATE, COUNTY, UNIVERSITY, AND FEDERAL.

CONVENE LAND BASED POLLUTION ACTION TEAM:

- Department of Land and Natural Resources, Division of Aquatic Resources (DLNR-DAR) (lead)
- Department of Transportation, Harbors Division (DOT-Harbors)
- Marine and Coastal Zone Advocacy Councils Representative (MACZAC) (advisory)
- Office of Planning, Coastal Zone Management Program (OP-CZM)
- University of Hawai'i - Sea Grant College Program (Hawai'i Sea Grant)

- National Oceanic and Atmospheric Administration - Office for Coastal Management (NOAA-OCM)

RECOMMENDED CONSULTATION AS NEEDED WITH:

- National Oceanic and Atmospheric Administration - Marine Debris Program (NOAA-MDP)
- National Oceanic and Atmospheric Administration - Marine Sanctuaries Program (NOAA-MSP)
- National Oceanic and Atmospheric Administration - Fisheries (NOAA-Fisheries)
- Papahānaumokuākea Marine National Monument
- University of Hawai'i - Sea Grant College Program (Hawai'i Sea Grant)

- Commander Navy Region Hawai'i
- United States Army Corps of Engineers (USACE)
- United States Coast Guard (USCG)
- Western Pacific Regional Fishery Management Council (WPRFMC)

- Community Organizations

PROPOSED COMPONENTS FOR GOAL SUCCESS:

Knowledge or management gaps related to Marine Ecosystems have been identified during the ORMP update process. The following projects and initiatives are proposed actions to be considered by the Focus Area III Action Team and may be further refined. These components are not ordered or prioritized unless otherwise noted.

- Support DLNR-DAR capacity to work with communities that wish to pursue fishing practices that adopt the wisdom of traditional and scientific ecological knowledge.
- Identify management gaps that inform existing efforts to prevent further damage to fragile nearshore ecosystems, and collaboratively seek and obtain funding for implementation.
- Identify management gaps that will support expansion of efforts to restore and enhance coral reef priority areas, and collaboratively seek and obtain funding for implementation.
- Supplement DLNR-DAR education and outreach efforts to build a greater public awareness for responsible behavior affecting aquatic resources such as nearshore fisheries and coral reef, including the impact of aquatic alien species on native ecosystems.
- Identify management gaps to develop capacity to address aquatic alien species introduction and spread into and within Hawai'i from sources associated with vessels, and collaboratively seek and obtain funding for implementation.

CHAPTER **'EHĀ** (4)

MANAGEMENT PRIORITIES

The ORMP acknowledges that the most challenging issues and pressures affecting Hawai'i's natural environment do not fall neatly within any single governmental agency's kuleana, *responsibility*. The Management Priorities herein require collaboration among agencies to achieve shared goals.

Photo: Guille Pozzi via Unsplash

MANAGEMENT PRIORITIES

The 2013 ORMP identified Management Priorities, which are topic areas supportive of the ORMP's holistic perspectives.

The Focus Areas (Development and Coastal Hazards, Land-Based Pollution, and Marine Ecosystems) are refinements of the 2013 ORMP Management Priorities (Appropriate Coastal Development, Management of Coastal Hazards, Watershed Management, Marine Resources, and Coral Reef). The remaining relevant Management Priorities: Ocean Economy, Cultural Heritage of the Ocean, Training, Education and Awareness, Collaboration and Conflict Resolution, and Community and Place-Based Ocean Management Practices apply broadly to all of the Focus Areas. Thus, they are not deleted but folded into the 2020 Update inasmuch as possible. Specific updates to these priorities are discussed in the following sections.

and qualitative indicators of resource health and agency investment. The 2020 Management Priorities relate to and support the three Focus Areas.

2020 MANAGEMENT PRIORITIES

- Ocean Economy
- Cultural Heritage of the Ocean
- Training, Education, and Awareness
- Collaboration and Conflict Resolution
- Community-and Place-Based Ocean Management Practices

2013 MANAGEMENT PRIORITIES	2020 FOCUS AREAS
Appropriate Coastal Development + Managment of Coastal Hazards	***DEVELOPMENT & COASTAL HAZARDS***
Watershed Management	***LAND-BASED POLLUTION***
Marine Resources + Coral Reef	***MARINE ECOSYSTEMS***

Many Management Priorities identified by the 2013 ORMP remain important to the comprehensive health of Hawai'i's environmental, social, cultural, and economic wellbeing. The Management Priorities generally mirror CZM's objectives and policies as stated in HRS § 205A-2 and serve as one way to monitor agency compliance and document ongoing actions that demonstrate consistency to further this management framework. Metrics are used to measure the status of agency activities related to each Priority area.

Focus Areas and Management Priorities are specific to this Plan but are supported by many parallel efforts of multiple agencies. Complementary efforts of Plan partners are highlighted through 'metrics', quantitative

The Metric, 'Number of Fenced acres in DLNR Priority Watersheds' supports Focus Area II, Land-Based Pollution. Photo: DLNR-DOFAW via Matt McDonald

MEASURING PROGRESS: METRICS RELATING TO THE THREE FOCUS AREAS

The following metrics listed below are drawn from existing data that are reported on a regular basis which reflect the work of many ORMP partners, and serve as indicators of ongoing agency efforts, which comprehensively support the objectives of each Focus Area detailed in Chapter 3. Metrics are not directly related to the Focus Area goals, which will be assessed and implemented by ORMP Action Teams as discrete initiatives. As an example, some metrics for Focus Area II reflect the ongoing progress of mauka watershed collaborations, which continue to be important to overall watershed health.

METRICS FOR DEVELOPMENT AND COASTAL HAZARDS

- Number of Public Access Sites Created or Enhanced from OP-CZM Funding or Staff (Data Source: OP-CZM)
- Number of County General Plans and County Development Plans that include a climate change adaptation component (Data Source: County Planning Departments)
- Number of shoreline erosion studies and maps completed or updated for the main Hawaiian Islands (Data Source: OP-CZM)
- Number of counties that have updated shoreline setback rules in the last five years (Data Source: County Planning Departments)

METRICS FOR LAND-BASED POLLUTION

- Number of fenced acres in DLNR priority watersheds (Data Source: DLNR-DOFAW)
- Miles of fencing inspected and maintained at DLNR priority watersheds (Data Source: DLNR-DOFAW)
- Number of impaired streams reported and Total Maximum Daily Loads (TMDLs) mandated and created in the latest State of Hawai'i Water Quality Monitoring and Assessment Report (Data Source: DOH-CWB)
- Percentage of wastewater recycled annually (Data Source: DOH-WWB)
- Number of pollutant load reductions achieved (Data Source: DOH-CWB)
- Number of "hits" to Department of Health Water Quality website (Data Source: DOH-CWB)
- Average score on DOT-HARBOR's environmental knowledge survey(s), as reported in the Small Municipal Separate Storm Sewer Systems (MS4) Annual Compliance Report for Honolulu Harbor and Kalaeloa Barbers Point (Data Source: DOT-HARBORS)

METRICS FOR MARINE ECOSYSTEMS

- Number of Makai Watch trainings provided to community groups (Data Source: DLNR-DAR)
- Area surveyed for aquatic alien/invasive species (Data Source: DLNR-DAR)
- Area of aquatic alien species treated (Data Source: DLNR-DAR)
- Number of ballast water risk assessments conducted (Data Source: DLNR-DAR)
- Percent of favorable dispositions (convictions) for fishing and marine resource violations that are adjudicated in the Environmental Court (Data Source: DLNR-DOCARE)
- Volume (tons) of ocean debris collected and converted into (renewable) energy under NOAA-MDP's Nets-to-Energy Program (Proposed Data Source: DBEDT-HSEO)
- Miles of beaches conserved or restored through projects employing nature-based practices. (Data Source: Hawai'i Sea Grant and DLNR-OCCL)
- Number of impaired coastal waters listed in the most recently published *State of Hawai'i Water Quality Monitoring and Assessment Report* (Data Source: DOH-CWB)
- Number of shoreline postings due to sewage or other water pollution (Data Source: DOH-CWB)

MEASURING PROGRESS: METRICS RELATING TO THE MANAGEMENT PRIORITIES

The following metrics track progress toward ORMP Management Priorities. These Metrics reflect the work of many ORMP Partners and are drawn from existing data that is reported by those partners on a regular basis.

MANAGEMENT PRIORITY: OCEAN ECONOMY

Marine-related industries such as fishing, aquaculture, tourism, recreation, and shipping make up a significant portion of Hawai'i's economy and civilian job market. Goals set out in the 2013 ORMP focused on the development of aquaculture standards, the encouragement of ocean-based energy toward achieving the Hawai'i Clean Energy Initiative (HCEI), and ensuring healthy and sustainable shipping and tourism industries. This iteration of the ORMP carries these goals forward through the three Focus Areas and the dashboard metrics. Focus Area I: Development and Coastal Hazards supports Hawai'i's ocean economy by preparing and adapting the State's beaches, which the visitor industry relies on, for climate change and sea level rise. It also enhances the protection of coastal and marine ecosystems and natural resources that other ocean industries (such as fishing and aquaculture) depend upon. Also complementary are Focus Area II, Land-Based Pollution and Focus Area III, Marine Ecosystems as Hawai'i's healthy nearshore waters are critical to tourism and fisheries.

MANAGEMENT PRIORITY: CULTURAL HERITAGE OF THE OCEAN

This Management Priority stems from the protection of Native Hawaiian access, cultural practices, and gathering rights, as founded in the Hawai'i State Constitution. The Plan Partners and sponsors have committed to weaving the principles of TEK that form the basis of this Management Priority throughout the goals and actions of the three selected Focus Areas. The goals established in 2013 center around protecting access for Native Hawaiians and their cultural practices, as well as restoration of Hawaiian fishponds by means of streamlined permitting and technical assistance. The agency process streamlining and other improvements demonstrate the progress that has been made toward these goals, and this was confirmed in discussions with Plan Partners, participants at Information Sharing Sessions, and cultural practitioners.

In recognition of the work that must continue, one common concern expressed by public and partner participants in 2019 pertained to the loss of cultural resources in the context of climate change and sea level rise. Future ORMP updates and focus projects may need to consider addressing these issues through a community forum or workshop on managed retreat focused on a Native Hawaiian community, with the goal of identifying cultural resources vulnerable to sea level rise. Outcomes might include a mapping project of cultural use areas that may be vulnerable either directly to sea level rise and climate change impacts, or indirectly from planned adaptation actions. Further steps can then be planned to develop the appropriate preservation, adaptation, or retreat strategies to mitigate for impacts to cultural resources and their host communities.

METRICS FOR OCEAN ECONOMY

The following metrics are proposed to track progress toward this focus area. The metrics reflect the work of many ORMP partners and are drawn from existing data that are reported on a regular basis.

- Dollar value of aquaculture sales annually (Data Source: HDOA)
- Number of viable classified shellfish growing waters (Data Source: HDOA)
- Number of hired workers in the Hawai'i aquaculture industry (Data Source: HDOA)
- State Department of Transportation's Annual Bond Rating (Data Source: DOT-HARBORS)
- Number of hotels with recognized sustainability certifications (Data Source: Hawai'i State Energy Office- Hawai'i Green Building Program (HSEO-HGBP))
- Number of tour operators who are recognized as Dolphin SMART (Data Source: NOAA-NMS)

METRICS FOR CULTURAL HERITAGE OF THE OCEAN

The following metrics are proposed to track progress toward this focus area. The metrics reflect the work of many ORMP partners and are drawn from existing data that are reported on a regular basis.

- Average number of months to obtain all permits necessary for fishpond restoration (Data Source: DLNR-OCCL)
- Number of fishpond restoration projects given technical assistance and support for permitting process (Data Source: DLNR-OCCL)

MANAGEMENT PRIORITY: TRAINING, EDUCATION AND AWARENESS

The priority of training and education was incorporated into the ORMP in recognition of the ever-changing body of science and technology that must inform good management practices in the fields of coastal biology and geology, as well as the rapidly evolving science of climate change. The goals set out under this priority concern *"...training... for state and county agency staff as well as boards and commissions working on ocean and coastal protection.... [as well as] citizen stewardship awareness and active engagement... for widespread dissemination through various community outlets."* A major achievement since the 2013 ORMP was the development of *Hawai'i Sea Level Rise Vulnerability and Adaptation Report* (Hawai'i Climate Change Mitigation and Adaptation Commission 2017) and its companion online viewer (PacIOOS for Hawai'i Sea Grant 2019) that gives the public access to online sea level rise models. The three Focus Areas of this ORMP Update will carry training and education forward through the various forms of information sharing, organizing of seminars and meetings, and creation of educational materials that will assist all partners, practitioners and decision-makers in the realms of the three Focus Areas.

MANAGEMENT PRIORITY: COLLABORATION AND CONFLICT RESOLUTION

HAWAI'I REVISED STATUTES §201A-3(7):[CZM Program shall]..."Prepare and periodically update a plan for use of coastal zone management funds to resolve coastal problems and issues that are not adequately addressed by existing laws and rules..."

The need for the difficult work of collaboration and conflict resolution is often brought to light when there is a dissonance in the perceptions of appropriate relationships with the natural world. The OP-CZM Program is uniquely positioned, and indeed mandated, to seek resolution to the conflicts that arise in coastal issues. To that end, the ORMP convenes the Council on Ocean Resources and the Coordinated Working Group to facilitate enhanced understanding of each other's responsibilities and challenges, finding management gaps and opportunities for action. The OP-CZM Program tracks partner progress in implementation of individual mandates and collective work through data collection and reporting on the ORMP Dashboard. The ORMP also provides structure for collaboration between agencies through the formation of Action Teams that can tackle projects that are identified by the Council on Ocean Resources and the Coordinated Working Group.

An illustration of this work is the process that initiated the report, "Assessing the Feasibility and Implications of Managed Retreat Strategies for Vulnerable Coastal Areas in Hawai'i." The need for challenging discussion around managed retreat was identified by the Coordinated Working Group, validated by the Council, and documented in the 2013 ORMP. An Action Team relating to "Appropriate Coastal Development" and the Management of Coastal Hazards (2013 ORMP Management Priorities 1 & 2) was formed, and that Action Team lead a community process that included a symposium on managed retreat, attended by over 100 individuals from public and private sectors. The insights gained from this collaborative effort were documented in the report, "Assessing the Feasibility and Implications of Managed Retreat Strategies for Vulnerable Coastal Areas in Hawai'i" (OP-CZM 2019a) the recommendations of which manifest in the recommended actions in Focus Area I.

METRICS FOR TRAINING, EDUCATION AND AWARENESS

The following metrics are proposed to track progress toward this focus area. The metrics reflect the work of many ORMP partners and are drawn from existing data that are reported on a regular basis.

- Number of hits to the State's Sea Level Rise viewer, http://www.hawaiisealevelriseviewer.org (Data Source: PacIOOS)

METRICS FOR COLLABORATION AND CONFLICT RESOLUTION

The following metrics are proposed to track progress toward this focus area. The metrics reflect the work of many ORMP partners and are drawn from existing data that are reported on a regular basis.

- Number of Management Priority issues that receive state funding and where needed, legislative attention (Data Source: OP-CZM)
- Number of Council on Ocean Resources and Coordinated Working Group meetings held annually (Data Source: OP-CZM)
- Number of ORMP Action Team projects completed (Data Source: OP-CZM)

MANAGEMENT PRIORITY: COMMUNITY- AND PLACE-BASED OCEAN MANAGEMENT PRACTICES

Themes of individual kuleana as well as a desire to use local knowledge in the management of resources were consistent throughout the ORMP Information Sharing Sessions. There was a time when the OP-CZM Program provided mini-grants directly to community organizations for resource-related work. However, the State has come to recognize that the ORMP's greatest power to affect change is through the collaborative relationships that the program facilitates. It is through this forum that the OP-CZM Program and the ORMP can best support community- and place-based ocean management practices. That is, rather than allocating a relatively small grant to one organization, the OP-CZM Program can drive incorporation of Traditional Ecological Knowledge into statewide planning practice through the Council, Coordinated Working Group, or Action Teams.

Some examples of how the ORMP process can advance place-based ocean management practices through agency-level actions:

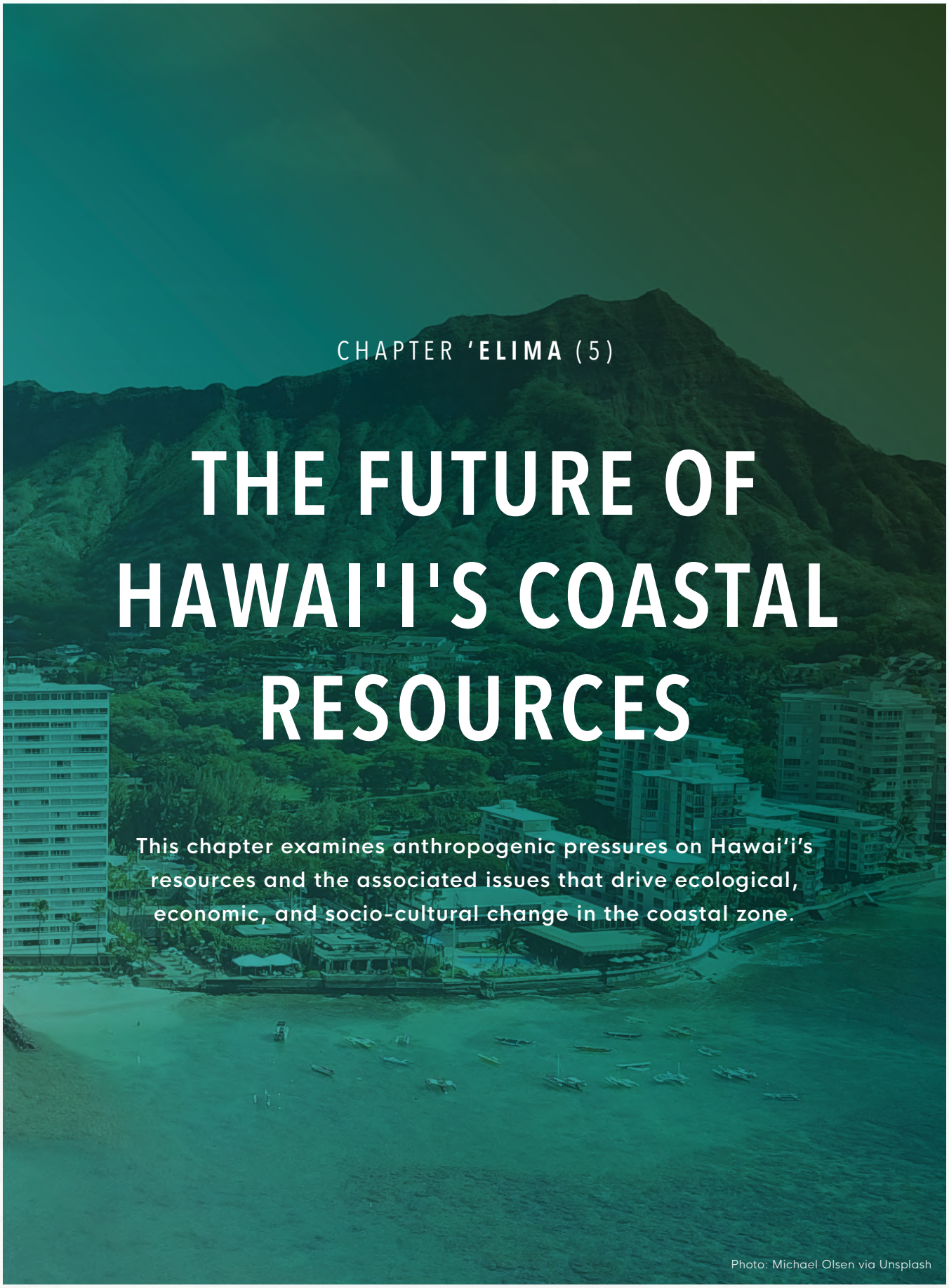
- Utilize the 'Aha Moku System, *a traditional community consultation process formally recognized by law*, for a two-way transfer of information between people and state agencies (DLNR 2013b).
- Report on the number of long-range community plans that are incorporating Traditional Ecological Knowledge into their planning process.
- Expand engagement with Office of Hawaiian Affairs and the Department of Hawaiian Home Lands to support place-based initiatives that are experiencing gaps in inter-agency collaboration, technical expertise, or funding.
- Support the Department of Health in expansion of the number of community organizations that are trained with water quality assurance and quality control protocols; and are sufficiently equipped to perform water quality monitoring.

Dating back to the 9th century, the 'Aha Moku system of land and marine resource management is a site-specific, resource-based methodology embodying traditional Hawaiian ways of knowing and doing. It is a system that embraces and relies on community consultation, regulated and non-regulated adaptive management guidelines and codes of conduct, intergenerational education and acknowledgment of specific practitioner eligibility criteria.

METRICS FOR COMMUNITY- AND PLACE-BASED OCEAN MANAGEMENT PRACTICES

The following metrics are proposed to track progress toward this focus area. The metrics reflect the work of many ORMP partners and are drawn from existing data that are reported on a regular basis.

- Number of Community-Based Fishing Area (CBFA) rule packages adopted by the Board of Land and Natural Resources (BLNR) (Data Source: DLNR-DAR).
- Number of Loko Iʻa, Hawaiian fishponds, participating in OCCL's Hoʻāla Loko Iʻa program (Data Source: DLNR-OCCL).



CHAPTER **'ELIMA** (5)

THE FUTURE OF HAWAI'I'S COASTAL RESOURCES

This chapter examines anthropogenic pressures on Hawai'i's resources and the associated issues that drive ecological, economic, and socio-cultural change in the coastal zone.

Photo: Michael Olsen via Unsplash

The natural environment is composed of an array of interconnected habitats and natural processes that require the support of one another to thrive. This understanding is fundamental to the ahupua'a system and underlies the modern conservation approach of ecosystem-based management. Single-species approaches, which are often critiqued as narrowly meeting the needs of the few to the detriment of the many, have been largely replaced by a conservation biology paradigm shift towards the management of nature's holistic complexities.

Despite this progressive view, principles of environmental management consistently fall short in translating ethos to action. The very implication that humans can, and should, manage natural ecosystems is ripe for debate. With the benefit of hindsight, humans can now assess that an anthropocentric (human-centered) worldview has resulted in evolutionary pathways of unnatural selection. Though, in today's highly altered world it can also be argued that humans have the responsibility to steward impacted ecosystems and right the wrongs of previous generations, however earnest their efforts may have been.

This chapter examines anthropogenic pressures on Hawai'i's resources and the associated issues that drive ecological, economic, and socio-cultural change in the coastal zone. The pressures included here are not all-encompassing, but rather highlight some of the most tenacious and impactful coastal problems facing Hawai'i's planning community today. Though the 2020 ORMP will focus its action on three select Focus Areas, this chapter serves to highlight the numerous interrelated factors that affect these Focus Areas, the scope and magnitude of issues impacting coastal health, positive examples of progress and change, and the many existing solutions that can be employed to restore Hawai'i's natural systems with the aim of a brighter future for the coastal zone.

The chronic and emerging management issues noted below have been composed through an analysis of the 2013 ORMP, public, stakeholder, and practitioner contributions between 2018-2019, relevant statutes, research, and scientific literature. Subject matter areas have been organized into three sections and loosely organized geographically from mauka to makai.

SECTION 1: LAND USE PRESSURES: TERRESTRIAL DETERMINANTS OF COASTAL WELLBEING

Land Use Pressures describe physical modifications to the Hawaiian Islands, largely occurring from the 19th Century to present day. These pressures have destabilized coastal ecosystems and increased the vulnerability of both built and natural environments.

CONSERVATION LANDS

- **Watershed Degradation: Impacts to Freshwater Resources**
- **Habitat Modification: Impacts to Native and Endemic Species**
- **Threats to Shoreline Ecosystems**

RURAL AND AGRICULTURAL LANDS

- **Food Production**
- **Fallow Lands**

URBAN LANDS AND URBANIZATION

- **Riparian Modification and Land-Based Pollution**
  - Management and Enforcement
  - Stormwater Runoff and Non-Point Source Pollution
  - Wastewater
  - Water Diversions and Channelization
- **Shoreline Access and Conflicting Uses**
- **Coastal Hazards, Sea Level Rise, and Coastal Erosion**

SECTION 2: SOCIOECONOMIC PRESSURES: IMPACTS OF THE ECONOMY

Socioeconomic Pressures are caused by physically intangible and dynamic local and regional systems which support commerce and provide societal benefits.

- **DEFENSE**
- **TOURISM**
- **ENERGY**
- **FREIGHT: BY LAND AND SEA**

SECTION 3: OCEAN AND NEARSHORE PRESSURES: TROUBLE BELOW THE SURFACE

Ocean and Nearshore Pressures are human-induced changes to aquatic environments, both direct and indirect, which impair ecological functionality and the provision of ecosystem services.

- **AQUATIC INVASIVE SPECIES**
- **MARINE DEBRIS**
- **MARINE SPECIES LOSS**
- **OCEAN WARMING AND ACIDIFICATION**

SECTION 1: LAND USE PRESSURES: TERRESTRIAL DETERMINANTS OF COASTAL WELLBEING

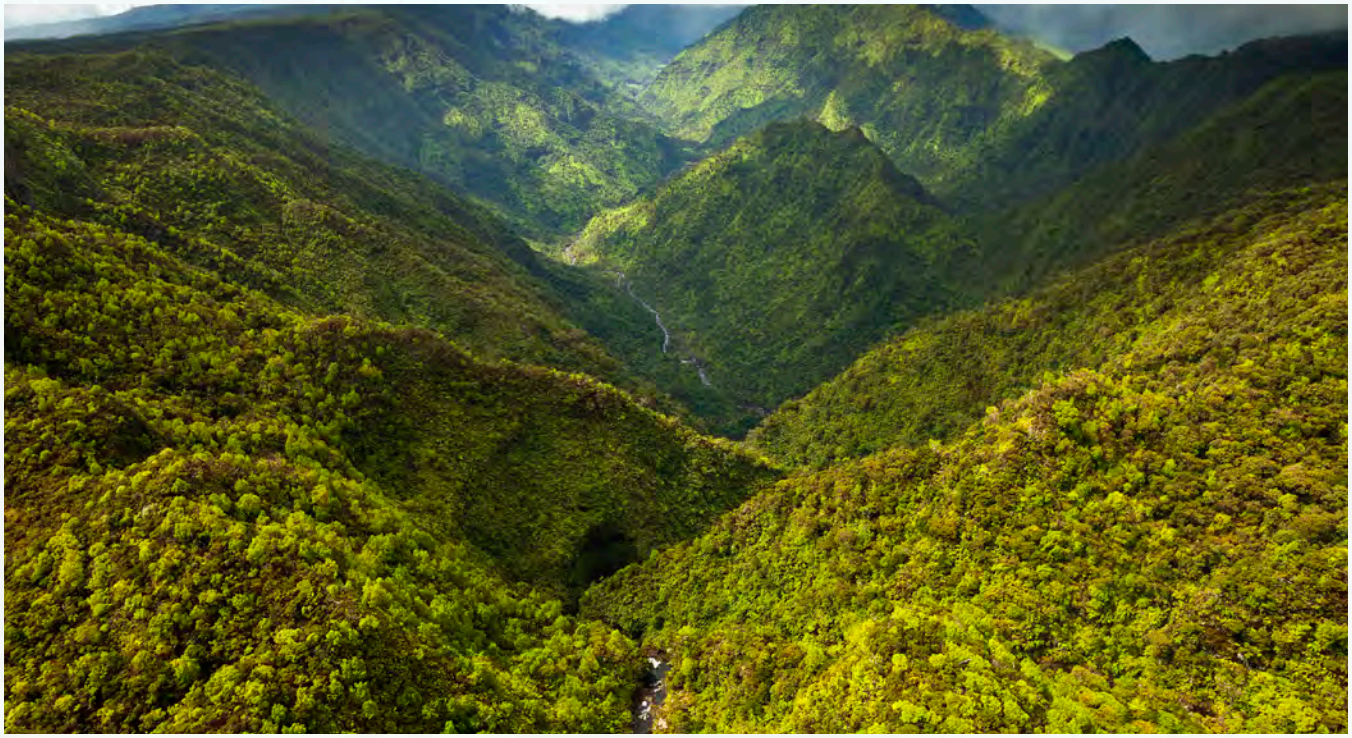
LAND USE PRESSURES

The land use system in Hawai'i includes four classifications: urban, rural, agricultural, and conservation. These classifications define which land-based activities are acceptable and where they are permitted to occur. As such, State land use policies both control (and consequently, enable) land-based activities which may place pressures on coastal resources.

Land use is designated at the state level by the Land Use Commission (LUC). County decisions regarding land use must follow the permissible uses in each district, as defined by HRS § 205-2. Each county has several mechanisms to manage land use in their jurisdiction including a General Plan (Island Plan), Development Plans/Sustainable Community Plans, Land Use Ordinances (Zoning Code), Subdivision rules and regulations, Special Management Area permits, and shoreline setback areas. Public conservation district lands are regulated by the State Board of Land and Natural Resources (BLNR). Federal land users, such as the Department of Defense, Fish and Wildlife Service, and National Park Service, are out of state and county jurisdiction. Each entity with land use authority, be it federal, state, or county, manages their jurisdiction uniquely based on innumerable local factors and agency needs. From mauka to makai, land use decisions have impacts on and implications for the health of coastal and ocean resources.

CONSERVATION LANDS

Hawai'i's State Land Use Conservation District includes nearly 2 million acres (809,371 hectares) of private and public lands (DLNR-OCCL 2020). The Hawai'i State Land Use Law, HRS Chapter 205, defines conservation as "the protection of watersheds and water supplies; preserving scenic areas; providing park lands, wilderness and beach reserves; conserving endemic plants, fish, and wildlife; preventing floods and soil



↳ Forested watersheds serve important ecosystem functions as aquifer recharge areas, in addition to providing habitat for some of the State's most threatened endemic species.
Photo: DLNR-DOFAW

erosion; forestry; and other related activities". The Conservation District designation contains a spectrum of sensitive lands, which are organized from the highly threatened 'Protective' to less sensitive 'General' subzones. Despite their classification, the management of all Conservation District lands are highly important and interdependent. For example, unmanaged invasive species in 'General' subzones will eventually make their way to more protective classes, impacting the integrity of the ecosystem function and Hawai'i's most imperiled native and endemic species. Hawai'i's Conservation lands span from mauka to makai and include forest areas, wetlands and swamps, lakes and fishponds, beach parks and islands. Sandy beaches, intertidal areas, and submerged lands extending from the certified shoreline out to the State 3-mile limit (See Graphic, Ch. II, Page 20) can be classified within the Conservation District.

Watershed Degradation: Impacts to Freshwater Resources

A watershed is defined as a catch-basin or drainage that channels rainfall and streamflow to outflow points such as estuaries, bays, and oceans. There are approximately 580 watersheds throughout the Hawaiian Islands (OP-CZM 2010). Hawai'i's watersheds are characteristically short and steep, with highly variable flow rates.

One hundred percent of Hawai'i's wai, *fresh water*, which sustains all life, arrives through precipitation. Healthy watersheds facilitate the infiltration of water into the ground, replenishing aquifers and streams. Natural porosity of the ground determines groundwater recharge and retention rates. If a watershed is saturated or repellant, water will not infiltrate into the ground and will instead flow on the surface as runoff. Surface waters may travel as overland sheet flow, in streams, and in rivers. Nearshore waters receive freshwater inputs in the coastal transitional zone from estuaries, river mouths, springs, submarine groundwater discharge, and through other processes. Hawai'i's water resources are finite due to the islands' geographic isolation and geologic makeup.

Within watersheds, native forests, riparian buffers, and species diversity provide priceless ecosystem services such as enhancing the hydrologic cycle and sediment retention. The degradation of watersheds implies the loss of these and other ecosystem benefits over time. Lower watershed areas are highly vulnerable to degradation through the channelization and diversion of waterways, clearing of forested lands for agriculture and urbanization, and suburban sprawl. Though most upper watershed areas are protected from development by their State Land Use designation subzone, they have been heavily impacted by the invasion of both plant and animal alien species.

Invasive plants and animals contribute to the degradation of conservation areas and diminish the quality and quantity of freshwater available statewide by displacing native forests and limiting the natural capacity of watersheds to capture and store water. In Hawai'i, invasive trees have been shown to reduce soil permeability, increase runoff and soil erosion, reduce

↳ Fences help to keep priority watersheds free from invasive species. Healthy native forests benefit coastal habitats by reducing erosion and sedimentation, which travel to the ocean through rivers and streams.
Photo: DLNR-DOFAW

epiphytic cover and rain throughfall, and consume more water than native species.

One of the most pervasive invaders in Hawaiian watersheds, strawberry guava (*Psidium cattelianum*), exemplifies the degrading qualities of invasive flora in Hawai'i's watersheds. Forest systems invaded by strawberry guava have been shown to lose 27% more water through evapotranspiration than pristine native forests dominated by 'ōhi'a (*Metrosideros polymorpha*) (Burnett, Wada and Balderston 2014, Giambelluca, et al. 2014). Non-native agricultural pests including fruit flies, birds, and feral pigs (*Sus scofa*) consume the fruit of guava and excrete seeds in other locations, perpetuating the cycle of invasion. In Hawai'i, physical, chemical and biological control methods are employed to limit the effects of non-native species on ecosystems and freshwater supplies. Though these treatments have documented biodiversity benefits, they are expensive and require continual maintenance and manpower.

'Ōhi'a Lehua is one of the well-known endemic trees in Hawai'i, growing in a range of biomes, soil types, climates, and elevations on the islands of Kaua'i, O'ahu, Moloka'i, Lāna'i, and Hawai'i. The 'ōhi'a is often the first to grow on fresh lava flows, and is sacred to Pele, the volcano goddess, and Laka, the goddess of hula. Lehua, flower of the 'ōhi'a tree, was designated the official flower of the island of Hawai'i in 1923 by the Territorial Legislature.
Photo: PBR HAWAII & Associates

Habitat Modification: Impacts to Native and Endemic Species

Globally, scientific consensus indicates that we are currently living through the Earth's sixth mass extinction event, sometimes called the Holocene or Anthropocene extinction. Most threatened by this era are isolated islands such as the Hawaiian archipelago, which is often called the 'extinction capital of the world' (DLNR-DOFAW 2016). Hawai'i's endemic species are found nowhere else on earth. Since European contact, habitat modification and loss has placed significant pressure on native and endemic flora and fauna, often pushing them to extinction. Also at stake is an intangible sense of place—the relationship between people and the spaces they inhabit.

Presently, the greatest threats to biodiversity are non-native invasive, habitat-modifying plants, animals, and disease (DLNR 2010). The most damaging alien species in Hawai'i today include hooved ungulates (feral pigs, goats, deer, sheep, and cattle), invasive weeds, disease carriers (mosquitos), and predators (rats, mongoose, feral cats, chameleons, wolf-snails). Physical changes in the upper watershed, such as the trampling, rooting and grazing of native vegetation by ungulates, enables the spread of invasive, shallow-rooted weeds, creates pools of standing water for disease-carrying mosquitos to breed in, and reduces water infiltration through soil disruption and compaction. These habitat changes have led to erosion and sedimentation issues in the lower portions of watersheds. Unnatural inputs of sediment diminish the value of stream habitats, impact reservoir capacity, and smother coral reefs. Fencing, replanting, and riparian buffer strategies have been shown to effectively curb the movement of fine-grained sediment, however these interventions require additional support and continual maintenance. Mitigative costs to control habitat-modifiers are high.

Some habitat changes are difficult to perceive but are capable of transforming entire ecosystems. In 2014, a fungal pathogen named Rapid 'Ōhi'a Death (*Ceratocystis sp.*) began to attack and kill native 'ōhi'a trees (*Metrosideros polymorpha*), a Hawaiian endemic species that comprises about 80% of native forests (Hawai'i Invasive Species Council 2019). As of 2019, Rapid 'Ōhi'a Death has spread from Hawai'i Island to

Kaua'i and O'ahu. Its spread foreshadows a potentially catastrophic future for native forests and watersheds. If Rapid 'Ōhi'a Death is uncontrolled, the resulting habitat change will inevitably lead to less water recharge and unknown challenges for the many species that depend upon the 'ōhi'a for food and habitat support.

When a native species goes extinct, the loss has a ripple effect throughout the ecosystem, producing a functional imbalance and opening a formerly-held niche to opportunistic invaders. In 2019 the last specimen of the Hawaiian land snail (*Achatinella apexfulva*), an individual known as George, passed away. Also lost is a species' cultural importance—Hawaiian oral tradition tells of singing snails—and scientific significance—Hawaiian snails guided naturalist's theories on evolution and biogeography in the Hawaiian Islands (DLNR-DOFAW 2019). Each native and endemic species is an important and irreplaceable part of the ecosystem, and humans cannot yet understand the magnitude of their individual and collective losses.

↳ Disturbances such as grazing, rooting, and trampling by invasive ungulates (wild boars, goats, and buffalo) can leave native forests vulnerable to the spread of invasive plants, water pooling that breeds disease-carrying mosquitos, and reduced water infiltration through soil disruption and compaction, as shown in this photo of the Hanawai Forest Reserve.
Photo: DLNR-DOFAW

Habitat loss can occur through the processes of development, fire, global climate change, and other destructive forces. Many of Hawai'i's unique habitats have been permanently lost. Staggeringly, over 61% of mesic (moderately wet) habitats and 90% of dryland forests in Hawai'i have been destroyed by human activity and encroachment. Less than 40% of Hawai'i's land area hosts native vegetation and 58% of perennial streams in the State have been modified (DLNR-DOFAW 2016).

Prior to the designation of Conservation Land Districts in 1961, many important habitat areas were converted to urban development or cleared for agriculture. Ecosystem changes form a negative feedback loop—development leads to degradation, which is then used to rationalize the development of subprime habitat for further expansion. This justification for fragmentary sprawl continues to threaten endangered species and biodiversity in the islands.

Threats to Shoreline Ecosystems

Along Hawai'i's coastline a diverse array of wetlands, estuaries, sandy beaches, and rocky shorelines provide valuable functions, including sediment collection, shoreline protection, water quality filtration, nursery habitat, and food web support. These areas support a multitude of cultural, subsistence, and economically-beneficial uses, such as fisheries, recreation, and tourism. Paradoxically, these ecosystem areas are threatened by the very activities they support. Noise and light pollution, recreational overuse, over-extraction, close human interaction with species, and other disturbances threaten wildlife in shoreline areas. Because marine ecosystems are located at the base of the watershed, they are affected by all upstream actions. Chemical and nutrient pollution, sedimentation, and debris outflow all negatively impact the health of ecosystems.

Hawai'i's sandy beaches could be considered the State's greatest economic asset, but they are also natural ecosystems that provide ecologic value. The built environment has encroached on beach areas, impounding sediment that sustains beaches during periods of high waves and storms and blocking the natural inland migration of beaches. Shore-

parallel armoring, such as seawalls and revetments, may prevent land loss but may also result in beach narrowing and a complete loss of sandy beach habitat. The construction of seawalls and revetments also accelerates erosional forces along neighboring, non-armored shoreline segments.

Though preferable to most forms of coastal hardening, modifications to natural beach systems through the movement or addition of sand must consider and mitigate potential impacts to beach-reliant species such as turtles, seals, crabs, seaweed, and shorebirds. Sand sources are transported through dredging and pumping, which can impact offshore benthic habitats. These activities can also temporarily impact recreation with unpredictable effects as sand moves and settles offshore. When implemented according to best management practices, beach nourishment is considered a nature-based solution with benefits for shoreline protection and habitat restoration. *Hawai'i's Statewide Small Scale Beach Restoration Program* provides guidelines to prevent negative impacts to nearshore ecosystems as a result of beach restoration projects (DLNR-OCCL 2020).

Though not heavily impacted by recreation, Hawai'i's rocky shoreline areas also face habitat threats. Principally, rocky shorelines lack the ability to migrate inland as sea levels rise. Unique intertidal species occupying niches in the State's tidepools and cliff areas may experience changes to their habitats, such as their period of exposure to the sun and inundation of the tides. Additionally, trampling and over-harvesting, invasion of alien species, and the inundation of debris and pollution from development threaten the health of intertidal ecosystems.

Hawai'i's wetlands and estuaries provide homes to some of the State's most threatened species. Almost a third of species listed by the U.S. Endangered Species Act are in Hawai'i, the majority of which rely on wetlands for at least part of their lifecycle (Rees and Reed 2013). Wetland areas are also vulnerable into themselves; statewide, estimates range between

↳ Hawai'i's beaches, some bustling and others tranquil, are regarded as world-renowned tourist destinations.
Photo: Office of Planning

15%–40% of wetland habitats have been lost to land reclamation and development pressures (DLNR-DOFAW 2016). Once filled and drained, wetlands are one of the most difficult ecosystems to restore and maintain in perpetuity. The cultural significance of wetland and estuary habitats in Hawai'i is profound, with adapted wetland ecosystems in the makai portion of the ahupua'a supporting agriculture, such as lo'i kalo, *taro patches*, and aquaculture, such as loko i'a, *fishponds*.

Lo'i refers to the *irrigated terraces* or *patches*, in which kalo, *taro*, was propagated. Also grown in dryland conditions, kalo is identified in the Kumulipo, *a Kānaka Maoli origin chant*, as an ancestor and the eldest brother of Hāloa, *the progenitor of all Hawaiians*, and the source of nutrition and cultural identity.

Loko i'a, a general term for *fishponds* or *fish traps*, refers to the aquaculture engineering practices of Kānaka Maoli utilizing and employing loko, *ponds or pools*, to capture, raise and harvest i'a, *fish*, limu, *seaweeds* or other marine resources. Different types of loko i'a include loko kuapā, loko pu'uone, loko wai, loko i'a kalo and loko 'ume iki, the differences between them being defined either by the materials used in construction, shoreline or inland locations, size, design and specific use.

Today, wetlands are regarded as an indispensable aspect of climate resiliency, due to their natural ability to control flooding, filter pollutants, and buffer the aquifer from groundwater salination. The enhancement of the He'eia ahupua'a on O'ahu provides a model for modern resiliency statewide. In 2017, the He'eia National Estuarine Research Reserve (NERR) was established, encompassing wetland, estuarine, and nearshore habitats. The area serves as a 'living laboratory' that acknowledges the importance of researching, understanding, and educating communities about ecosystems from mauka to makai. Landward of the reserve's boundaries, ongoing river restoration and reforestation complement lower watershed efforts, connecting land and sea.

RURAL AND AGRICULTURAL LANDS

Hawai'i's agricultural lands have been classified as 47% of the State's Land Use and rural lands occupy less than 1% of district designations (DBEDT 2018a). Together, rural and agricultural lands compose almost half of the State's acreage and have the potential to greatly affect the health of Hawai'i's coastal resources. Hawai'i's uniquely mild year-round climate presents plentiful opportunities for agriculture. However, food production is only one of many competing priorities in the State. The diametrically opposing force of development has created tensions with agricultural interests. The demand for the conversion of agricultural areas to urban zoning comes with a corresponding decreased potential for local food production, which is needed to support growing urban populations (Kurashima, Fortini and Tick 2019). Intensive agricultural practices, which produce sediment and nutrient inputs to waterways, have been identified as sources of pollution to nearshore waters in Hawai'i (Ryder 2008). Best management practices are critical to improving environmental conditions, maintaining crop yields, and refining efficiency. Looking forward, new challenges on the horizon have already begun to impact Hawai'i's agricultural productivity. The increasing salinity of groundwater is directly impacted by rising sea levels and water withdrawal from the aquifer (U.S. Global Change Research Program 2018). Increasing heat, extreme weather, pests, and decreasing freshwater resources associated with global climate change threaten future food production in Hawai'i.

↳ Much of the agricultural land in Kunia on O'ahu that historically grew sugarcane and pineapple has been converted into seed crop production for large-scale mainland agricultural operations.
Photo: PBR HAWAII & Associates

Food Importation and Production

Islands throughout the Pacific were once places of high food security. Prior to European contact in 1778, between 150,000-1 million inhabitants obtained their food from local sources (Dye 1994). However, Hawai'i presently imports the vast majority of its food. This reliance on importation increases the State's dependence on consistently favorable trade and weather conditions. Loss of traditional food sources and practices as well as growing human populations have changed the way food is produced and consumed, often with detrimental health effects for native communities (Oneha, et al. 2016).

The main driver of food importation is economic efficiency, as the cost to produce food locally exceeds the cost of producing and transporting food from elsewhere (Kent 2016). Increasing local production would reduce 'food miles' traveled, correspondingly lowering the risk of invasive species introduction, transportation costs, and the State's carbon footprint (OP and HDOA 2012).

Despite the benefits of reducing Hawai'i's reliance on foreign sources of food, local conditions for agriculture can be challenging. In April 2018, an extreme rainfall event caused flash flooding resulting in damage to homes, infrastructure, and agricultural crops. On O'ahu, the event led to the closure of farms following repeated flood damages. The flooding also impacted taro fields in Kaua'i, resulting in a statewide crop shortage. Statewide agriculture was also setback by the Kīlauea lava flow of 2018, which impacted farming communities in Puna on Hawai'i Island. The compounding impact of repeated weather events and unpredictable acts of nature have had a discernable effect on local agriculture production and availability, bringing attention to the instability of food security in the islands.

There are many culturally significant components to self-sufficiency, the support of which mutually benefits the transfer and practice of traditional ecological knowledge. Wetland and nearshore aquaculture systems modify natural areas for food production. These local production methods support healthy ecosystems, including water quality, sediment/nutrient retention, and 'downstream' benefits to coral reef health. Other sources of food security, such as shoreline and forest gathering, are reliant on abundant and healthy ecosystems. Once common, the collection of land snails, limpets, and limu have become increasingly difficult, with some species listed as endangered or extinct. Subsistence fishing practices have also become challenged by decreasing nearshore biomass. Though feral ungulates (i.e. pigs, deer, sheep, goats) are non-native and can diminish ecosystem values, they can also be a valuable source of food. The active management of ungulates through strategic hunting practices is an evolving issue of cultural and environmental significance. Biocultural restoration practices can enhance social connections and relationships to place, important aspects of a community's resiliency (Bremer, et al. 2018).

Limu is the general Polynesian term for seaweed or other edible plants that live under or near water, such as algae. There are over 600 species of limu, and based on their color pigmentations, can be organized into three basic groups: green, red and brown seaweeds. In ancient Hawai'i, as many as 75 varieties of limu were consumed.

↳ The Natural Energy Laboratory of Hawai'i Authority (NELHA) promotes aquaculture innovation as a means to improve local self-sufficiency for food, energy, and fuel sources.
Photo: Office of Planning

Today, Hawai'i is focusing on transitioning from industrial, plantation systems to diversified agriculture. In 2016, Hawai'i committed to doubling local food production as a means to promote food security. At that time, 16,900 acres (6,839 hectares) of diversified agriculture were grown in the State, compared to 7,489 acres (3,021 hectares) in 1980. Since the production of 90,920,000 pounds (43,695,802 kg) of food produced locally in 2016, local food production has steadily increased with 104,635,130 pounds (47,461,697 kg) produced in 2018 (State of Hawai'i Dashboard 2018). As of 2018, Hawai'i's highest value planted crops included coffee ($50 million), macadamias ($42 million), papayas ($6 million), taro ($2 million), and avocados ($1.6 million) (USDA 2018). The economic value of Hawai'i's seed crops, 97% of which is seed corn, is especially significant, with a valuation of $106 million for the 2018-2019 season (USDA 2019). However, seed crops are not grown for local consumption.

Though energy intensive, agricultural technology may be important to Hawai'i's future portfolio of local food production. On Lāna'i, hydroponic vegetables are being produced to support the growth of the island's resort community and plans for desalination have been discussed to support the island's future growth.

Fallow Lands

Over time, the privatization of lands and growth of industrial agriculture have changed the character of food production. From the late 19th to the mid-20th Century, these changes triggered a loss of mauka to makai connections and a focus on plantation agriculture—mainly sugarcane and pineapple production. Beginning in the 1950's, plantation agriculture declined and closures accelerated by the Century's end (Seattle Times 2016). Hawai'i's last sugar mill closed in 2016.

As plantations shuttered, farmlands were allowed to sit fallow. Because these areas were previously disturbed by agriculture, they have been quickly invaded by non-native grasses and shrubs. These fire-prone plants have enabled grassland fire cycles in fallow areas. Fires have allowed invasive vegetation to encroach into native forests and increased rates of erosion, landslides, surface water runoff, and sedimentation in streams and coral reef ecosystems (Trauernicht 2014).

Correspondingly, fire areas experience reduced evapotranspiration and groundwater infiltration, impacting the health of the State's water cycle and sustainability of surface and groundwater resources. In 2019, over 10,000 acres in Central Maui burned in a single event, diverting flights away from Kahului Airport, evacuating residents, and damaging the electrical grid (Maui Now 2019).

Fallow lands have been denuded from years of intensive farming practices, including the application of pesticides, herbicides, and fertilizers. In addition, the regular use of irrigation piping and plastic sheeting to retain moisture in the ground and suppress weed growth led to a buildup of foreign material in soils. Plastic was often tilled into the ground at the end of each harvest cycle. Today, fallow fields are a persistent reminder of the land's past, and the challenges that lie ahead in remediation and restoration.

↳ Fallow and active agricultural operations in central Maui.
Photo: Office of Planning

Despite these trials, fallow lands present many opportunities, including a future of diversified agriculture, native ecosystem restoration, cultural practice, and even receiving areas for relocation from vulnerable shorelines. Erosion control practices, including cover crops, barriers, and strategic planting can mitigate some of the negative externalities of fallow croplands until a beneficial use for them is determined.

Diverse partnerships have thus far been critical in the transition of fallow lands to new uses. In 2018, the State and the Trust for Public Land, a non-profit organization, acquired almost 3,000 acres of forest and fallow lands from Dole Food Co., with plans for recreational opportunities, forest restoration, water source protection, and improvements to habitat for native species. As of 2019, the State is pursuing the conversion of fallow agricultural lands into high-production farming operations to increase Hawai'i's food security. One such project is located on the former Galbraith Estate in Central O'ahu, which has been fallow since 2004. The $25 million-dollar property was purchased by the Trust for Public Land with a combination of state, county, U.S. Army, County of Honolulu, and private sector funds, and was then transferred to two state entities. The Agribusiness Development Corporation is currently preparing 1,200 acres for diversified farming leases from 5 to 90 acres, in what is being called the Whitmore Project. Prosperous yields of cabbage, watermelon, and bell peppers on the property have demonstrated a powerful proof of concept—modern diversified agriculture can be successful on former pineapple lands. The remaining 500 acres surrounding the five-acre Kūkaniloko Birthing Stones, a royal and sacred birthing site, was transferred to OHA.

↳ Lāna'i's agricultural past is evidenced by plastic sheeting embedded in historic pineapple fields.
Photo: Office of Planning

URBAN LANDS AND URBANIZATION

Urbanization is characterized as a process that takes place through rapidly changing human population and land cover (Seto, Parnell and Elmquist 2013). Coastal areas make up less than a tenth of the global landmass but contain nearly half of the global population (Barragán and de Andrés 2015). In Hawai'i, all urban areas are located in the coastal zone. As of 2018, 200,843 acres of urban land use district existed in Hawai'i, representing 4.9% of the State's total land area (DBEDT 2018a). The impacts of Hawai'i's relatively small urban areas have had disproportionate effects on ecosystem health, with many of the State's urban areas constructed in and around vulnerable watersheds, floodplains, wetlands, and estuaries.

As an island state with limited land area, the issue of urbanization is particularly pressing in Hawai'i. The competing pressures include sustaining local food production through the maintenance of prime agricultural lands, production of green energy, support of industry, and the need for affordable housing, tourism, and conservation. These requirements create tensions around the issue of urbanization, especially as related to greenfield development, construction on previously undeveloped land. Socio-environmental factors of Hawai'i's urbanization have manifested in a

lack of walkable urban areas, increasing impervious surfaces and urban heat, decreases in greenspace, and pressures on freshwater resources. Despite the fact that there would appear to be 'room to grow' in certain regions, environmental conditions cannot always support increased development. For example, recent analyses of the Waimea aquifer in the relatively unpopulated South Kohala district of West Hawai'i have found that the water source is currently being utilized to 86.4% of its sustainable yield (Environment Hawai'i 2019).

Global climate change is likely to intensify the challenges of historically unsustainable building practices, with increasing heat, drought, and intensifying storms projected in Hawai'i's future. Real time, rapidly-evolving data is being incorporated into planning practices to better inform the way the Hawaiian Islands are developed, including modifications to strategic growth areas and the identification of regions that are more appropriate for restoration and conservation measures.

Hawai'i's development is largely concentrated around the shoreline. Dense oceanfront construction has reduced accessibility for cultural practices and recreational uses. The built environment's proximity to the ocean has increased the State's vulnerability to coastal hazards, including sea level rise, storms, and chronic coastal erosion. Building practices have also endangered the perpetuation of Hawai'i's economy, including tourism and industry. Heavy rains and high tide flooding in the tourist center of Waikīkī Beach and industrial area of Māpunapuna on O'ahu have served as indicators of a future impaired by nuisances and expense.

Since 2013, extensive construction in the retail and housing center known as Kaka'ako has converted an industrial district into a lively, walkable neighborhood. However, recurring issues of stormwater flooding and failing wastewater infrastructure portend a problematic future for the area. Kaka'ako, like the areas of Waikīkī and Ala Moana, was constructed largely on filled wetlands. The entirety of the area is located within the National Flood Insurance Program's Zone AE (Special Flood Hazard Area subject to inundation by the 1% annual chance flood) and is projected to begin seeing inland inundation at only 0.5 feet of sea level rise (Hawai'i National Flood Insurance Program 2019, PacIOOS for Hawai'i Sea Grant 2019). One of Kaka'ako's most popular features, a shopping center called 'Salt' was named for the pa'akai, *salt*, ponds "that once dotted the low-lying wetlands of [the] area" (Salt at Our Kaka'ako 2020). Without creative intervention, Kaka'ako's bustling streets may begin to transition back to their original state—wetland. Similarly, goals of increased affordability, density, and walkability around some Honolulu Rail transit stations have come into conflict with aims to reduce vulnerability and development within areas projected to experience sea level rise inundation in the future.

↳ King tide conditions pose a challenge for commuters and industry operations in Mapunapuna, O'ahu.
Photo: Hawai'i Sea Grant King Tides Project

Rising sea levels have shone a spotlight on the often-incompatible ambitions of economic development, social welfare, environmental stewardship, long-term risk reduction. Time is of the essence as we work to understand the complex dynamics of coastal urban spaces and the challenges they create in resource management; Hawai'i's population is projected to grow from 1.43 million in 2016 to 1.65 million in 2045 (DBEDT 2018a).

Riparian Modification and Land-Based Pollution

The State Water Code establishes the goal of "maximum beneficial use" of the waters of the State. Such uses include household, aquaculture, agriculture, energy, commercial, and industrial practices, providing that public interests are protected with "adequate provisions...made for the protection of traditional and customary Hawaiian rights, the protection and procreation of fish and wildlife, the maintenance of proper ecological balance and scenic beauty, and the preservation and enhancement of waters of the State for municipal uses, public recreation, public water supply, agriculture, and navigation" (HRS Ch. 174C 1987).

While each county faces unique issues in their management of terrestrial water, statewide themes and challenges include a lack of active riparian management and enforcement, surface and submarine water quality problems caused by stormwater runoff and non-point source pollution (soil, fertilizers, animal waste, oil, grease, litter, and agricultural and household chemicals), wastewater (cesspools, septic tanks, treated wastewater, non-native mammals, accidental releases), and the impact of water channelization and diversions on ecosystem health. Out of 108 marine water bodies assessed statewide, 88 do not attain water quality standards for at least one or more conventional pollutants (DOH-CWB 2018).

↳ Organic materials block storm drains after heavy rains, leading to drainage related flooding.
Photo: Office of Planning

Statewide, much of the infrastructure used to maintain water quality and control flooding is aging and additionally stressed by the demands of the changing climate. The American Society of Civil Engineers graded Hawai'i's waste and stormwater infrastructure as D+ and D-, respectively (American Society of Civil Engineers 2019).

Management and Enforcement

Rivers and streams are a direct connection from mauka to makai. Hawaiian waterways are characterized by steep profiles and flashy (intermittent, high volume) flow spikes. The management regime of island streams has impacts on habitat, pollution, and flood risk. Though the water that flows down a stream is held in the public trust, the streambed itself can be privately owned (stream ownership is indicated on property deeds).

↳ Many of Hawai'i's waterways have been modified from their natural state. Pristine rivers and streams, such as the one pictured here, provide a model for ecosystem health.
Photo: DLNR-DOFAW

State law designates landowners as responsible for keeping portions of streams on their property free of trash and debris. In the case that private property owners do not maintain their streams, enforcement of this provision lies with each county. While this law is important to reduce the impact of flooding to adjacent properties and areas downstream, it does not provide any incentive to improve stream habitat or reduce nutrient loading into waterways. Unconsolidated management issues are compounded by the presence of invasive species and hydromodifications for agriculture and urbanization, which may negatively impact a riparian area's biodiversity and ability to purify and control runoff. With over 3,300 miles (5,300 km) of rivers and streams statewide, consistent enforcement of stream management is a vast mandate (DOH 2018).

Stormwater Runoff and Non-Point Source Pollution

Nutrient and bacterial inputs to waterways and nearshore areas impact both human and environmental health. In Hawai'i, there are many vectors for pollutants to enter rivers, streams, canals, and ultimately, nearshore areas. In developed areas throughout the State, rain and floodwaters are collected and discharged into waterbodies without treatment. Stormwater infrastructure like drains and pipes are designed to efficiently move water and reduce the risk of flooding—not to filter it. As a result, stormwater is the primary conduit for untreated waste and pollution to travel from land to sea in the Hawaiian islands.

In upper watershed areas rain falls on relatively pristine native conservation lands. As it flows towards the ocean, the water often becomes contaminated. In forested areas, water mixes with the waste of non-native ungulates (i.e. feral pigs, goats, sheep, and deer) and can move relatively unimpeded through fringing, denuded ecosystems (such as those damaged by fire, invasive flora, or deforestation). Adjacent to conservation lands, land use changes such as agriculture and pasturelands can additionally impact water quality. Pathogens, pesticides, herbicides, and sedimentation from barren soil, tilling, and unpaved roads contribute to non-point source runoff from these areas. Lower in the watershed, household chemicals, roadway oil and heavy metals, and other debris can be collected by stormwater. Cumulatively, these non-point source pollutants negatively impact Hawai'i's freshwater and marine ecosystems.

Because many ecosystem services (i.e. the filtering capacity of wetlands and estuaries) have been lost due to land use changes, it is important that urban and residential areas promote positive stewardship practices and advocate for the use of green stormwater solutions. Green stormwater infrastructure, also called low impact development, capitalizes on the natural capacity of plants to filter pollutants from water, reduce flow velocity, collect sediment, and absorb excess nutrients in runoff. This alternative form of management diverts water that would otherwise flow directly into waterways and channels it through planned areas that replicate wetland ecosystems or promote the movement of water from the ground surface into the aquifer. Options such as rain gardens, bioswales, bioretention basins, and flow-through planters have the addition benefit of providing hydraulic connectivity, urban biodiversity, evapotranspiration, and groundwater infiltration and can be designed as scenic (i.e. urban ponds and waterways) or recreational amenities (i.e. boardwalks and floodable sports fields). Where conditions permit, culturally significant practices such as the cultivation of lo'i kalo, and restoration of loko i'a, can serve as components of stormwater management.

↳ Sediment is carried by stormwater runoff on Lāna'i Island. Without intervention, sediment from mauka areas may reach coastal waters, impacting their health and longevity.
Photo: PBR HAWAII & Associates

↳ The DOH-CWB conducts water quality monitoring in He'eia O'ahu during mangrove removal. While regarded as keystone species elsewhere in the world, mangroves are not native to Hawai'i.
Photo: DOH-CWB

Wastewater

The water that we use each day in toilets, showers, and kitchen sinks undergoes various levels of disinfection. For the majority of State residents, about 60%, wastewater travels through pipes to a centralized wastewater treatment plant. Most of Hawai'i's population served by a sewer system are concentrated on the populous island of O'ahu. The cleaning of water can occur at different levels of sophistication: primary (removal of solids), secondary (use of aerobic digestion to degrade biological components), and tertiary (particulate filtration with sand, charcoal, activated carbon and disinfection with ozone, ultraviolet light, chlorine, etc.). Following treatment, water is permitted for release. Pharmaceuticals, microscopic plastic fibers, and nutrients (i.e. nitrogen and phosphorous) can survive treatment processes and negatively impact the environment when treated water is discharged.

The remaining 40% of residents are served by an Individual Wastewater System, a decentralized system serving one residence or a cluster of homes. Individual Wastewater Systems vary in complexity and include cesspools, seepage pits, and septic tanks. Cesspools deposit untreated human waste into large, cylindrical holes the ground. These excavated areas retain solids and rely on the process of percolation to dispose of fluids. In 2017, Act 125 was signed into law requiring the replacement of all cesspools in Hawai'i by 2050. Currently, 88,000 cesspools deliver 53 million gallons of raw sewage into the State's ground and surface waters each day (DOH 2018).

When wastewater systems fail or are improperly maintained, polluted runoff can enter streams, groundwater, and the ocean. Excess nutrients in freshwater and the ocean can lead to eutrophication, excess nutrients, causing algal blooms and harming organisms. The presence of fecal bacteria can impact human and economic health. In recreational waters, accidental ingestion of bacteria can lead to gastrointestinal distress and hepatitis A. Fecal bacteria have been found to persist and even grow in Hawai'i's beach sand at levels of 10 to 100 times higher than nearby seawater (Cui, et al. 2013). With a highly tourism-dependent economy, brown water and high bacteria count advisories, visibly degraded water quality, and sickness may impact tourism revenues.

The disposal of treated municipal wastewater is of local concern, particularly as related to impacts on nearshore habitats. Groundwater injection wells transfer treated water into the ground. The geological process of submarine groundwater discharge, the subsurface movement of freshwater, is critical to the health of coral reefs and other nearshore ecosystems. When subsurface waters are polluted, even by treated wastewater, this geologic process can serve as a vector for the movement of nutrients. Because of Hawai'i's porous sub-surface geology, treated wastewater percolates into submarine groundwater and exits into nearshore areas as nutrient-laden submarine groundwater discharge. Wastewater injection wells from West Maui's Lahaina Wastewater Reclamation Facility have been found to endanger local coral reef habitat. The issue of point source discharge traveling through groundwater and into

United States navigable waters is currently before the U.S. Supreme Court in *County of Maui, Hawai'i v. Hawai'i Wildlife Fund, et al.* (Supreme Court of the United States 2019).

Similarly, groundwater submarine discharge quality on Hawai'i Island has been impacted by decades of land use decisions, including the utilization of dry wells for industrial and sewage disposal. The discharge of impaired groundwater around Kaloko-Honokōhau National Historical Park has impacted restoration efforts on land, in historic fishponds, and in nearshore coral reef habitats. Brine, the highly saline byproduct of brackish desalination in West Hawai'i, is disposed of in shallow, brackish waters, which are excluded from DOH oversight. Brine disposal may impact aquifer water quality and negatively impact the health of nearshore resources. Additionally, abandoned wells have been identified as a potential conduit for groundwater contamination in the *Water Resources Protection Plan* (DLNR-CWRM 2019).

The State has invested in recycled water as one means to counter growing demand and disposal problems. Instead of relying on injection wells, recycled water facilities supply treated wastewater for agricultural and landscaping uses in designated zones. The application of recycled water increases water security and reduces the burden of discharging treated wastewater into ecosystems.

Water Diversions and Channelization

Surface water habitats support unique endemic species that require consistent flow and safe passage from land to sea to complete their lifecycle. Equally, the flow of waterways in Hawai'i have cultural importance, with land-based cultivation of staple crops and aquaculture requiring natural patterns of water flow. The diversion and channelization of water to serve industry, agriculture, and urbanization causes water quality issues by reducing the natural capacity of ecosystems to filter pollutants and altering water volume, velocity, temperature, and habitat availability. The establishment of instream flow standards as directed by the State Water Code can help to restore habitat and the use of water for traditional customary practices. In 2018, instream flow standards were established to promote the restoration of streamflow in Kanahā and Kahoma streams in West Maui. The waterways were originally diverted to irrigate sugar cane fields and more recently have supported the Lahaina Water Treatment Plant. On O'ahu, the Ala Wai watershed, at the base of which is Waikīkī Beach, serves as a definitive

↳ Channelized streams eliminate habitat value and serve as conduits of polluted stormwater runoff.
Photo: Office of Planning

cautionary tale for urban watershed alterations. The area's place name alone suggests an incompatibility with the built environment; translating to 'spouting waters'. The modification of Waikīkī's wetlands began in the mid-15th Century and culminated in the construction of a two-mile drainage system in the 20th Century. The construction of the Ala Wai canal enabled the widespread urbanization of O'ahu's southeastern shore in a natural floodplain. Today, the canal collects water and pollution from one of the most densely populated watersheds in the nation, with 12.36 people per urbanized acre (0.40 hectares) (USACE 2019). At the seaward end of the watershed, Ala Wai Canal's

waters are notoriously degraded. The canal drains into the nearshore area fronting Waikīkī Beach, the State's most popular and economically important tourist destination. The loss of natural wetlands in the lower watershed has left the highly developed Waikīkī area vulnerable to catastrophic flooding. A recently proposed flood risk management project for the Ala Wai Canal was Federally authorized for construction at a cost of $345 million. The USACE estimates a major flood in the watershed could damage 3,000 structures and cost more than $1.14 billion (USACE 2019). As of late 2019, the USACE is amending planned improvements based on community input in order to reduce projected impacts to private property. Additionally, the DLNR announced dredging of the Ala Wai Canal in October 2019 at a cost of $21 million, representing the first removal of accumulated debris since 2002.

Shoreline Access and Conflicting Uses

The impacts of coastal hazards and sea level rise have compounded shoreline access issues. Hardened structures like seawalls and revetments lead to the narrowing of beach areas and accelerate beach loss (Fletcher, et al. 2012). Similarly, rip rap, temporary sandbags and other methods of shoreline protection limit the public's ability to transit to and along the shoreline corridor. Global climate change projections and intensifying coastal hazards are likely to further narrow beach areas, increasing both the demand for shoreline armoring and corresponding conflict with the public's right to access the shoreline. In certain areas, the removal of hardened structures and development may allow for beaches to migrate inland as sea levels rise. The concept of managed retreat, also known as strategic realignment, is an emerging field of planning practice that assesses the potential to proactively mitigate probable losses to beach ecosystems, with the perpetuation of shoreline access as major consideration of project feasibility.

↳ The Ala Wai Canal is one of the largest water diversion projects in the islands, and enabled the transformation of wetlands and lo'i into the famous tourist district of Waikīkī.
Photo: PBR HAWAII & Associates

↳ Armored shorelines like the one seen here in Kailua-Kona, Hawai'i provide protection to walkways and roads but can create access limitations for shoreline users.
Photo: PBR HAWAII & Associates

The balance of local recreation and the tourism economy can result in resource use-conflicts in public access areas along the shoreline. Limitations to shoreline access impact traditional and customary rights, such as fishing and the gathering of limu, and 'opihi, *limpets*, (*Cellana sp.*).

As the number of shoreline users continues to grow, improving and acquiring access areas can mitigate impacts to resident and visitor experiences in beach areas. However, new access areas are generally slow to be acquired due to the high cost of property and limited availability of shoreline parcels. Some counties have protected public access by requiring private properties to provide transitways as a permit condition. A trend towards improving the accessibility of shoreline access areas has resulted in laudable efforts to digitally record the location, condition, and accessibility of accessways for users of all physical abilities, enforce the maintenance of permitted access easements, and acquire new accessways when they become available for purchase.

WHERE IS THE SHORELINE?

In Hawai'i, Hawai'i Revised Statutes §205A-1 defines the shoreline as: "the upper reaches of the wash of the waves, other than storm and seismic waves, at high tide during the season of the year in which the highest wash of the waves usually occurs, usually evidenced by the edge of vegetation growth, or the upper limit of debris left by the wash of the waves". The public has a right of access to, and transit along, the area seaward of the shoreline, which is defined as a beach transit corridor by Hawai'i Revised Statutes §115-5(a). Several authorities have shoreline access responsibilities in the state including creation, maintenance, and protection. Counties have the primary authority and duty to develop and maintain public access to and along the shorelines, per HRS §§ 46-6.5, 115-5 and 115-7. Shoreline access for Native Hawaiian traditional and customary gathering practices is guaranteed by law, HRS §§1-1, 7-1, and is protected by Hawai'i's Constitution, Article 12 §7. Public access rights do not exist on federal military lands, some of which extend to beach and shoreline areas. Military properties are governed by national homeland security laws and the Supremacy Clause in Article VI of the U.S. Constitution, both of which preempt state laws (OP-CZM 2014).

In 2017, the Hawai'i Attorney General issued a formal advisory opinion stating, "when the shoreline migrates [mauka] due to erosion or sea level rise, the dividing line between public and private ownership also migrates mauka" (Department of the Attorney General 2017).

Coastal Hazards, Sea Level Rise, and Coastal Erosion

Global climate change has led to a melting of glaciers and ice sheets and the thermal expansion of seawater. As a result, sea levels are rising. Sea level rise impacts coastal areas in many ways, including the high-tide inundation of low-lying areas, increasing frequency, severity, and duration of flooding, beach erosion, groundwater inundation (groundwater flooding above the surface), aquifer salinization (saltwater contamination of groundwater), changes to wave dynamics, loss of taxable real estate and infrastructure, and the displacement of coastal communities (Vitousek, et al. 2017). The rate of global mean sea level rise is accelerating, impacting coastal areas of the globe in different ways. Even under considerably ambitious cuts to climate emissions, sea levels are 'locked in' to rise between 0.95-1.94 feet (0.29-0.59 meters) in this century (Intergovernmental Panel on Climate Change (IPCC) 2019). The 2017 *Hawai'i Sea Level Rise Vulnerability and Adaptation Report* focused on the impacts of 3.2 feet of sea level rise, which is consistent with an 'intermediate' projection for 2100 (NOAA 2017). Projections indicate that approximately 3 feet of sea level rise could be expected as early as the 2060s and as much as 8.5 feet by 2100 is physically plausible in an 'extreme' scenario of greenhouse gas emission and ice melt. While there is still variability in the projections and rate of change, at nearly any rate sea level rise will significantly impact the State's infrastructure, natural resources, and economy over the coming decades, through this century, and beyond. A rise of 3.2 feet of sea level would render over 25,800 acres of land in the State unusable (permanently-chronically flooded), affecting over 6,500 structures and displacing more than 20,000 residents (Hawai'i Climate Change Mitigation and Adaptation Commission 2017).

The effects of sea level rise and coastal erosion are already impacting Hawaiian coasts. It was found

that 70% of beaches studied on Kaua'i, O'ahu, Maui, indicated a trend of long-term, chronic erosion (Fletcher, et al. 2012). A follow-up study predicted erosion of 92-96% of shorelines by 2050 and 2100 (Anderson, et al. 2015). Until recently, seawalls and other hardened shoreline structures were frequently constructed to protect coastal properties from land loss. However, a growing recognition of the negative repercussions of seawalls has resulted in increasing public and agency pressure to seek alternatives to coastal hardening. Statewide, coastal highways - which were historically constructed as shoreline-fringing 'ring' or 'belt' roads - are failing due to erosion and wave action. Transportation planners are currently considering the future of Hawaiian roadways, which will likely include a combination of hardening, relocation, elevation, and natural infrastructure approaches to mitigate the impact of increasing chronic and episodic coastal hazards.

The proximity of coastal development to the ocean has led to significant threats to life, safety, property, and the integrity of coastal ecosystems. O'ahu is recognized for perennial erosion problems, particularly in the North Shore region. Between October 2013-January 2014, significant portions of backyard areas, including decks, staircases, and swimming pools at Rocky Point were lost to the sea. In December of 2017, waves upwards of 40 feet (12 meters) caused extreme erosion at Sunset Beach. The resulting twenty-foot escarpment destroyed part of a bike path and threatened homes and public infrastructure. In West Maui, numerous multi-level condominium structures have become imminently threatened by seasonal coastal hazards. Storms, wave action, and erosion have led to the undermining of historic seawalls, an increase in the placement of temporary barriers (often left in place for many years, or indefinitely), and beach narrowing or loss. As mitigative options are discussed and lengthy

↳ A lifeguard station located in Waikīkī, the tourism center of O'ahu, is inundated on a king tide day in 2019.
Photo: PBR HAWAII & Associates

↳ Sandbags and geotextile cloth are used to protect homes from sandy shoreline erosion on O'ahu's North Shore.
Photo: Hawai'i Sea Grant

approvals processes are initiated, creative solutions are needed to mitigate present-day threats. A landmark decision by the County of Maui in 2014 permitted the construction of a temporary seawall, to be removed following the completion of a beach nourishment project. This decision reflects the challenging nature of balancing economic and environmental considerations, as well as the growing consensus that ubiquitous statewide shoreline hardening and beach loss is flatly unacceptable to Hawai'i's constituency.

In addition to chronic coastal hazards, the warmer waters and shifting circulation caused by global climate change may lead to increased frequency and strength of hurricanes and other extreme weather events. In 2015, the Pacific experienced its second-most active hurricane season on record. A record-breaking 15 named storms in the Central Pacific skirted Hawai'i's shorelines, boosted by warm waters and El Niño conditions. In August of 2015 alone, three Category 4 hurricanes were simultaneously active in the Central Pacific. In 2018, Hawai'i experienced a brush with 'rapid intensification', the modern phenomenon of hurricanes strengthening on unprecedented timescales as they move over warm waters with low wind shear. Though the storm's eyewall did not make direct landfall, Hurricane Lane dropped over 4 feet (1.2 meters) of rain on parts of eastern Hawai'i Island (National Weather Service 2018).

↳ King tides render the Maunalua Bay boat ramp inoperative.
Photo: Hawai'i Sea Grant

During the same hurricane season, Hurricane Walaka devastated East Island in Papahānaumokuākea Marine National Monument, an important habitat for the 'īlioholoikauaua, *Hawaiian monk seal (Neomonachus schauinslandi)* and honu.

For island destinations it has been found that dependency on beach tourism is a main driver of reduced resilience to natural disasters, attributed to unsustainable tourism practices and environmental degradation (i.e. incentives for construction adjacent to beach areas and in flood zones). Because tourism is Hawai'i's prime economic driver, consideration of built infrastructure critical to tourism's success, such as airports, coastal roads, ports, is important to both disaster management and adaptation to global climate change. The loss of natural infrastructure from global climate change could lead to devastating economic consequences for the State. It is estimated that without Waikīkī Beach, visitor revenue could decline annually by $2 billion (U.S. Global Change Research Program 2018).

Several glancing blows and near-misses during recent hurricane seasons have highlighted Hawai'i's at times disconcerting isolation and the corresponding need for increased emergency preparedness. Climate adaptation and resilience strategies present opportunities for integration with mitigative actions and long-term recovery planning frameworks. In the event of a catastrophic episode such as a tsunami or hurricane, rebuilding efforts must integrate global climate change and sea level rise considerations which, lacking in historic planning frameworks, have led to significant vulnerability of the built environment around Hawai'i's shorelines. Resources such as the *Guidance for Improving Disaster Recovery Preparedness in Hawai'i* (DLNR, Hawai'i Sea Grant, OP 2019) recommend initiating proactive planning efforts before disaster strikes in order to thoroughly account for community input and incorporate climate adaptation with recovery efforts.

SECTION 2: SOCIOECONOMIC PRESSURES: IMPACTS OF THE ECONOMY

Hawai'i's economic stability relies on commerce and hospitality, the transportation of goods, and national security operations. However, the externalities of these industries often burden the very systems they rely upon. Efforts to temper the pressures exerted by economic sectors on Hawai'i's natural environment encompass many logistical, financial, and ethical complexities. The State's main sources of revenue and employment—defense, tourism, and agriculture—have reduced the capacity of coastal resources to function and support sustainable socioeconomic development.

The United States military relies on the Hawaiian Islands as a strategic outpost, but historic mismanagement of resources has resulted in a loss of both operational capacity and community trust. Tourists visit Hawai'i to explore its natural bounty, but paradoxically degrade ecosystem health as a product of their visits. The passage of freight to, from, and around Hawai'i has connected the State with global trade networks, but unease has mounted about the State's inescapable isolation, presenting vulnerability both in times of bounty and catastrophe. Without intervention, these negative feedback loops will degrade the foundation of the State's economy as well as the resources that support its wellbeing.

DEFENSE

The Department of Defense is one of the nation's largest landowners. There are 142 military (Army, Navy, Air Force, and Marine Corps) sites in Hawai'i, totaling nearly 60,000 acres owned or licensed and permitted for use (DOD 2017). Defense spending in Hawai'i totaled $6.4 billion dollars in 2016 (DBEDT 2018a). As both an economic force and land manager, the presence of the military in Hawai'i is impactful and has many notable effects on coastal resources, both biological and cultural. Military policies can restrict public access to the shoreline at varying levels for national security, public safety, military recreation, and the protection of certain species. Persistent concerns regarding uranium contamination, unexploded ordnance, compromised habitat integrity, and access to cultural and gathering sites exist on military lands. Three of Hawai'i's four Environmental Protection Agency (EPA) Superfund sites are former and active military areas with soil, sediment, and groundwater contamination by metals, organic compounds, and fuel from industrial operations and site activities. In 2019, the Hawai'i Supreme Court found that the State has a duty to manage all ceded lands, including land leased for military operations. The court ruling prohibits new leases of certain areas until they are found to be compliant with original lease terms, including removal of ammunition and remediation of natural resources.

Department of Defense lands are home to a large number of endangered and threatened Hawaiian taxa. More than a third of all species with U.S. Endangered Species Act status which are found on military lands are Hawaiian species (Stein, Scott and Benton 2008). As a result, the military has a profound duty and opportunity to steward the State's natural resources. All military installations are required to institute wildlife, fish, and game conservation through the creation and implementation of an integrated natural resource management plan (105th Congress 1997). The Department of Defense's Readiness and Environmental Protection Integration Program is used to reduce land-use conflicts and encroachment of incompatible uses near military instillations. While not focused on mitigating environmental issues, the program's land acquisitions often result in benefits to local communities, such as increased recreational and open spaces, as well as habitat acquisition and preservation.

Between 2013 and the present, military environmental programs have elevated their efforts to conserve the State's imperiled species and their habitats as well as cultural resources on Department of Defense lands. The O'ahu Army Natural Resource Program oversees compliance with Federal environmental laws and has implemented ecosystem management programming. The program engages with local communities through volunteer opportunities and publishes educational materials about research and restoration efforts. Recently, the program documented discoveries on and adjacent to military lands including newly discovered petroglyphs along the Wai'anae shoreline and the first active Band-rumped Storm Petrel (*Oceanodroma*

castro) nest in the Hawaiian Islands. The Air Force has employed alternative energy technologies like hydrogen fuel cells to employ cleaner methods while supporting mission requirements. The U.S. Navy has partnered with local experts to reintroduce native shellfish species to improve water quality in the Pearl Harbor estuary following a successful DLNR-DAR feasibility study. The Navy is also a partner in the relocation of Laysan Albatross from airfield areas of the Pacific Missile Range Facility, Barking Sands, on Kaua'i to O'ahu's James Campbell National Wildlife Refuge. Service personnel have become active and valued partners in the voluntary maintenance of streams, removal of invasive vegetation, removal of debris from beaches, and the restoration of ancient Hawaiian fishponds located on or near military lands.

TOURISM

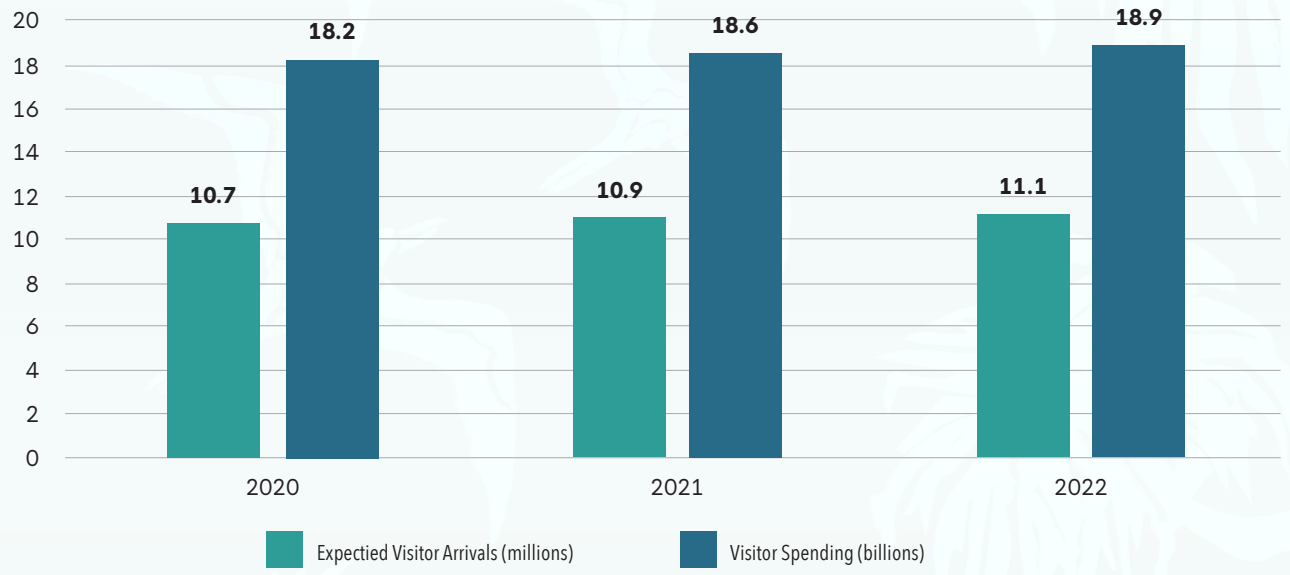
While tourism is a vital economic component of many Pacific islands, sustainable development and adaptive management are necessary to prevent environmental degradation and to perpetuate cultural practices in an appropriate manner. In 2018, Hawai'i hosted over 9.9 million visitors, spending $17.8 billion dollars during their travels and supporting 217,000 tourist industry jobs statewide (Hawai'i Tourism Authority 2019). No single entity is responsible for managing the impacts of tourism on Hawai'i's natural and cultural resources.

Over 80% of Hawai'i's visitors take part in marine activities, grossing approximately $800 million dollars for the marine tourism industry annually (Friedlander, et al. 2019). Though often unintentional, ocean-users may impact natural resources through illegal or harmful practices, such as trampling coral and following marine life (Wiener, Needham, & Wilkinson 2009). Feeding or chasing turtles, manta rays, sharks, and dolphins may promote increased reliance on human interactions or change species behavior. Commercial and recreational ocean activities can cause overcrowding and site congestion, reducing the effectiveness of designations such as Marine Protected Areas as well as tourist satisfaction with their experience in a natural area. A 2017 survey of tourists in the Molokini Marine Life Conservation District (MLCD) found that 67% of users reported feeling overcrowded (Filous, et al. 2017). With targeted outreach and regulation of recreational practices, experiences in the ocean can help participants to develop an ethic for natural conservation and encourage environmentally-responsible behavior (Wiener, Manset and Lemus 2016).

Concerns about the commodification of Hawaiian cultural identity in the tourist industry are prevalent. Historically, the branding of Hawaiian heritage has lacked accuracy and nuance, missing the opportunities to educate tourists and perpetuate authentic Hawaiian cultural practices. Land uses associated with tourism such as resort districts and golf courses can limit access to or destroy culturally significant sites, impact the productivity of gathering areas on the coastline, and damage water quality. Often located on the kona, *leeward*, side of islands for their dry climate, resort areas virtually guarantee sunny weather for vacationers. However, these zones require high water use for irrigation, amenities, and landscaping. Drought is more likely to threaten such areas, and fire has already become a persistent threat in some leeward areas, particularly on the island of Maui.

↳ Waikīkī, in addition to its designation as a MLCD also serves as one of the most well-known and heavily trafficked tourist destinations in the islands.
Photo: Channey via Unsplash

2020-2022 Tourism + Spending Forecast (Data Source: DBEDT)



While tourism is a critical component of Hawai'i's economy, the local perception of tourists has steadily fallen in recent years. According to the Hawai'i Tourism Authority Resident Sentiment Survey, the majority (66%) of Hawai'i's residents that feel that tourism is being run at the expense of local people (Hawai'i Tourism Authority 2019). Residents have expressed frustration toward short-term rentals in residential areas, increasing traffic, and visitor conduct. The increased usage of social media has motivated tourists to leave resort areas and seek unique experiences, leading to crowding, trespassing, and safety concerns. On State lands with conservation and cultural significance, such as the closed areas of Sacred Falls State Park on O'ahu and Kohala Forest Reserve on Hawai'i Island, resources must be expended to enforce access restrictions. Enforcement activity diverts funding that could otherwise be used on restoration and enhancement.

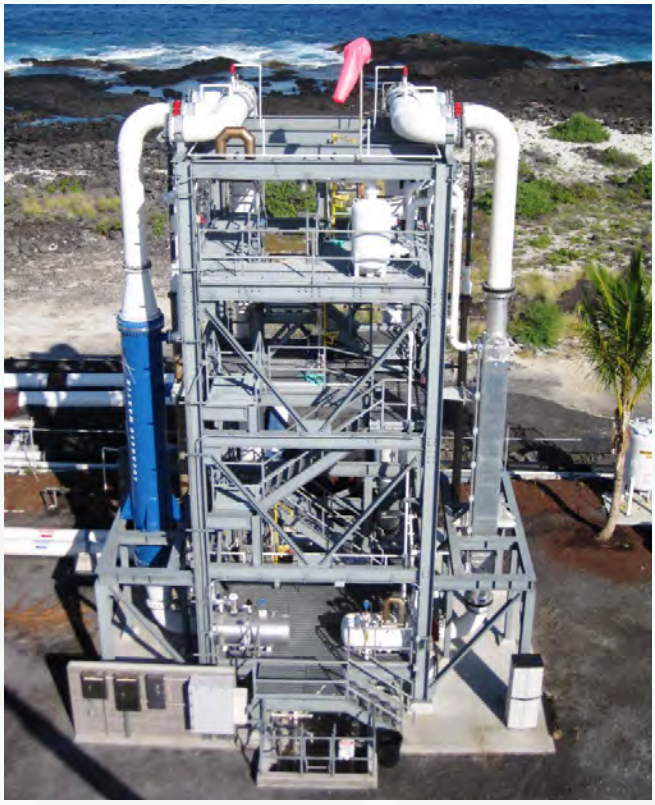
Recent efforts have been made to mitigate the impacts of tourist activities. The County of Maui prohibited commercial activity in parks on Sundays and holidays to reduce use impacts and enhance resident experiences on public lands. Information about the social, economic, and environmental effects of tourism were gathered in a survey to Kailua, O'ahu residents in an effort to identify visitor management strategies. Kaua'i has implemented a unique strategy to curb overcrowding, including increased fines and parking restrictions, a reservation system to access Hā'ena State Park, and a North Shore shuttle run by non-profit entities to reduce vehicle traffic on roadways. Statewide, restrictions have been considered to counter the proliferation of unpermitted vacation rental units in areas zoned for residential use. While incipient, these efforts may represent a sea of change in the way the State manages the tourist industry.

ENERGY

The impacts of non-renewable resources and reliance on their diminishing availability endangers Hawai'i's economic and environmental future. At present, Hawai'i's reliance on petroleum for a large part of its energy portfolio perpetuates a high cost of living for Hawai'i residents with electricity prices nearly triple the United States average (DBEDT-HSEO 2019). In addition to high electrical bills for the average Hawai'i household, Hawai'i's high energy and fuel costs are also passed onto consumers through every industrial, municipal, and commercial enterprise that uses energy to provide its services.

Hawai'i uses more petroleum for electricity than any other state. In 2018, Hawai'i used petroleum to produce 61.3% of its electricity and coal to produce 11.9% of its energy; in the U.S. as a whole, only 0.6% of electricity was generated using petroleum (DBEDT-HSEO 2019). The unpredictable fluctuation of petroleum pricing on the open global market makes Hawai'i's dependence a significant socioeconomic risk. In addition, Hawai'i's reliance on imported fuel for energy makes the State particularly vulnerable to manmade or natural disruptions to shipping. Hawai'i stakeholders view renewable energy and energy efficiency measures as primary mechanisms to stabilize, control, and ultimately lower electricity costs in the long run.

The Hawai'i Clean Energy Initiative (HCEI) has helped to guide energy activity in Hawai'i since 2008. There are several components to the HCEI, including the energy efficiency portfolio standards (HRS § 269-96) that mandate a 4,300-gigawatt-hour reduction in electricity use by 2030 and the renewable portfolio standards (HRS § 269-92) that mandate 100% renewable energy in the electricity sector by 2045. The initiative also includes a goal to reduce petroleum use in Hawai'i transportation sector (ground, marine, and air), which in 2017 accounted for 62.7% of Hawai'i's petroleum use; more than twice as much as the 24.5% used to generate electric power. In 2018, Act 15 (HRS § 225P-5) established a target of a zero emissions clean economy by 2045. Supplementing reduction in energy consumption from efficiency technologies such as solar water heating, low energy lighting, and energy-efficient building practices, Hawai'i's island power grids utilize the alternative technologies of solar photovoltaic (distributed rooftop and utility-scale), hydropower, geothermal, biomass including waste-to-energy, biofuels, and wind energy.



↳ Hawai'i's Ocean Science and Technology Park (HOST) is administered by the Natural Energy Laboratory Hawai'i Authority (NELHA) and features the world's largest operational Ocean Thermal Energy Conversion (OTEC) power plant.
Photo: HOST/NELHA

Hawai'i is uniquely positioned to explore alternative energy from ocean sources. The waves around Hawai'i offer the potential for a clean and constant source of energy for the State. Although ocean energy technologies are being tested in Hawai'i, it does not currently supply electricity to any Hawai'i power grids (DBEDT-HSEO 2019). Wave energy conversion (WEC) devices are currently being tested off the windward coast of O'ahu at the Kāne'ohe Marine Corps Base Hawai'i. Another ocean energy technology uses the temperature difference in warm surface waters and cold, deep ocean waters to generate electricity through a process called Ocean Thermal Energy Conversion (OTEC). The technical feasibility of WEC and OTEC have been proven at demonstration scale in Hawai'i, however, costs have thus far been prohibitive to scalability. Extensive federal, state, and county permitting requirements can require 5-years or more for the processing and approval of commercial projects, further limiting the feasibility of new ocean energy projects (Hawai'i National Marine Renewable Energy Center 2019). Other innovative ideas include the use of limu to produce energy, sequester carbon, create biofuel, and even mitigate ocean acidification. Ongoing private industry trials in West Hawai'i are exploring and field-testing some of these possibilities. Offshore wind could also be a viable renewable energy technology for Hawai'i and has been included in utility

plans as a means to reach 100% renewable energy on the island of O'ahu. In 2012, the U.S. Bureau of Ocean Energy Management (BOEM) established the BOEM/Hawai'i Intergovernmental Renewable Energy Task Force to promote planning and coordination, and to facilitate effective and efficient review of requests for commercial and research leases and right-of-way grants for power cables on the Federal outer continental shelf (OCS), including offshore wind. Members of the Task Force include representatives of federal, state and local government agencies, and offices who regularly engage with members of the Native Hawaiian community. Ocean technologies such as seawater air conditioning are currently in limited use and offer a renewable alternative to conventional air conditioning systems.

Large alternative energy projects can impact human health, protected species and environments, water, air, and land resources, archaeological resources, cultural resources, civil activities, and social behaviors. Intensive due diligence, transparent outreach, and mitigation are needed to ensure a sustainable transition to clean energy. Thus, though renewable technologies are necessary to attain Hawai'i's statutorily-mandated sustainable energy future, many concerns and uncertainties endure over the preferred application, placement, and process for establishing a 100% renewable energy portfolio in the State.

FREIGHT: BY LAND AND SEA

Almost 350,000 people in Hawai'i are employed in freight-related sectors, accounting for nearly 40% of the State's total population (DOT-Highways 2018). Freight-related sectors include (in order of economic output): accommodation and food service, retail trade, construction, transportation and warehousing, wholesale trade, manufacturing, agriculture and fishing, and mining/quarrying/oil and gas construction. Hawai'i's top four export industries (in terms of expenditures) are visitors, defense, and agriculture (DOT-Highways 2018)). Just as each of these industries have a social and environmental cost associated with their respective economic gains, the movement of

↳ Honolulu Harbor and the mouth of Kapālama Stream. Of the goods that are imported from out of state, 98% arrive by sea.
Photo: Office of Planning

goods as freight puts pressure on terrestrial, coastal, and ocean resources.

Approximately 80% of all goods consumed in Hawai'i are imported from out of state, and of those, 98% arrive by sea (DOT-Highways 2018)). From 2013-2017, Hawai'i's total cargo tonnage increased by 1,150,000 short tons, or 2.3 billion pounds (1 short ton=2,000 pounds) (Moody's Investors Service 2018). Hawai'i's reliance on the shipping industry to import goods from domestic and international ports substantially increases the risks of exposure to aquatic alien species in local waters. The importation of liquid fossil fuel and its transport amongst the Hawaiian Islands poses a low-probability yet high-risk threat of unintentional releases directly into Hawai'i's marine environments. Weather can jeopardize the movement of essential goods to and between Hawaiian communities, with mandatory port closures in poor weather conditions. Port infrastructure is vulnerable to tsunamis and hurricanes and is critical to the movement of recovery supplies and personnel responding to such events. Hawai'i's harbors are also vulnerable to changing sea levels. Unlike other forms of development, ports cannot retreat from rising waters but must instead adapt to function in future conditions.

Hawai'i relies on the freight sector not only to bring goods to the State, but to efficiently move food and products between islands and on land. Because the Hawaiian Islands were formed by volcanos and feature elevated topography in their interiors, most of the State's roadway infrastructure has been constructed as coastal roadways in flat, eroded shoreline areas. Roadway construction in these areas has fragmented coastal habitat areas, including beaches and wetlands, and exposed infrastructure to coastal hazards. In the short-term, roadway vulnerability to wave-action can cause nuisance traffic and roadway closures, however, long-term trends of sea level rise and increasingly powerful coastal hazards threaten the very integrity of the roadways themselves. Recent events, including landslides, wave run-up, flash flooding, river course changes, and partial collapse have challenged Hawaiian roadways, with the freight industry, visitors, and residents alike feeling the consequences. Chronic coastal hazards plague the Honoapi'ilani Highway in Mōpua, Maui as well as Kamehameha Highway in the areas of Hau'ula and Ka'a'awa on O'ahu. These coastal highways were identified as the top three priority roadway areas in the State requiring active management (DOT-Highways 2019). Without viable roadways in these areas, major economic centers would be isolated, effectively halting the movement of land-based freight.

SECTION 3: OCEAN AND NEARSHORE PRESSURES: TROUBLE BELOW THE SURFACE

OCEAN AND NEARSHORE PRESSURES

All of Hawai'i's ecosystems are irreplaceable, however none may be as cherished or definitive of place as the State's nearshore and ocean resources. With so many activities occurring terrestrially, it is conceivable to overlook that change is also constantly occurring beneath the water's surface. Over time, global, regional, and local forces have altered Hawai'i's marine ecosystems. Incremental changes have shifted the baseline of what we consider healthy in the transitional spaces that connect land and sea. While actively under study, the probable extent of these changes is thus far unknown; their drivers are continually materializing, escalating, and evolving. The common thread connecting the chronic pressures faced by Hawai'i's ocean and nearshore resources is degrative human activities, the solutions to which, both simply and quite complexly, lie within our grasp.

MARINE DEBRIS

Marine debris is any persistent, manufactured or processed solid material disposed of or abandoned into the marine environment (NOAA National Ocean Service 2018b). Marine debris is known to accumulate in subtropical convergence zones worldwide, resulting in what are now called "garbage-patch" gyres (Law, et al. 2014). Plastics, composed of moldable synthetic polymer, have become popularized for their many uses, including packaging, household items, polyester clothing fibers, and fishing nets. Today, plastics are a ubiquitous component of modern life and represent the majority of global marine debris.

The impact of marine debris on wildlife is unprecendented and severe. Entanglement, ingestion, and suffocation are common threats to many bird, fish, and marine mammal species. Discarded fishing nets, known as ghost nets, can settle on and destroy coral reefs. Alien species transport, vessel damage, navigational hazards, bycatch, aesthetic degradation of shorelines, and habitat damage are among the economic repercussions of marine debris (NOAA-MDP 2019).

↳ Honu (*Chelonia mydas*) entangled in a gill-net. Derelict nets, ropes, line or other fishing gear, and a variety of marine debris can entangle or be ingested by marine life. Marine debris can also smother important marine habitats and carry alien species hundreds of miles.
Photo: NOAA Marine Debris Program

Between 2011 and 2013, Kaua'i, Maui, and Hawai'i Islands adopted ordinances to regulate the use of single-use plastic bags. The City and County of Honolulu joined them in 2015, effectively banning single-use plastic bags statewide (National Conference of State Legislatures 2019). In 2019 the City and County of Honolulu successfully passed Bill 40, a ban on the use of plastic straws and utensils and polystyrene foam to take effect between 2021-2022 (Honolulu City Council 2019).

Local efforts to change social behaviors around plastic consumption and reduce land-based plastic pollutants are undoubtedly important. However, Hawai'i's geographic position makes it especially vulnerable to the impacts of plastic consumption and use around the Pacific Rim. Windward beaches collect 1-2 orders of magnitude more plastic pollution than leeward beaches, despite reciprocal population concentrations. A recent study found that leeward beaches collected debris from local inputs and maritime activities, which are more readily controllable by the efforts of residents and tourists alike. Leeward debris included 'whole' items with greater density (i.e. sunglasses, dive masks, fishing gear), indicating minimal exposure to environmental conditions and prolonged sunlight. Debris on windward beaches was highly weathered and buoyant, indicating longer residence time in the ocean and foreign debris origin. Interestingly, coastal development density was negatively correlated with debris quantities observed, meaning the abundance of debris collected increased with distance from population centers. This finding further suggests that the main Hawaiian Islands receive an abundance of marine debris from non-local sources (Brignac, et al. 2019). Papahānaumokuākea Marine National Monument, which protects the uninhabited Northwestern Hawaiian Islands, is more than a thousand miles (over 1,600 km) from any city but receives over 50 tons of marine debris on its shores annually (Papahānaumokuākea Marine National Monument 2019).

Technological innovation has begun to take on the issue of marine debris in the Pacific. Hawai'i's 'Nets to Energy' program converts marine debris into electricity by collecting derelict fishing nets and burning the debris, producing steam and driving a turbine to create energy. While this program is well-suited to Hawai'i's geographic isolation and limited waste management and recycling resources, the economic and environmental sustainability of burning plastic and other debris as an energy source is up for debate. In 2019, a device was deployed between Hawai'i and California to collect plastic pollution from the Eastern North Pacific Gyre, also known as the Great Pacific Garbage Patch. Efforts to collect existing marine debris must be combined with aggressive public campaigns to stop consuming plastic products in order to derive a global, long-term solution to the pervasive issue of marine debris.

MARINE SPECIES LOSS

Each species plays an ecological role that contributes to a functioning ecosystem. Loss of keystone species (i.e. phytoplankton and zooplankton) or apex predators (i.e. sharks, tuna) can change the structure and hierarchy of food webs and ecological networks (Evans, et al. 2016). Animal sightings are a driver of ecotourism in Hawai'i, with whale watching and dolphin tours a popular activity for visitors on many Hawaiian Islands. Species loss threatens not only ecosystem and economic integrity, but also the perpetuation of Native Hawaiian traditions. Hawaiian native and endemic species from land and sea have cultural significance as 'aumākua, *the ancestral embodiment of animals such as sharks, turtles, owls, and whales.* 'Aumākua appear in dreams and visions, providing guidance and a connection between the physical and spiritual worlds. Native species are present in Hawaiian legends, place names, and petroglyphs (carvings in stone). Restrictions, protocol, and expertise guided the select harvesting of native plants and animals for use in adornments, canoe construction, and medicine. 'Ahu'ula, *cloaks*, mahiole, *helmets*, and nā lei hulu, *lei*, were created out of native bird feathers and worn as a symbol of status.

Koholā, the *humpback whale* (*Megaptera novaeangliae*), a federal and state protected species of ecological and cultural significance. The koholā utilizes warm waters around Hawai'i as its wintering ground where they mate, give birth, and raise their calves. Observations of humpback whales naturally fluctuate; however, scientists observed a significant

reduction in sightings between 2014 and 2017 (Weinberg 2018). While it is too early to gauge the scale of these changes, warming waters, marine debris entanglements, declining food sources, disease, and increased competition all may have some impacts on the distribution and numbers of humpback whales. As global conditions change, the carrying capacity of the ocean will likely shift in tandem. Species like humpback whales may experience population decline or behavioral shifts (i.e. vocalizing less, migrating at different times, remaining further offshore) which may make their migratory behavior and population status more difficult to ascertain.

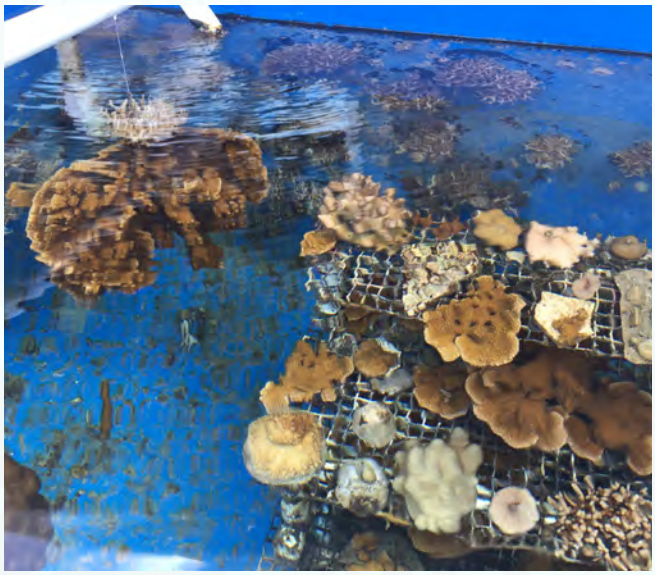
↳ Before a moratorium on commercial whaling in 1985, all populations of humpback whales were greatly reduced. The species is increasing in abundance in much of its range, but faces threats from entanglement in fishing gear, vessel strikes, vessel-based harassment, underwater noise, and habitat impacts.
Photo: NOAA-NMS

While some endangered species are iconic and well-known, such as Hawaiian monk seal, many humble yet important species still need to be considered by management plans. All native terrestrial animals, endemic aquatic animals, and endemic algae as well as various indigenous aquatic animals and native plants have been identified as 'Hawai'i's Species of Greatest Conservation Need', indicating the staggeringly comprehensive nature of threats to Hawai'i's unique flora and fauna (DLNR 2015b). Species that inhabit shoreline areas are particularly vulnerable to global climate change and rising sea levels. Freshwater wetland and estuarine waterbirds such as the 'Alae ke'oke'o, *Hawaiian Coot*, (*Fulica alai*), Ae'o, *Hawaiian Stilt*, (*Himantopus mexicanus knudseni*), and the 'Alae 'ula, *Hawaiian Gallinule*, (*Gallinula galeata sandvicensis*) are 'conservation reliant' species that require management intervention to sustain them (Underwood, Silbernagle, Nishimoto, and Uyehara 2013). Populations of the Black-footed Albatross (*Phoebastria nigripes*) have begun to be relocated from their colonies on Midway Atoll to the North Shore of O'ahu in order to safeguard the species from the future threat of sea level rise and current threats of ocean debris, long-line fishing practices, and non-native species predation.

Coral reefs protect coastlines from storms, flooding, and erosion, produce carbonate sediment (sand), and attract millions of spectators each year to the Hawaiian Islands. Numerous studies have found that the majority of the world's coral reefs are under immediate threat from local stressors, including overfishing, sediment and nutrient runoff, competition with macroalgae, declining herbivorous fish populations, damage from recreational use, disease, bleaching from high sea temperatures, and aquatic alien species. These stressors threaten the coral animal and its symbiotic algae zooxanthellae, as well as the habitat that coral reefs provide for other species. As Hawai'i's corals are repeatedly damaged by bleaching events and crippled in their recovery by other pressures, shorelines will face reduced protection from storms and wave action. A decline in reef health will also lead to increased effort and decreased yield from fishing and gathering practices. Tourism expenditures may also decline as coral reef health deteriorates.

As environmental conditions place immense pressure on reef habitats, coral restoration work is underway in Hawai'i to preserve these valuable and unique ecosystems. 'Super corals' have been identified in O'ahu's Kāne'ohe Bay with a high tolerance for warm and acidic waters, which may be representative of wider ocean conditions in the near future. Research in thermal acclimatization to expedite coral evolution to warmer sea temperatures is ongoing. Coral restoration nurseries are innovating to speed up the process of native Hawaiian coral growth, some of the slowest growing coral species in the world. Successfully

transplanted corals represent a pioneering proof of concept that combines timeless natural resources with the latest technological advancements. Hawai'i is a global leader in reef science, an effort that highlights the immense value of reefs to the State's environment, economy, and wellbeing. Legislative interventions have also been attempted to reduce pressure on corals. In 2018, Hawai'i was the first place in the world to ban sunscreen products which have been found to harm the marine environment. The ban on the sale of sunscreens containing oxybenzone or octinoxate begins January 1, 2021 (State of Hawai'i 2018a).



↳ The DLNR-DAR Coral Restoration Nursery located on Sand Island, O'ahu grows indigenous corals in an ex-site environment for later outplanting to restore habitat where it is most needed.
Photo: Office of Planning

AQUATIC ALIEN SPECIES

Aquatic alien species are non-indigenous species that have the potential to harm environmental and human health as well as the economy. Invaded aquatic habitats frequently exhibit increased turbidity and nutrient concentrations, impacting the ability of native species to occupy them (Gallardo, et al. 2016). Aquatic alien species can often outcompete native and endemic species, which vie for the same resources. These invaders are usually successful due to a lack of natural predators, their ability to rapidly reproduce and take over habitat areas, and their ability fight off diseases. These advantages effectively evade the 'checks and balances' of an ecosystem. Many aquatic plants and invertebrates reproduce asexually, either through fragmentation or resting eggs and seeds (Havel, et al. 2015). Thus, a single organism can produce an entire population, thereby inducing irreparable ecosystem phase-shifts, not only affecting the natural environment, but also commercial industries (i.e.: fisheries, aquaculture, tourism) that rely on the ecological stability of that environment. Other defining characteristics of aquatic alien species include a high reproductive output, generalist feeding strategies, and broad environmental tolerance (Havel, et al. 2015). Aquatic alien species have been introduced to Hawai'i through intentional stocking, accidental releases, and 'hitchhiking' on vessels and marine debris. Alien species may also undergo dispersal through natural vectors, such as currents, tides, and storms.

While a handful of invasive species were intentionally introduced in Hawai'i for aquaculture, other alien algae species were unintentionally introduced and propagated to neighboring islands as stowaways on vessels either through ballast water, tanks of water used to stabilize ships, or biofouling, species attached to the submerged ship hull (Smith, Hunter and Smith 2002). Ballast water and vessel biofouling are the top two pathways of marine non-indigenous species introductions, exceeding aquaculture, marine debris, and the pet aquarium trade, and associated with nearly 80% of over 300 alien marine species currently established in the State (Davidson, Ruiz and Gorgula 2014). A significant research gap exists in understanding the impacts of invaders in tropical waters. A forty-year review of research papers on aquatic invasion found that only 1% of studies focused on coral reefs (Thomsen, et al. 2014). In Hawai'i, aquatic alien species threaten reef ecosystems, estuaries, anchialine ponds, intertidal habitats, beaches and freshwater systems.

Historical introduction of non-natives for baitfish and aquatic vegetation control have led species like black chin tilapia (*Sarotherodon melanotheron*), native to coastal west Africa, to take up residence in the Hawaiian Islands since the 1960's. In 2019, tilapia were spotted in Nu'alolo Bay on the Nāpali

↳ Divers survey for biofouling on a ship's hull. Biofouling, the attachment of organisms to wetted areas of a ship or boat, is the most common way that alien marine algae and invertebrate species have invaded the Hawaiian Islands.
Photo: DLNR-DAR

↳ Alien Stinging hydroids *(Pennaria disticha)* growing on the hull of a boat. The introduction of the hydroid and prickly seaweed *(Acanthophora spicifera)* in Hawaiian harbors are attributed to biofouling and ballast water (Eldridge 2009).
Photo: DLNR-DAR

Coast of Kaua'i. The fish are presumed to have moved through irrigation canals in West Kaua'i and traveled into the ocean during rain events, emphasizing the importance of land-sea networks in the management of Hawai'i's alien species. Tilapia are highly invasive and adaptive—they can survive in salt, brackish, and freshwater environments and can hybridize, making them difficult to identify. Tilapia and other aquatic invaders are one of many threats to the unique habitats and endemic inhabitants of Hawai'i's anchialine ponds. Over 90% of anchialine ponds on Hawai'i's Kona coast contain non-native species.

Prevention and early detection are essential in the control of aquatic alien species, however their detection can be more difficult than terrestrial invaders due to challenging nature of consistent monitoring below the water's surface (Moorhouse and Macdonald 2015). Presently, the DLNR "lack[s]...authority to regulate invasive organisms attached to ship hulls". As one of two top vectors for marine introductions, this lack of authority severely inhibits the State's prevention of marine alien species introduction (HDOA 2017). Once an invasive species becomes established it can become difficult to manage and nearly impossible to eradicate. With current budgetary and staffing allocations, the DLNR "lack(s) capacity to detect and control invasive algae, weeds, and predators in our waters and forests" (HDOA 2017).

OCEAN WARMING AND ACIDIFICATION

Carbon emissions from anthropogenic sources are responsible for global climate change, which has caused warming and acidification of the world's oceans.

Ocean Warming

Over 90% of the warming that has occurred on Earth in the last 50 years has occurred in the ocean (Dahlman and Lindsey 2018). In addition to generalized warming, marine heat waves are increasing in frequency, duration, and intensity. Impacts related to ocean heatwaves have included algal blooms, the stranding of young and changes in feeding behaviors by marine mammals, and declining fisheries catch. While ocean warming is known to lead to coral bleaching, an event from which corals may recover, the intensity of marine heatwaves has been shown to cause immediate heat-

induced coral mortality and colony collapse (Leggat, et al. 2019).

Global climate change is expected to increase coral reef damage by eroding baseline conditions for health and creating higher intensity storms with shorter intervals for recovery between events (Cheal, et al. 2017). Under current climate change projections, coral reef ecosystems may be lost entirely sometime in the next century unless unprecedented changes to human behavior are made. Under lower greenhouse gas concentration scenarios, high-latitude reefs including Hawai'i and the Northwestern Hawaiian Islands could live decades longer than equatorial reefs before annual severe bleaching transpires. However, in a 'business as usual' emissions scenario the temporary refugia of latitude will provide far less relief to Hawai'i's coral. With carbon emissions rising throughout the 21st Century, global reefs are projected to face severe annual bleaching by 2050 (Van Hooidonk, et al. 2016).

From 2014-2016, species in Hawaiian waters experienced unprecedented thermal stress due to the warming of the global ocean, an El Niño cycle, and a concurrent Pacific Basin heatwave. The alignment of these conditions resulted in large-scale coral bleaching recorded two years in a row, a first in Hawaiian waters. On the west side of Hawai'i Island, 60% of coral reefs experienced bleaching. Approximately 50% of corals in the West Hawai'i region perished, with some reef areas experiencing up to 90% mortality (Associated Press 2019, DLNR-DAR 2017).

Ocean Acidification

Increasing concentrations of carbon dioxide in the Earth's atmosphere have been absorbed by the ocean, the world's largest 'carbon sink'. The dissolution of carbon dioxide in the ocean sets off a chain of chemical reactions that cause seawater to become more acidic and decreases the abundance of carbonate ions. This change in seawater chemical composition directly impacts organisms that use carbonate ions as building blocks to form their calcium carbonate shells and skeletons (i.e. barnacles, mussels, corals, calcifying plankton) and affects the structure and function of local marine ecosystems (including coral reefs, kelp forests, and sea grass meadows). In Hawai'i, culturally significant calcifying species are at risk of acidification and are already experiencing population decline from fishing pressure and habitat modifications. The extent of impacts on nearshore species important to subsistence, including 'opihi (*Cellana sp.*), native Hawaiian oysters (*Dendostrea sandcivensis*), urchins, octopus, squid, and lobsters are currently unknown. Hawai'i's coral reefs will be impacted by acidification through decreases in coral growth rates, the reduction of substrate available for larval coral settlement, and erosion of existing calcium carbonate structures. Other calcifying species, including Halimeda spp., a calcareous green macroalgae that contributes to the production of sand and marine sediment, are considered especially vulnerable to acidification. The loss of nursery habitat, recreational spaces, sand-producing organisms, and shoreline protecting species may have far reaching environmental, social, and economic implications.

If carbon emissions are dramatically curbed, significant acidification of the oceans may be avoided (IPCC 2019). Though global carbon emissions are difficult for a single state, or even nation, to influence, there are management considerations that can mitigate the localized impacts of ocean acidification. Eutrophication, the nutrient-loading of water from fertilizer, stormwater, treated wastewater, septic and cesspool systems, livestock, and terrestrial erosion, may increase the susceptibility of coastal waters to ocean acidification (Kelly and Stoutenburg 2012). A combination of ecological restoration and improvements to stormwater management are critical to minimizing the impacts of ocean acidification in Hawai'i's nearshore aquatic habitats. The combination of ocean acidification and warming waters may reduce the capacity of the global oceans to absorb further carbon dioxide, amplifying the effects of increasing carbon in the world's atmosphere. Both ocean acidification and warming waters can be locally mitigated by adhering to best management practices, both on land and in the water, to reduce the numerous pressures on nearshore habitats and increase their capacity to combat global stressors.

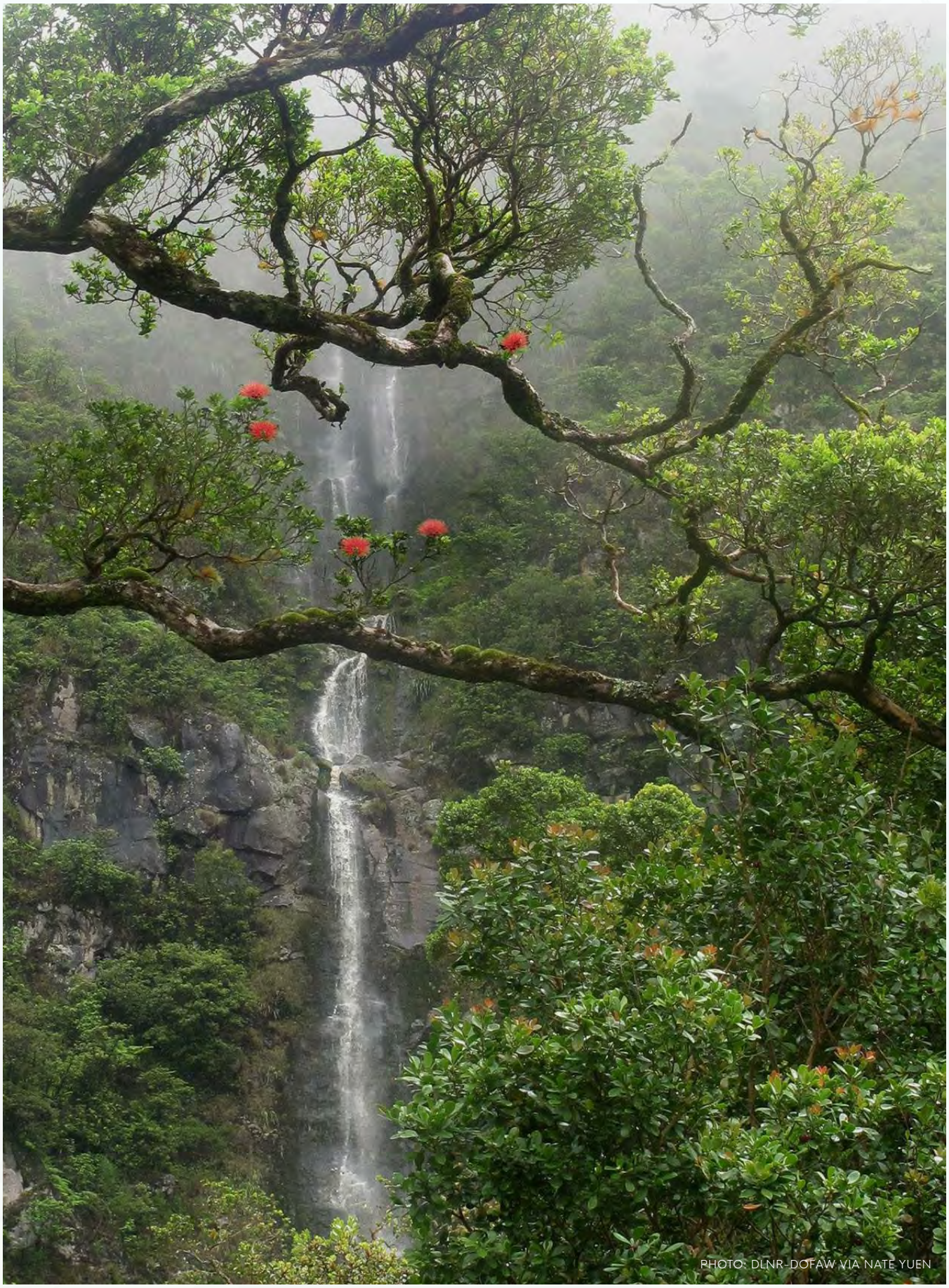


PHOTO: DLNR-DOFAW VIA NATE YUEN

CLOSING REMARKS

The Ocean Resources Management Plan is one component within the complex management framework for Hawai'i's land use and environmental management system. It is the continued vision that a collaborative approach to addressing the identified Focus Areas within this Plan will result in tangible outcomes for the betterment of the State, as enabled by the Hawai'i Coastal Zone Management law.

The ORMP will continue to work towards addressing the challenges chronically affecting Hawai'i's natural resources and evolve with the emergence of new issues and information, including climate change science. The CZM Program looks to the ORMP not only as a plan document, but as a vehicle to convene entities towards a common goal and to implement activities that will strengthen and improve upon the CZM network's policies.

The 2020 ORMP addresses a longstanding desire from agency participants to improve upon the State's incorporation of traditional ecological knowledge in decision-making and planning processes. We are grateful to those practitioners who contributed their experience, perspectives, and mana'o, thoughts, towards informing this process. It is recognized that within the historical context of Hawai'i's host culture, this Plan and its intentions are but a small piece within a much longer story—one that existed prior to the establishment of the State of Hawai'i, land use laws, the CZM Program, and the ORMP—and continues to this day. Therefore, the conversation should **reflect** the Plan's **respect** towards, and **reverence** to, Hawaiian culture by focusing on how the ORMP may serve a function within this robust living history of indigenous knowledge, rather than the initial effort to include traditional ecological knowledge into the ORMP. Both the practitioners and the CZM Program acknowledge that many of these issues are systemic and cannot be resolved within one Plan, however specific concepts and principles were identified as potential actions that government agencies can incorporate into their practices to build stronger relationships and trustworthiness with the public.

These concepts and principles were echoed in the comments from the eight (8) public listening sessions conducted for this update, whereby communities were wary of government agency practices that seek public feedback but lack mechanisms to share with contributors, either through compensation, knowledge or resource exchange, or consistent updates on the status of a project or initiative. This lack of **reciprocity** continues to foster distrust. Indeed, the primary output for the status of the 2013 Ocean Resources Management Plan's implementation is located online and there has been little in-person follow-up with the public that contributed to the 2013 plan update process. In implementing the 2020 Plan actions, the ORMP will strive to acknowledge these gaps and seek ways to address the resounding themes contributed by practitioners and community members during the ORMP update process, beginning with the dedication of resources for improved outreach and feedback loops.

Likewise, this updated iteration of the ORMP has placed an emphasis on building and strengthening **relationships**. Often, practitioners, community members, and agency personnel are informed by their kinship with and affection for their 'place', or home. Place-based information does not always directly translate to the creation or amendment of policy; however, the collective voice of communities can draw attention to and elevate issues of statewide concern. The spatial mismatch between local knowledge and statewide action requires **reflexivity**. Place-based information is critical to the identification of issues that resonate statewide, and state-level action is often necessary to solve issues in localities.

We appreciate the contributions, partnerships, and dedication that have been forged since the original 1985 Ocean Management Plan to this *2020 Ocean Resources Management Plan: Collaborative Coastal Zone Management from Mauka to Makai*. It is these sustained existing connections and the desire to build new relationships that will keep the Plan **relevant** and **responsive**. Relationships are what has driven the ORMP through its inception, and what will carry it forward into the next 10 years. We welcome additional partners that see themselves within the Plan to participate as opportunities arise. We look forward to sharing the journey through the decade with you.

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