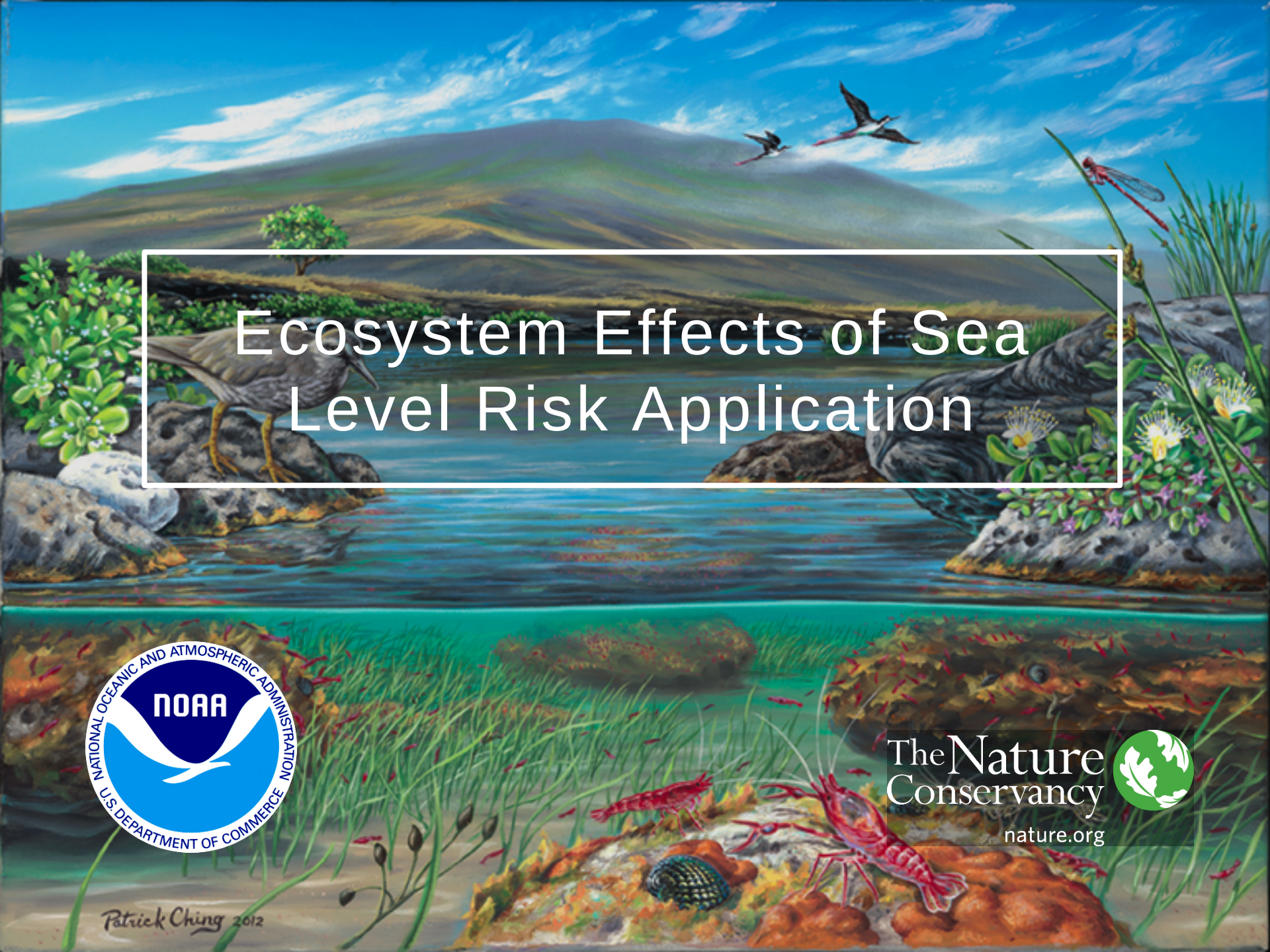

Ecosystem Effects of Sea Level Risk Application
NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE
The Nature Conservancy
nature.org
Patrick Ching 2012

PROJECT TEAM







Chad Wiggins, Lisa Marrack, Eric Conklin – *Co-PIs*

Doug Harper and Rebecca Most– *Field Data*

Ayesha Genz and John Marra – *Scenario Model*

Lisa Marrack and Kim Falinski – *GIS & Data Analysis*

Laura Flessner and Zach Ferdana – *App DEVO*

NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce

University of Hawai'i Hilo

The University of California Berkeley

The Nature Conservancy


BACKGROUND


MAUKA


MAKAI


PU‘U KU ‘ILI


Mai Maka'u

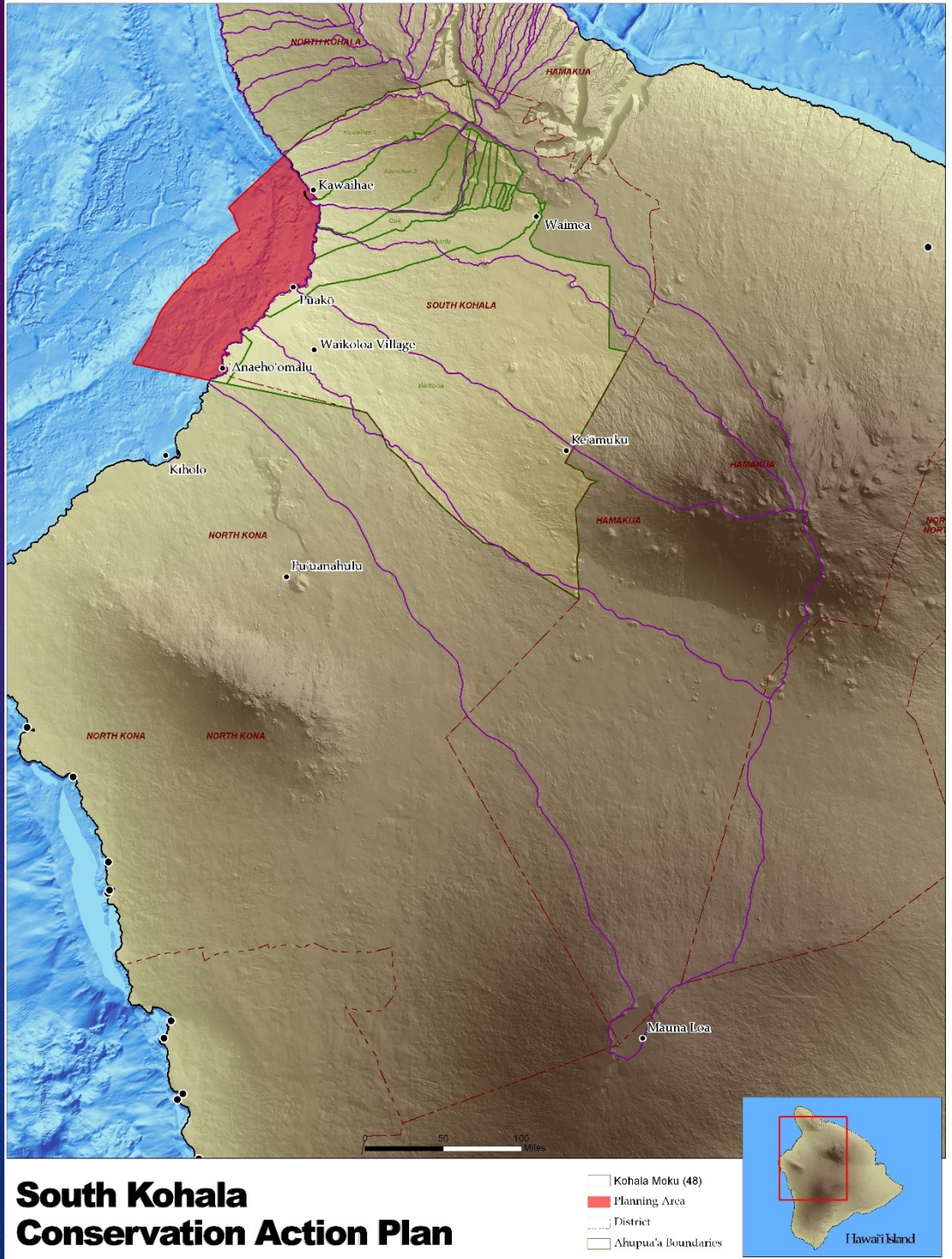

Na ke kai ka hā


Na ke kaiāulu
keiki
YAMAHA

2010 CORAL REEF WORKING GROUP PRIORITY AREA

Goal: Reduce anthropogenic stressors to coral reefs

But, how?




NOAA
CORAL REEF
CONSERVATION PROGRAM
State of
Hawaii Office
of Planning
Defining
Your Project
Developing
Strategies &
Measures
Implementing
Strategies &
Measures
Using Results to
Adapt & Improve
Conservation
Action
Planning
KWP
Kohala Watershed
PARTNERSHIP
U.S.
& WILDLIFE
SERVICE
Kohala Coast
RESORT ASSOCIATION
Puako
COMMUNITY ASSOCIATION
Fisheries Ecology Research Lab
NATIONAL
PARK
SERVICE
Hawai'i
OHA
OFFICE OF HAWAIIAN AFFAIRS
National Fish and Wildlife Foundation
NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE
Department of Land and Natural Resources
State of Hawaii
SOUTH KOHALA
COASTAL PARTNERSHIP
COUNTY OF HAWAII
STATE OF HAWAII
Kanu o ka 'Āina
Mauna Lani
Sea Adventures
NĀ KĀLAI WA'A
NATIONAL MARINE
SANCTUARIES
NRCS
Natural Resources Conservation Service
USGS
science for a changing world

NOAA CORAL REEF CONSERVATION PROGRAM

State of Hawaii Office of Planning

HPA Hawai'i Preparatory Academy

KWP Kohala Watershed PARTNERSHIP

DAR Hawaii Division of Aquatic Resources

U.S. FISH & WILDLIFE SERVICE DEPARTMENT OF THE INTERIOR

Kohala Coast RESORT ASSOCIATION

THE KOHALA CENTER

Puako COMMUNITY ASSOCIATION

Fisheries Ecology Research Lab

NATIONAL PARK SERVICE

The Nature Conservancy Hawai'i

OHA OFFICE OF HAWAIIAN AFFAIRS

National Fish and Wildlife Foundation

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

Department of Land and Natural Resources State of Hawaii

HAWAII INSTITUTE CDCONB

SOUTH KOHALA COASTAL PARTNERSHIP

COUNTY OF HAWAII OLA NA MOKU STATE OF HAWAII

Kanu o ka 'Aina

Mauna Lani Sea Adventures

NATIONAL MARINE SANCTUARIES ™

NRCS Natural Resources Conservation Service

USGS science for a changing world

CONSERVATION ACTION 5.1:

REMOVE HABITAT MODIFYING NON-NATIVE AND INVASIVE SPECIES, STARTING WITH MANGROVE **AND TILAPIA**, TO RESTORE/MAINTAIN ECOSYSTEM FUNCTION FOR 50% OF MANAGED PRIORITY ANCHIALINE POOLS AND FISHPONDS BY 2020. (H)

LEADS: TNC AND DAR W/ FISHPOND MANAGERS

PROGRESS TO DATE

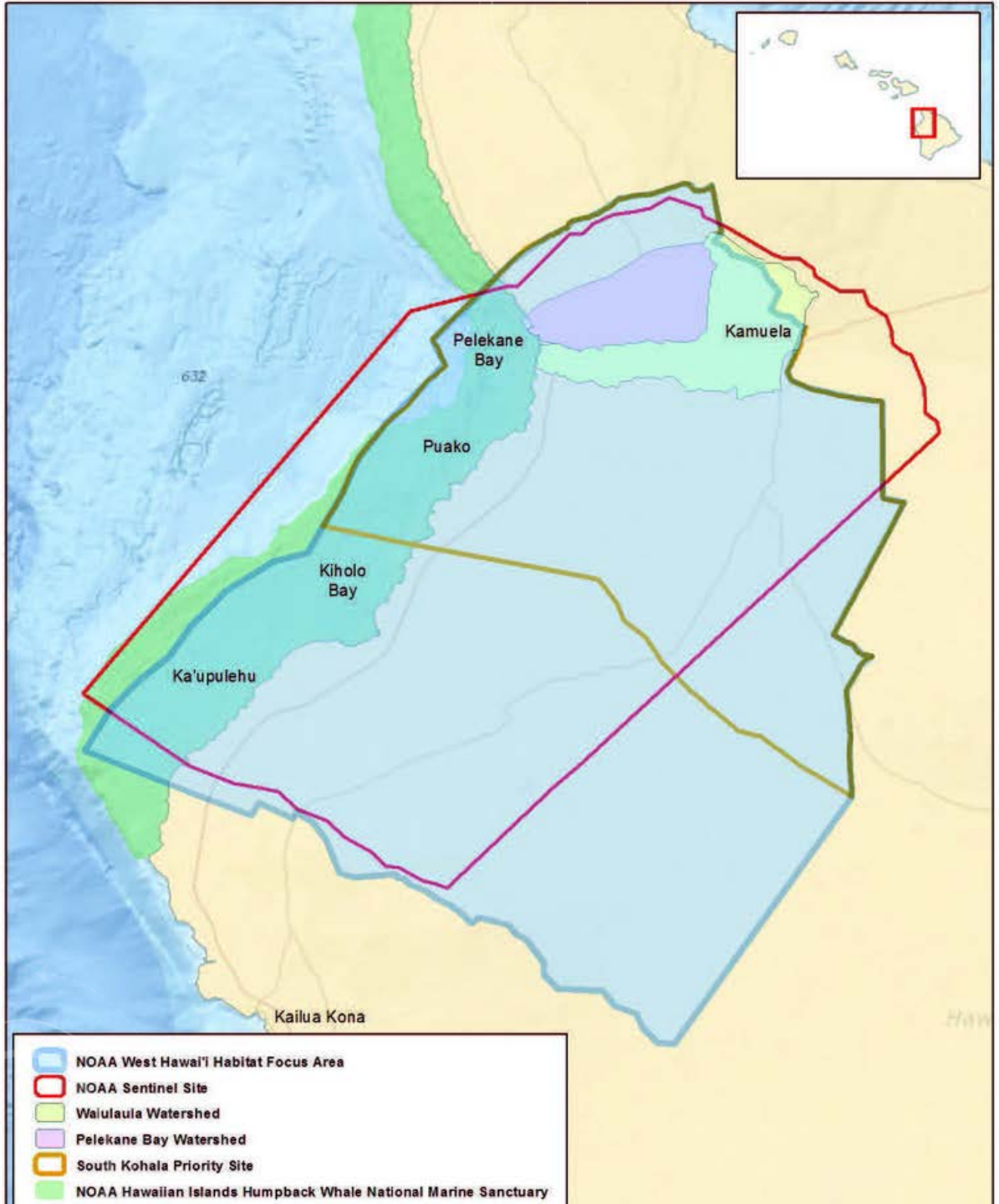
Mangrove removed by hand, no sign of regrowth

Tilapia removed by hand, continue to spread to new habitat

CONSERVATION ACTION 6.5:

ASSESS THE PROJECTED IMPACTS OF **CLIMATE CHANGE** ON THE TARGET COASTAL RESOURCES IN SOUTH KOHALA AND IMPLEMENT PRIORITY ACTIONS TO OPTIMIZE CLIMATE CHANGE RESILIENCE BY 2020. *(M)*

LEADS: NOAA SENTINEL SITE



NOAA PRIORITY AREAS

NOAA SENTINEL SITE PROGRAM SUPPORT

DATA

- Elevation
- Inundation/Migration
- LiDAR

GRANTS

- Ecological Effects of Sea Level Rise (EESLR)

EESLR PROJECT OVERVIEW

2016

- Data Collection
- Analysis
- Tool Design
- Partner Feedback

2017

Tool Development

- Training and Local Capacity Building
- Mapping Impacts
- Plan Review

2018

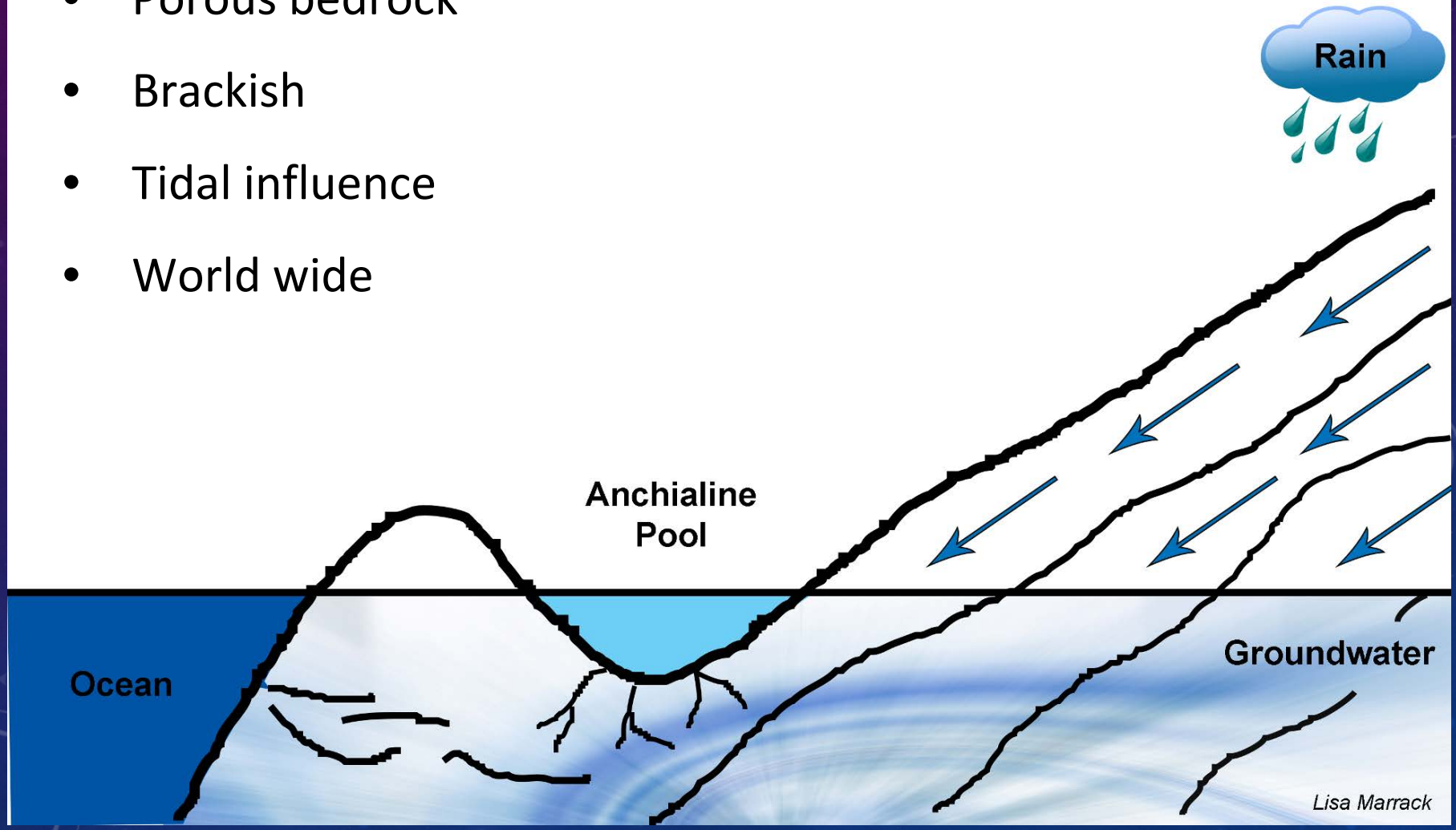
Prioritizing Action

Sharing Process and Lessons Learned


CONTEXT

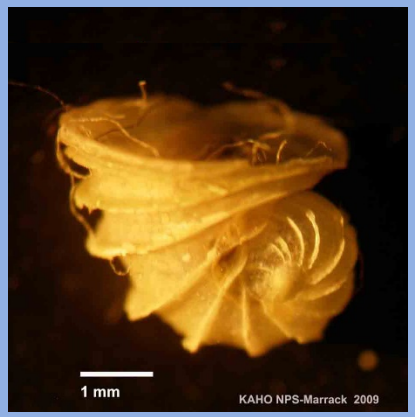
ANCHIALINE POOL ECOLOGY

- Porous bedrock
- Brackish
- Tidal influence
- World wide



ANCHIALINE POOL ECOLOGY

Megalagrion xanthomelas **-** endemic



Metabetaeus lohena & Halocaridina rubra

Antecaridina lauensis - Indo-Pacific

Calliasmata philodota **-** rare

ANCHIALINE POOL ECOLOGY

4% of pools

24% of pools

In 400 pools:

Fish had strongest negative effect on shrimp daytime occurrence.

Beavers

Marrack, Beavers and O' Grady *Hydrobiologia*, 2015


PROCESS


DATA
PROCESS

WHERE ARE POOLS NOW & WHERE EXIST WILL THEY EXIST IN THE FUTURE?

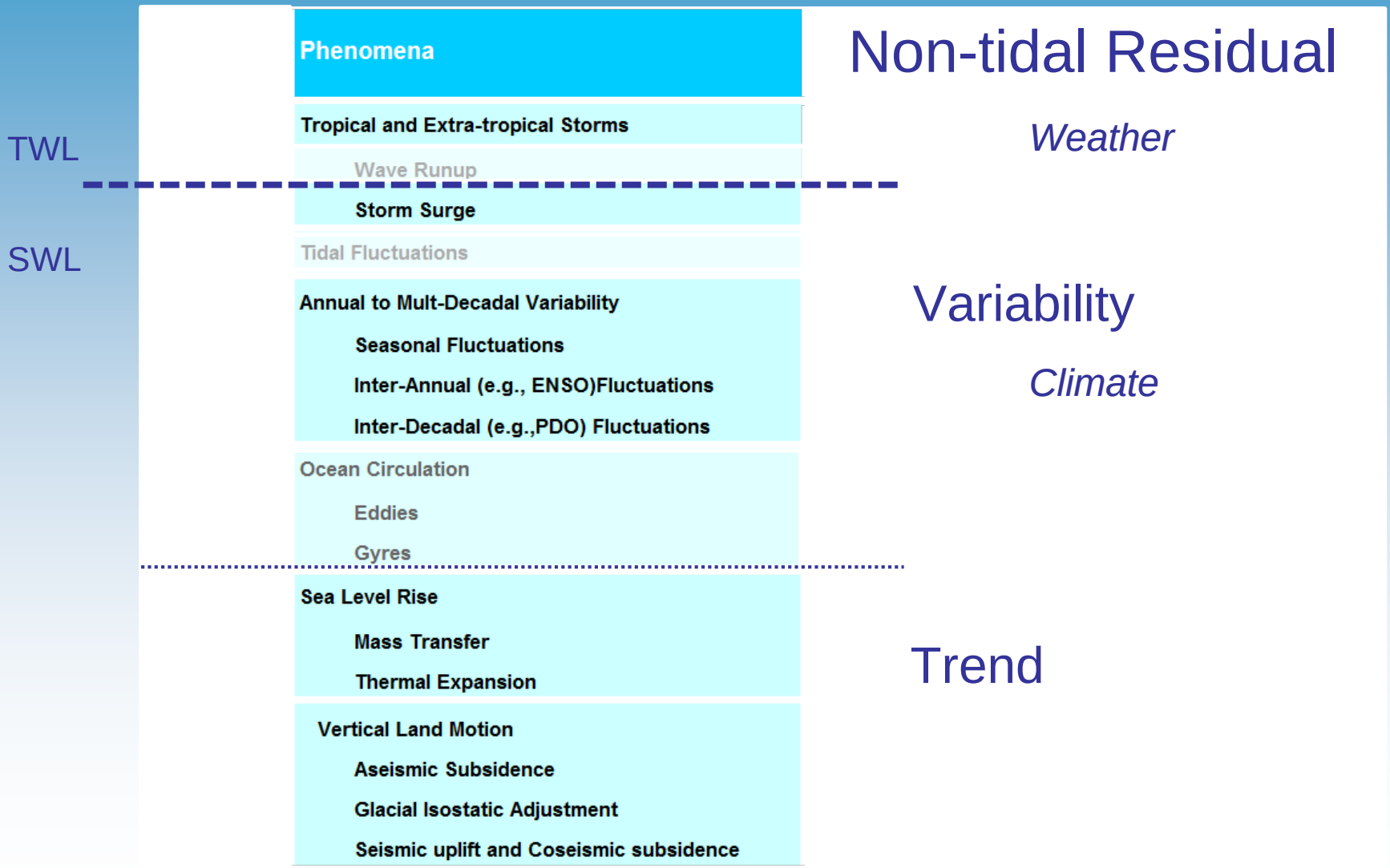
Goal: Provide tools to identify anchialine pool habitats of concern

Incorporate:

- **high resolution (1 m grid) maps (4 intervals)**
- **flood freq./extremes based on predicted SLR***
- **field measured groundwater levels above sea level**
- **current and future anchialine pools w/ & w/out invasive fish**
- **Current protection and land-use**

- **(Kopp et al. 2014)**

Factors Affecting Extreme Water Levels in the Pacific Islands



(Marra slide, 2016)

Predictions of Flooding

- **West Hawaii Specific**

(Local tide gauge and buoys)

- **Flood Frequency**

(When does an area flood enough to become new habitat?)

- **Extreme Flooding (Still Water Levels)**

(Short frequency wave action in TWL are not as relevant to inland water levels and habitat. Being developed for other uses)

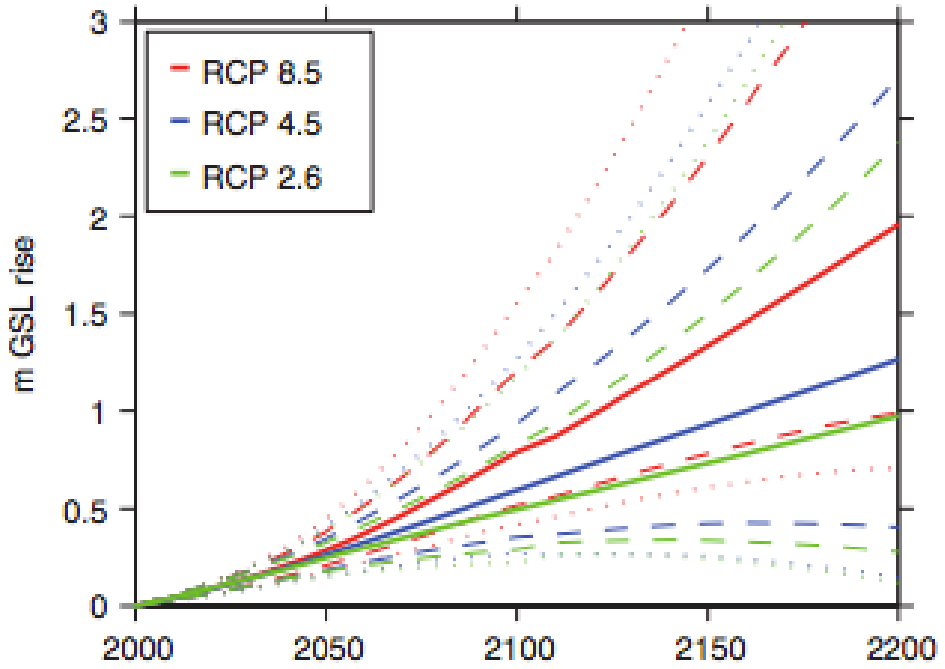


Figure 3. Projections of GSL rise for the three RCPs. Heavy = median, dashed = 5th–95th percentile, dotted = 0.5th–99.5th percentiles.

(Kopp et al 2014)

Elevation Data Collection

Elevation Data

- **Line Leveling**
- **GPS Surveying**
- **Critical Infrastructure, Ecological and Cultural Sites**

Total Water Levels (TWL)

Kīholo Specific

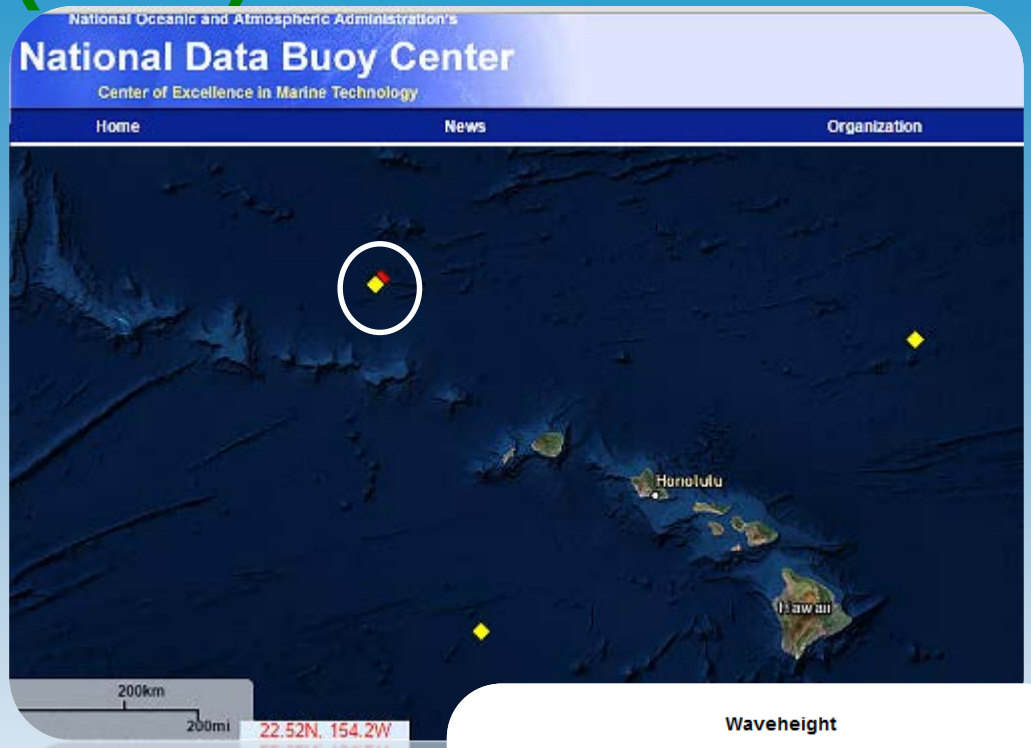
TWL = SWL + Runup

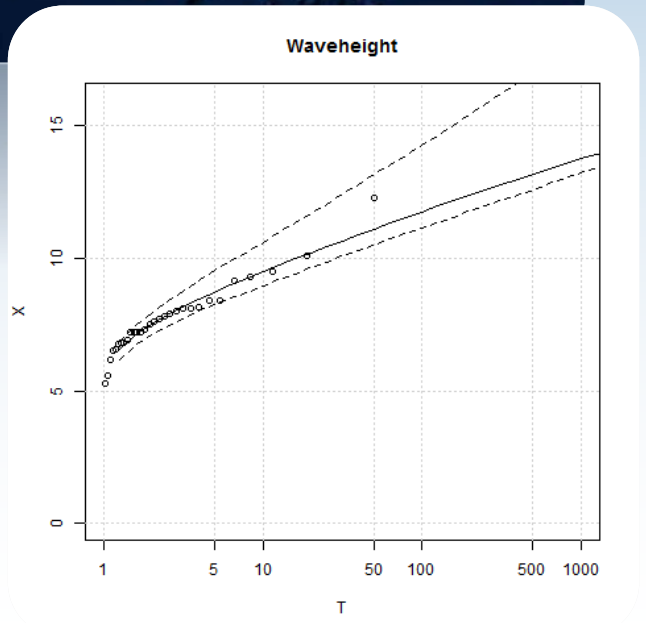
Runup = setup + swash

From EVA of: significant wave heights and results obtained from Vitousek et al (2010).

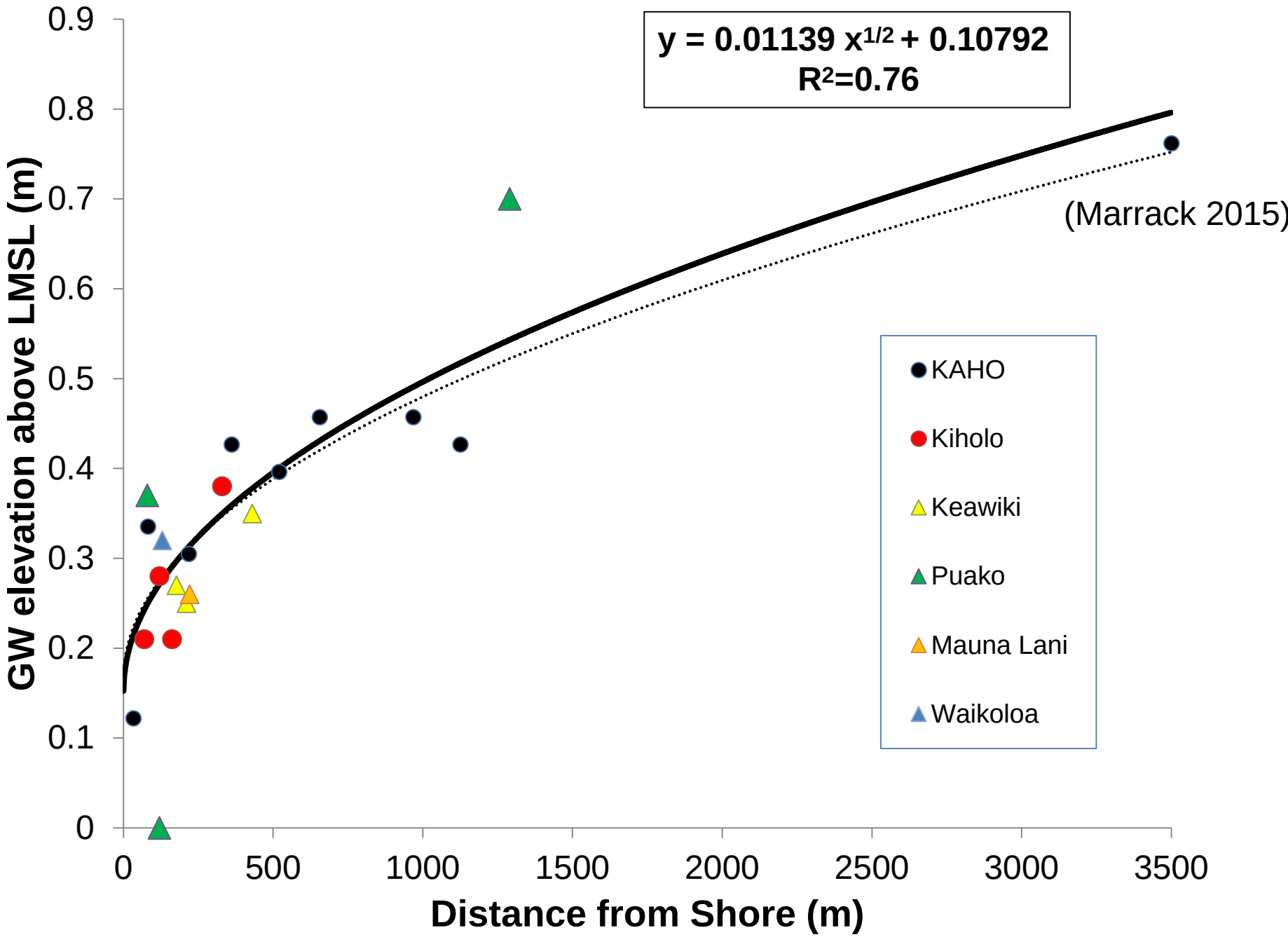
Corrections:

- sheltering
- shoaling
- percolation



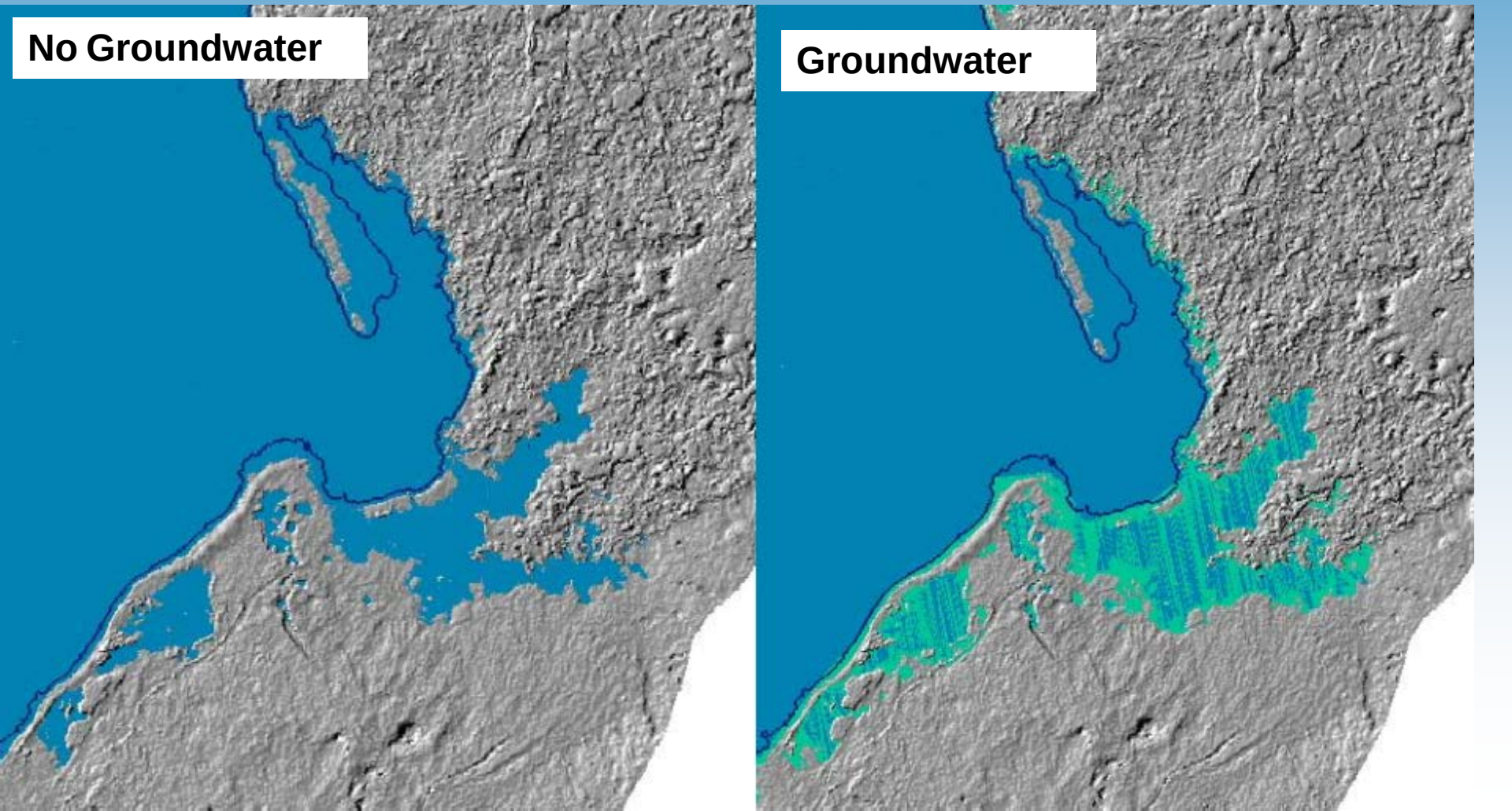


Frequency of Flooding and SWL Extremes


y = 0.01139 x^1/2 + 0.10792
R²=0.76
(Marrack 2015)
KAHO
Kiholo
Keawiki
Puako
Mauna Lani
Waikoloa
GW elevation above LMSL (m)
Distance from Shore (m)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
0
500
1000
1500
2000
2500
3000
3500

Flood maps

GW levels + SLR scenario elevations > current ground height = flooding occurs



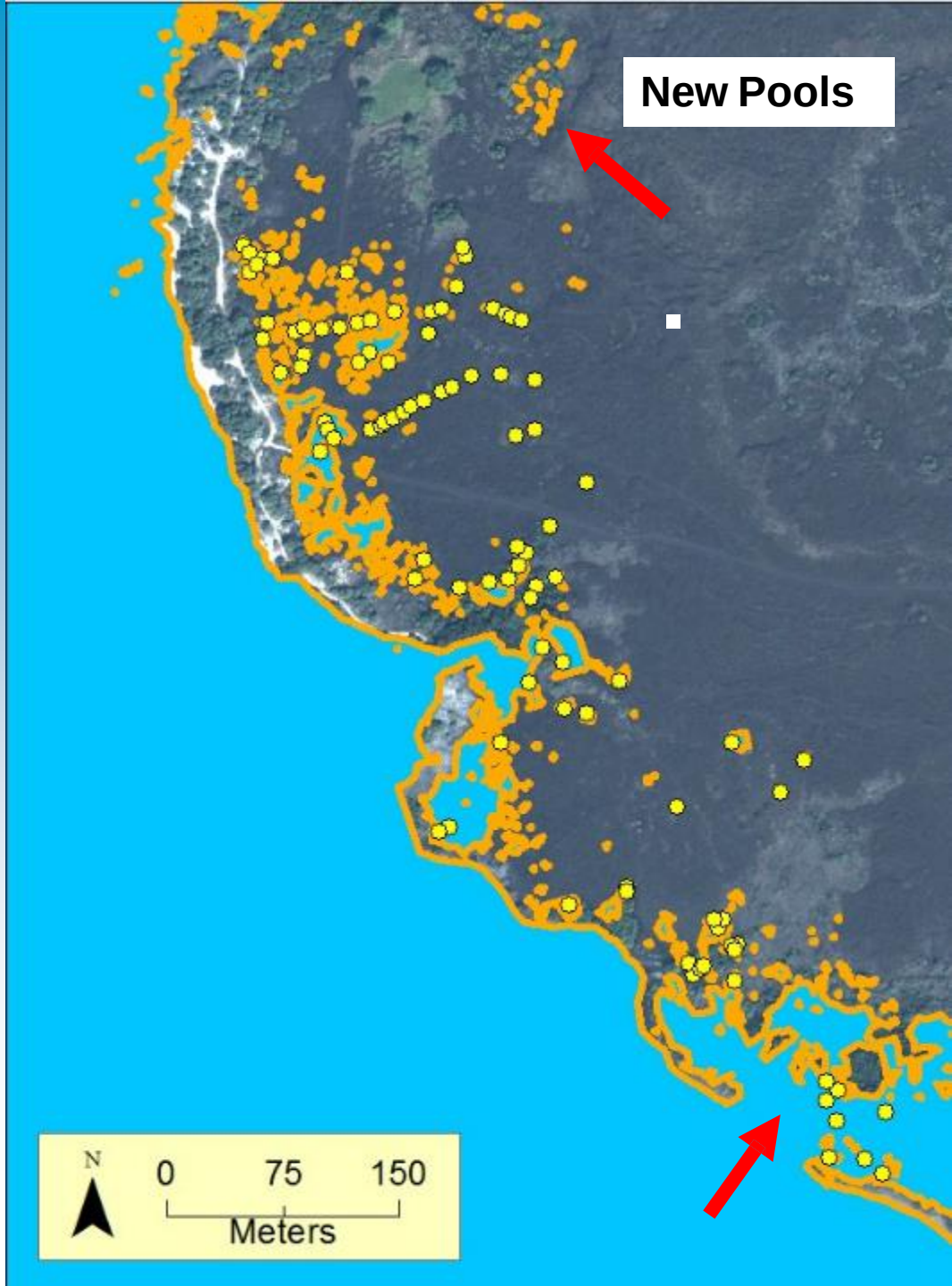
New Pools

- Over 40 ft from ocean
- No overland contact with ocean

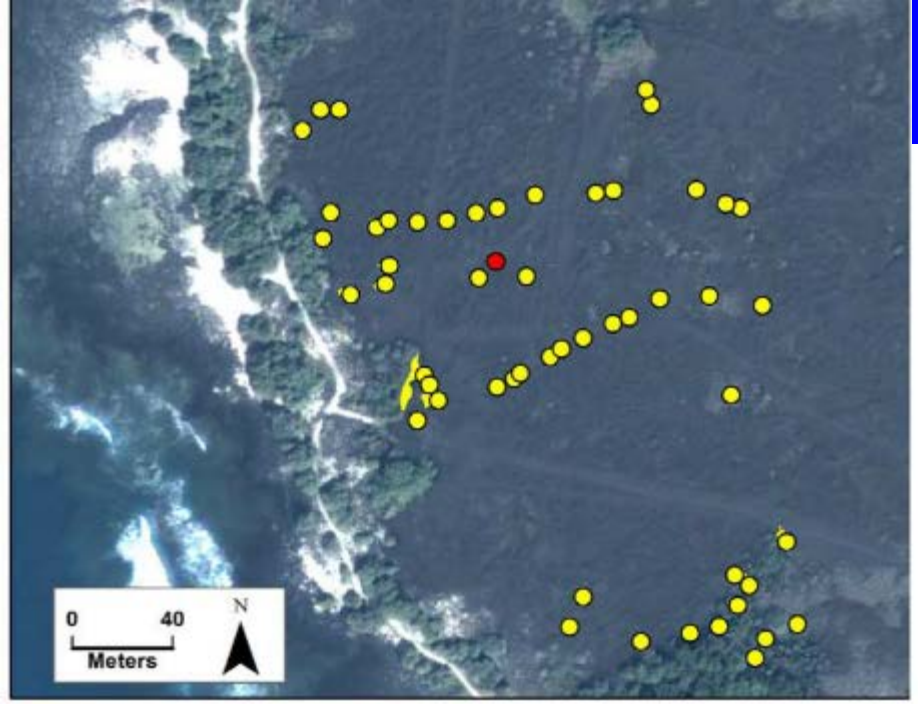
Destroyed Pools

- Overland contact with ocean

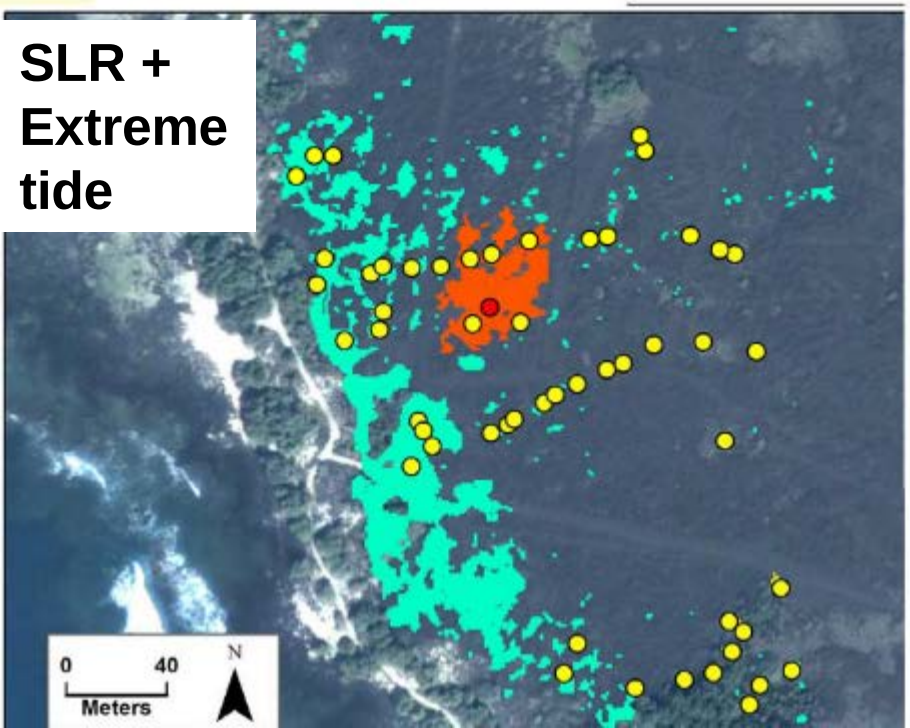
Existing pools

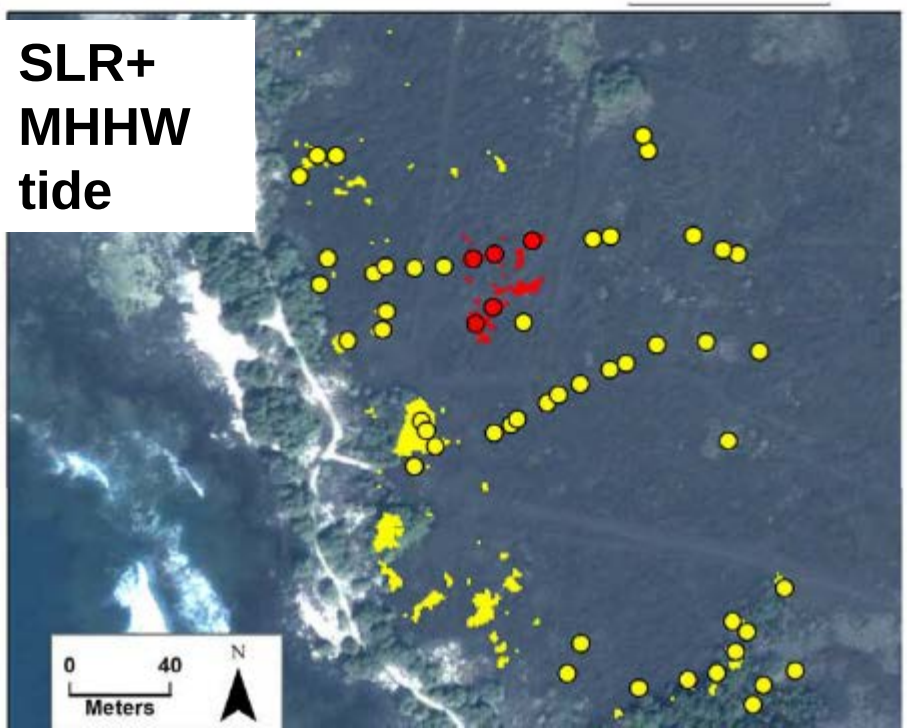


Mapping NEW Fish Pools



Anchialine Pools
- no fish
- fish
- Fish Potential
- Extreme tide flooding





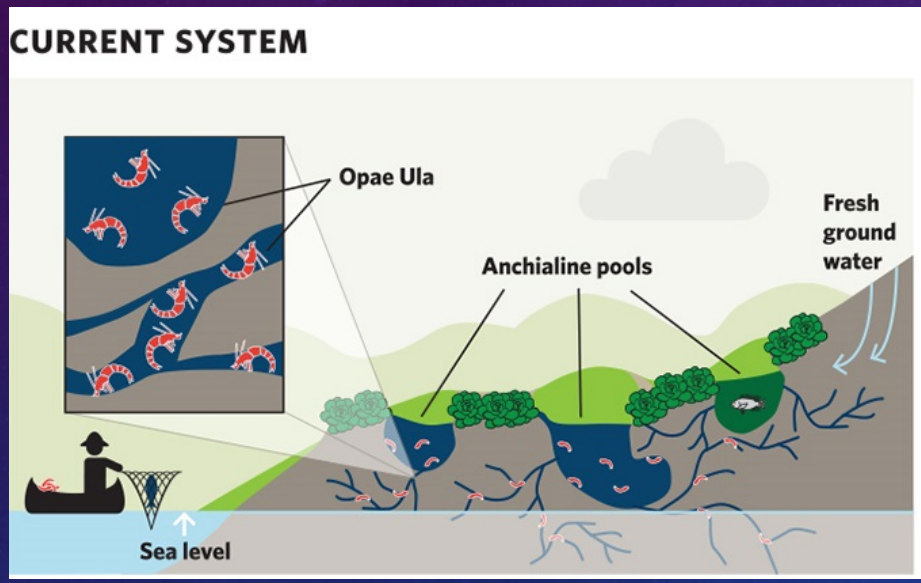
ENGAGEMENT

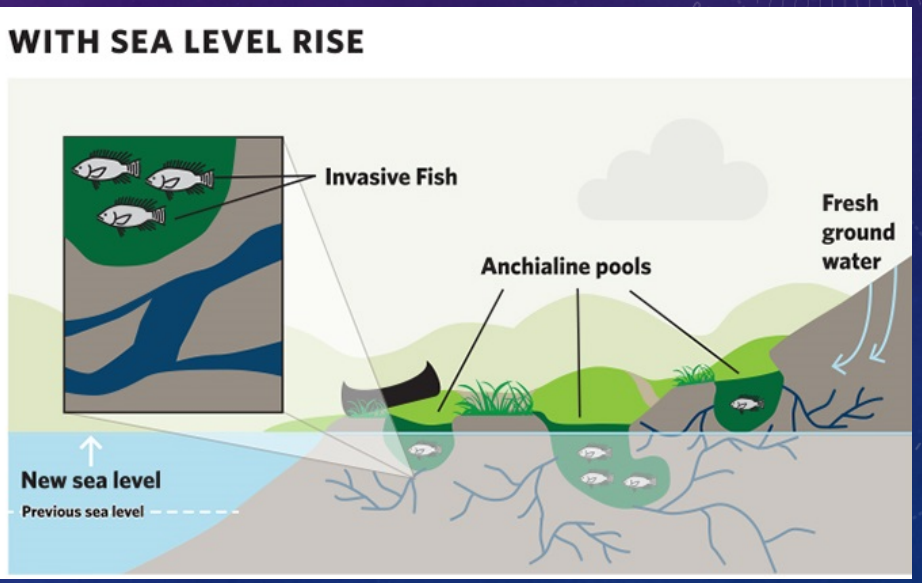
PROCESS

HAWAII– ECOSYSTEM EFFECTS OF SEA LEVEL CHANGE

Purpose: Screening tool to help planners understand the potential risks associated with sea level change and future development to anchialine pools over time.

Use: Prioritize pool conservation & restoration opportunities and help make the case to influence future development decisions.





Stakeholder Needs & Expert Guidance → Data & Analysis → App Development → Stakeholder Usability Workshops → App Customization → Training & Implementation

Cooperative Tool Development 2/16-2/17

3 WORKSHOPS W/ COMMUNITY, AGENCY, GOVERNMENT, AND NGO PARTICIPANTS

FEEDBACK*

SHOW MORE PLACES – ESPECIALLY MINE

PROTECT SENSITIVE LOCATIONS

MAKE IT CLEARER

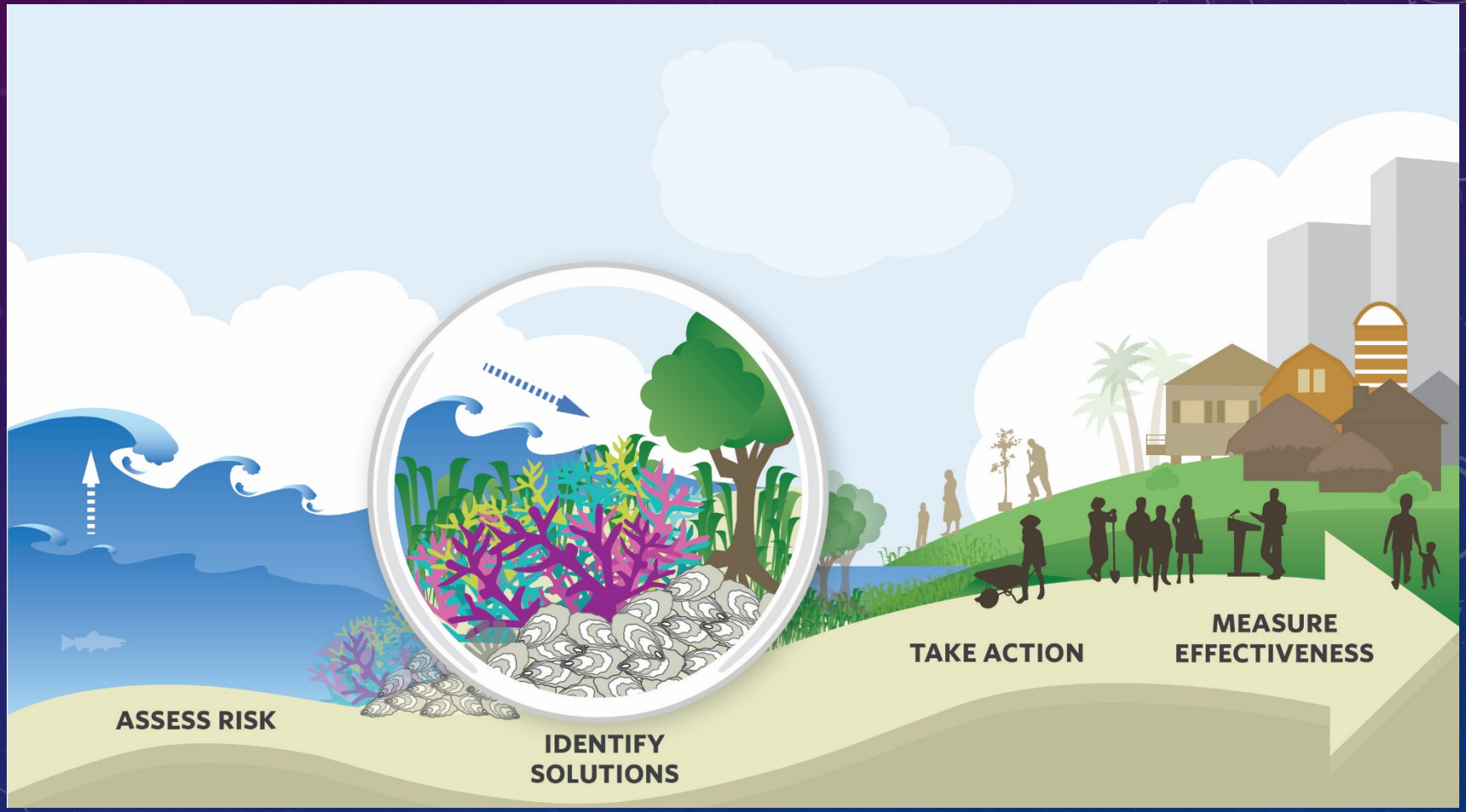
SHOW MORE LAYERS

* *From September 2016 Workshop*

SHOW MORE PLACES AND PROTECT SENSITIVE LOCATIONS

MAKE IT CLEARER AND ADD MORE LAYERS

Coastal Resilience



COASTAL RESILIENCE WEB APPS

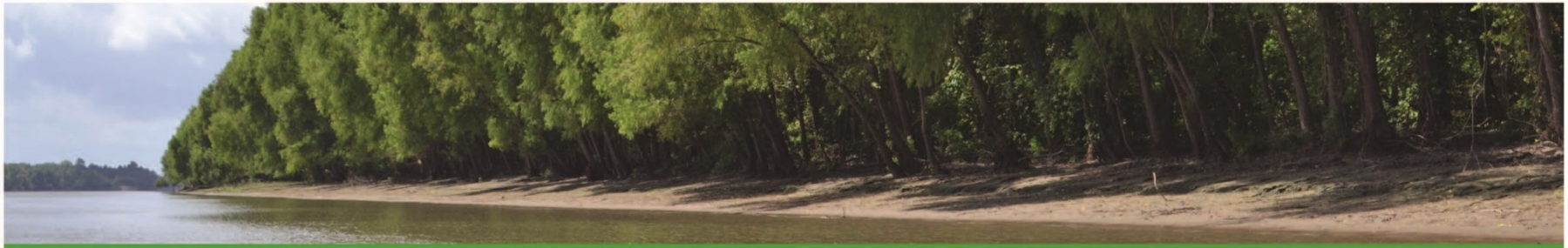
An innovative web-mapping tool designed to engage key stakeholders and provide decision support in identifying nature-based adaptation and risk mitigation solutions.

esri Special Achievement in GIS 2015 Award Winner

esri RESILIENCY APP WINNER

Contact us at **coastalresilience@tnc.org**

Discover the tool at **maps.coastalresilience.org** | Follow us **@CoastResilience**



NATURAL SOLUTIONS TOOLKIT

SPATIAL DECISION TOOLS AND WEB APPS
TO CATALYZE CONSERVATION

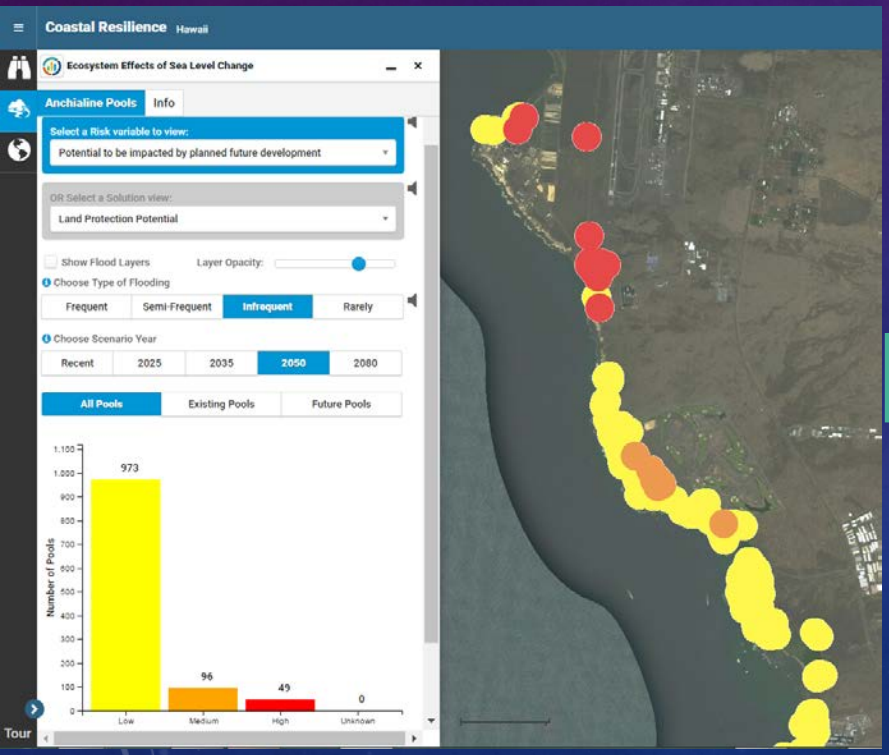
- Coastal Resilience
- Floodplains by Design
- Mapping Ocean Wealth
- Freshwater Network
- Natural Resource Navigator
- The Global Water Atlas
- Cities

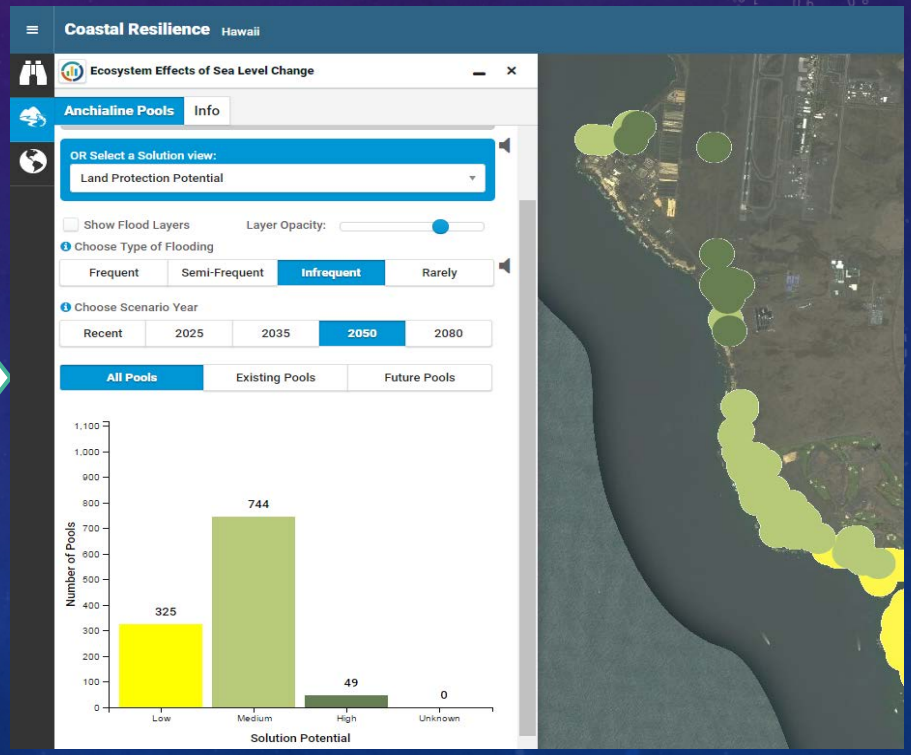
RISKS

- Likelihood of invasive fish species transmission
- Potential to be impacted by planned future development
- Likelihood of being inundated by the ocean
- Likelihood of cesspool contamination
- Cumulative Risk

SOLUTIONS

- Land Protection Potential
- Invasive Fish Removal Priorities





WWW.MAPS.COASTALRESILIENCE.ORG/HAWAII