Mapping Wetlands on Hawai‘i Island

EPA WETLAND PROGRAM DEVELOPMENT GRANT (WPDG) III

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ANCHIALINE POOLS

Brackish, groundwater-fed ecosystems without surface connection to the ocean.

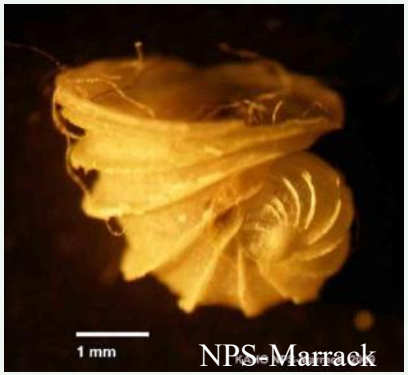
Global distribution with >900 located in the Hawaiian Islands

- 92% located on the island of Hawai‘i

Still understanding how these ecosystems function and develop

ANCHIALINE POOLS SUPPORT ENDEMIC SPECIES

Megalagrion xanthomelas



Metabetaeus lohena & Halocaridina rubra

Procaris hawaiana

H. mexicanus knudseni

ANCHIALINE POOLS : SUBTERRANEAN HABITATS

- Porous bedrock
- Brackish (1-28ppt)
- Tidal influence

Freshwater

Saltwater

Brackish water

Illustration by Michael Furuya

LOKO WAI ‘ŌPAE / WAI KAI : CULTURAL IMPORTANCE

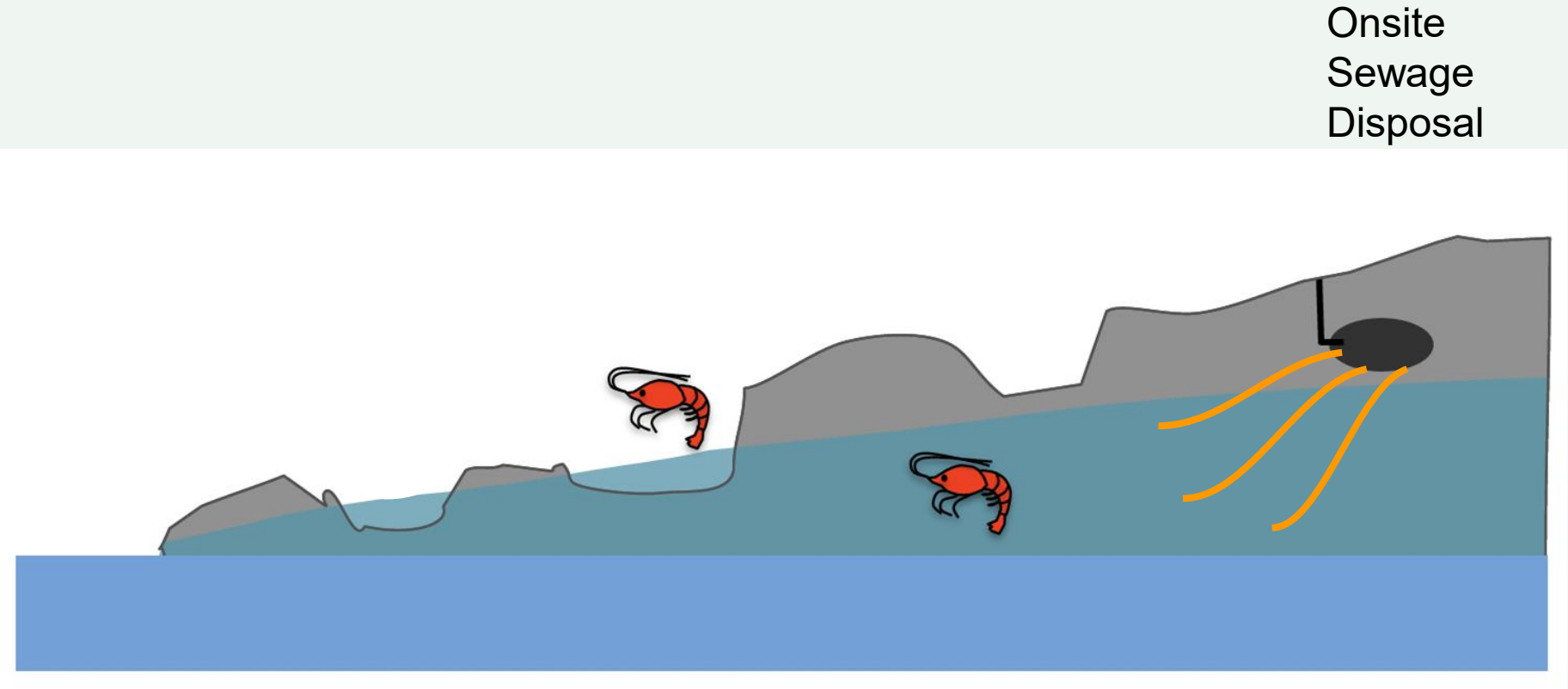
- Historical source of drinking water, especially along the arid Kona coast
- Cultural practices:
  - Harvesting for bait, food, mollusc shells
  - Sedges used to weave mats

Makaloa

Weaving

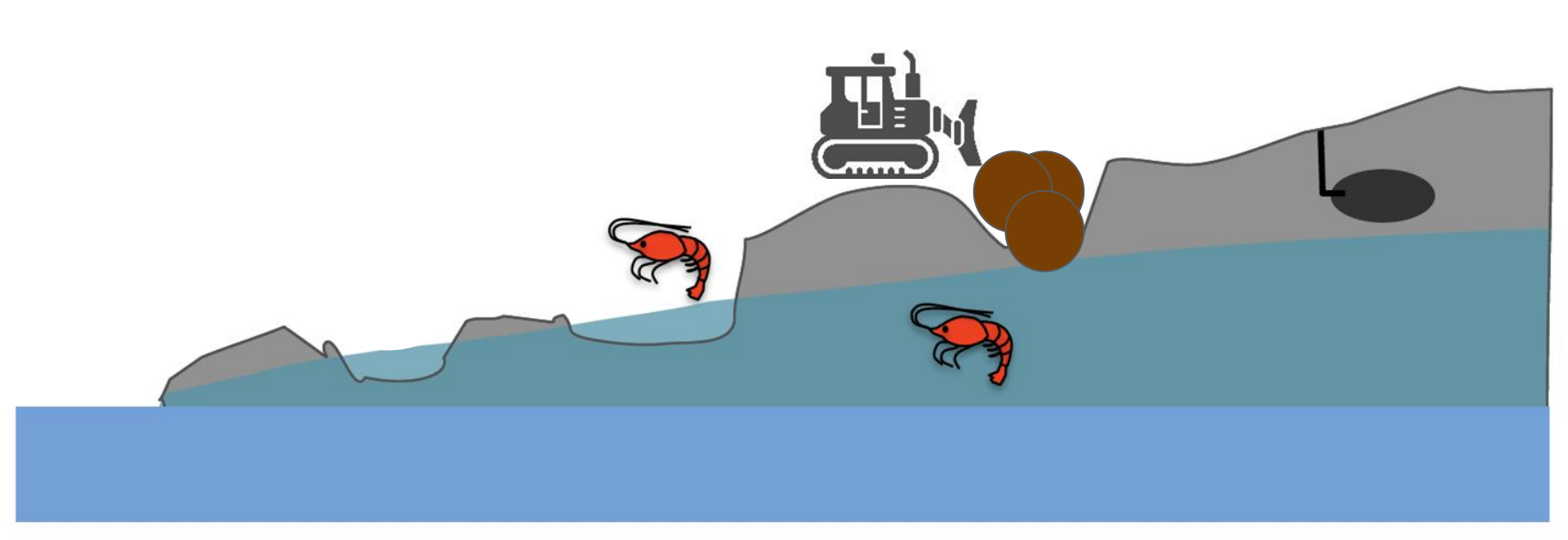
THREATS to ANCHIALINE POOLS

- **Groundwater Pollution**



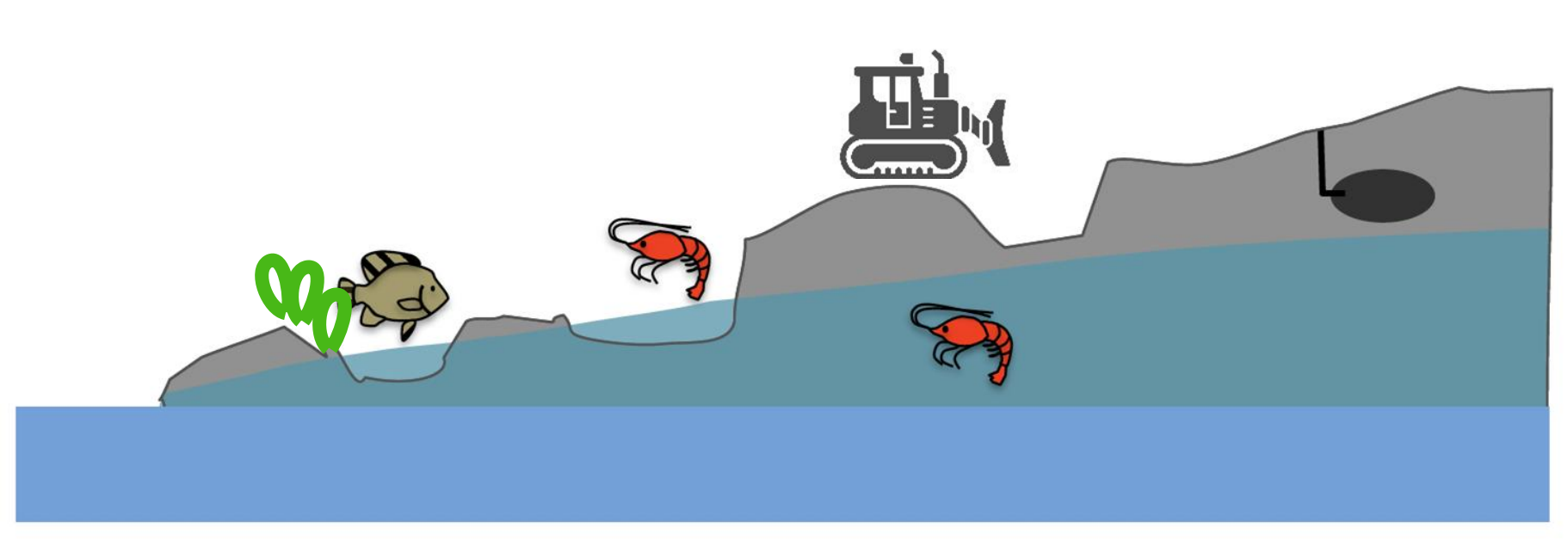
THREATS to ANCHIALINE POOLS

- Groundwater Pollution
- **Development - infilling**

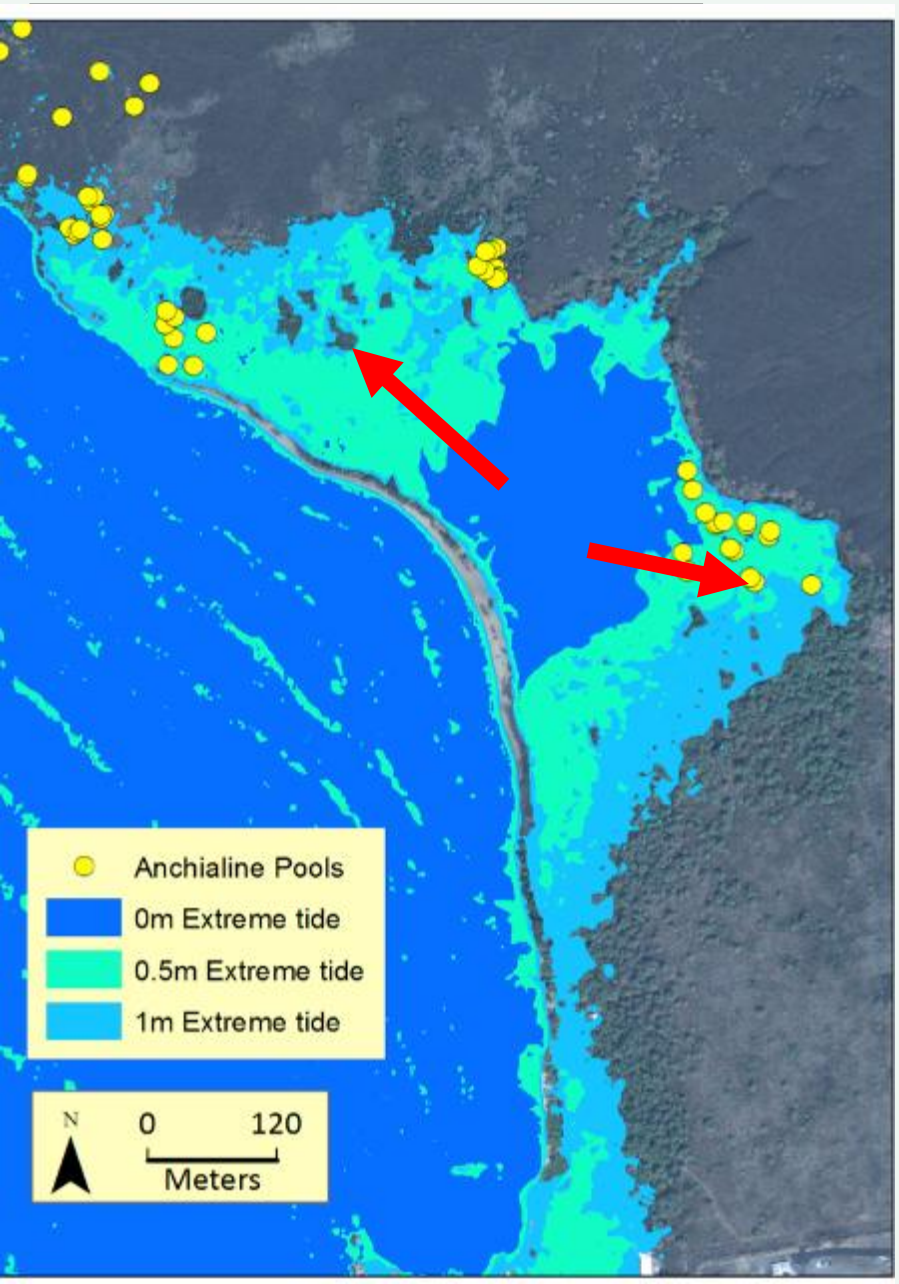


THREATS to ANCHIALINE POOLS

- Groundwater Pollution
- Development - infilling
- **Introduced fishes/ plants**



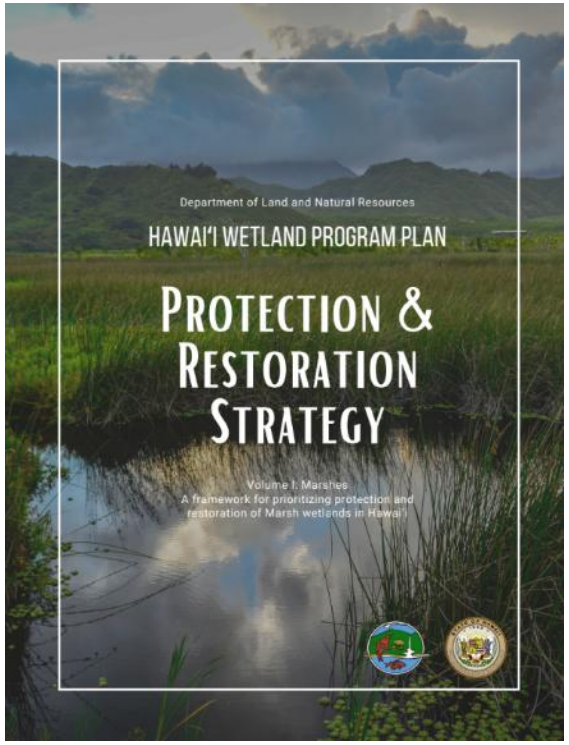
SEA LEVEL RISE WILL AID INVASIVE FISH DISPERSAL

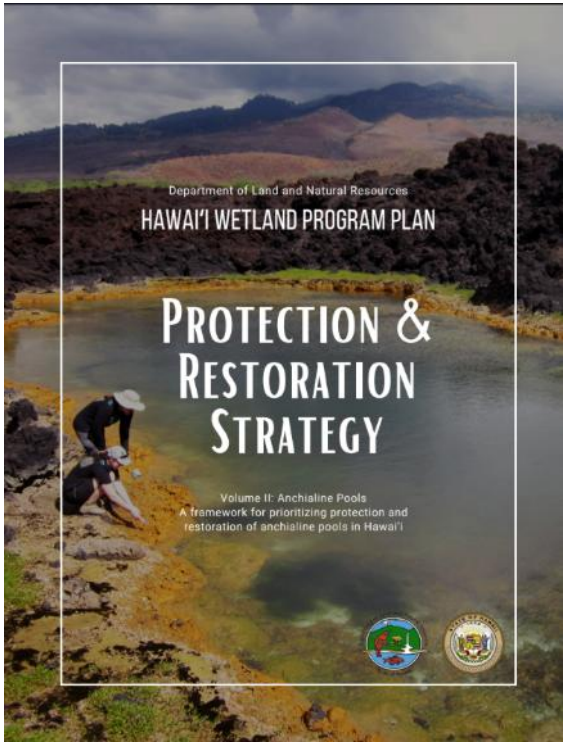


PREVIOUS EPA PROJECT

Protection and Restoration Strategy for Wetlands (2023-2025)

- Developed an evaluation framework to aid anchialine pool protection and restoration in Hawai‘i
- Use priority and feasibility criteria to determine the threats and evaluate potential solutions





PREVIOUS EPA PROJECT

Community members prioritized these factors:

- Geology
- Hydrology
- Land ownership, Regulatory, Management
- Native biodiversity
- Biocultural value
- Climate sensitivity
- Restoration
- Key threats

← Lindsey Kramer (both photos by Hawai‘i Wildlife Fund.)

CURRENT EPA PROJECT

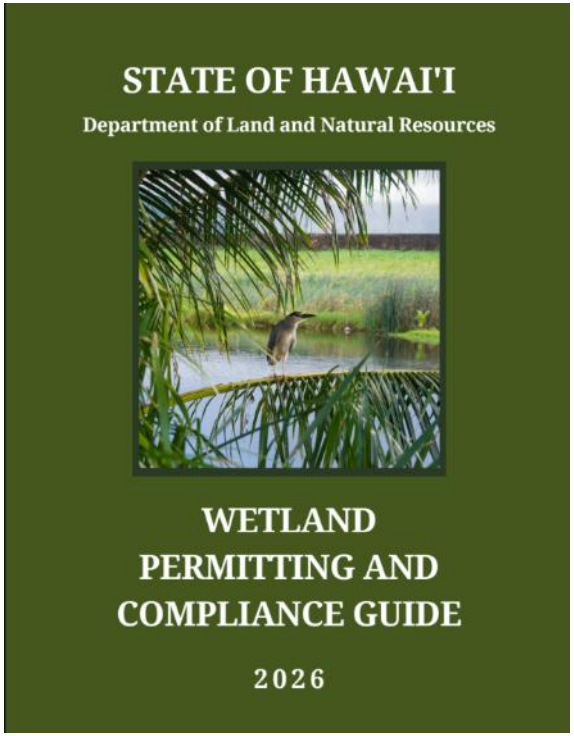
Completing the Hawai‘i Wetland Program Plan Protection and Restoration Strategy (2025)

1: *Estuaries Strategy:* identify management priorities for Estuaries

2: *Wetland Workshops*: rotate among the main Hawaiian islands

3: *Regulation:* Research and pursue regulatory mechanisms to improve protection and restoration capacity across the state

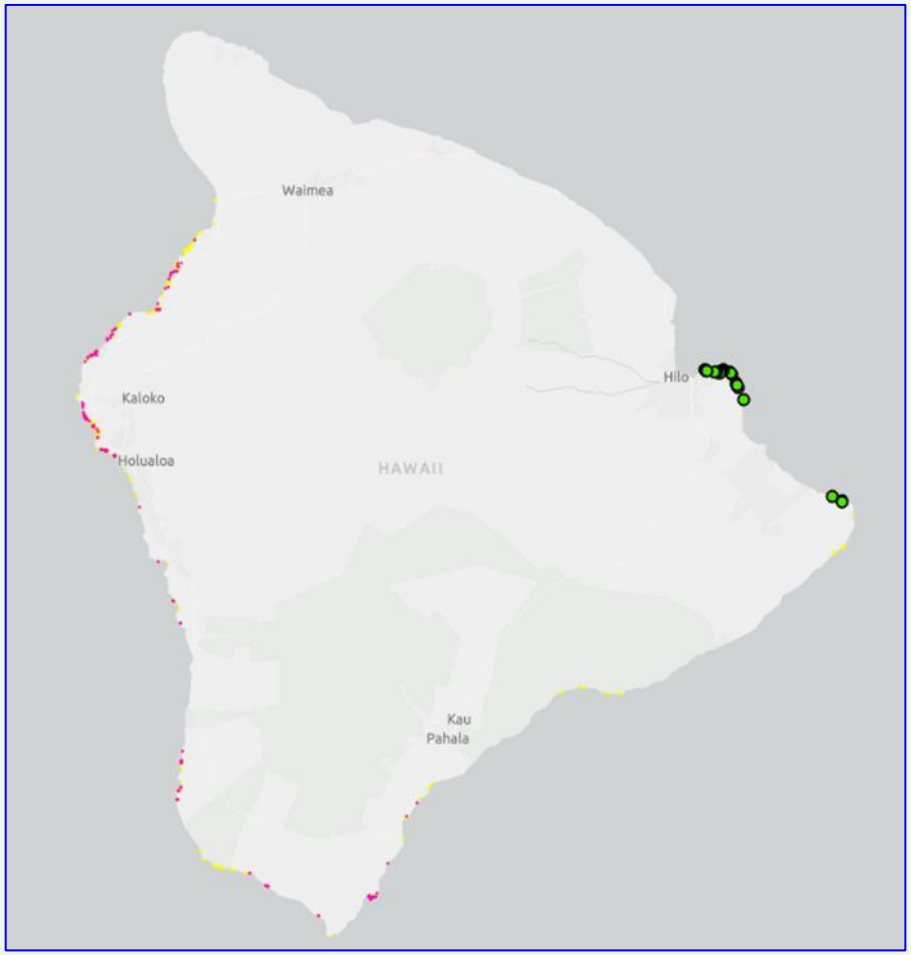
- *Completed a Wetland Permitting Compliance Guide*
- *In Progress:* ***Anchialine pool mapping and wetlands inventory update***



PROJECT: MAP COASTAL WETLANDS ON HAWAIʻI ISLAND

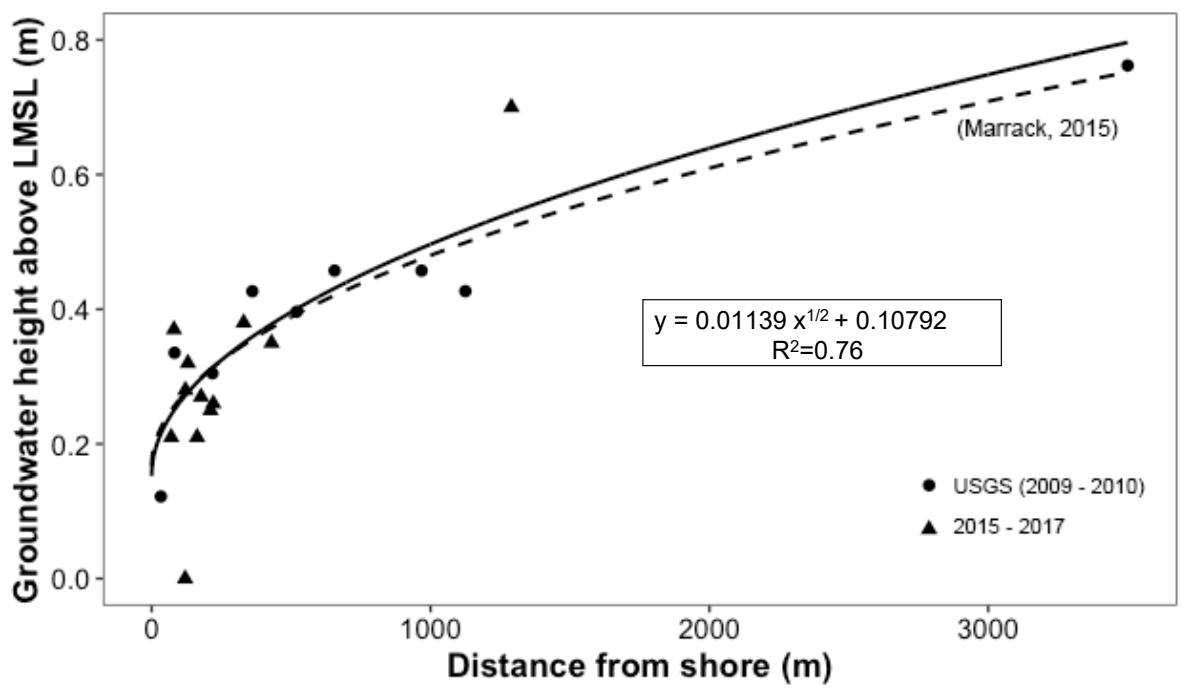
Focus: Map & protect anchialine pools in Hawaiʻi (Hawaiʻi Island)

- **Scope: 750m coastal buffer zone**
  - Public & private lands
- **National Wetlands Inventory (NWI)**
  - ALL wetlands in project boundary
- **Wetlands (1+ of the following)**
  - Wetland vegetation
  - Flooding during growing season
  - Soil/mineral indication

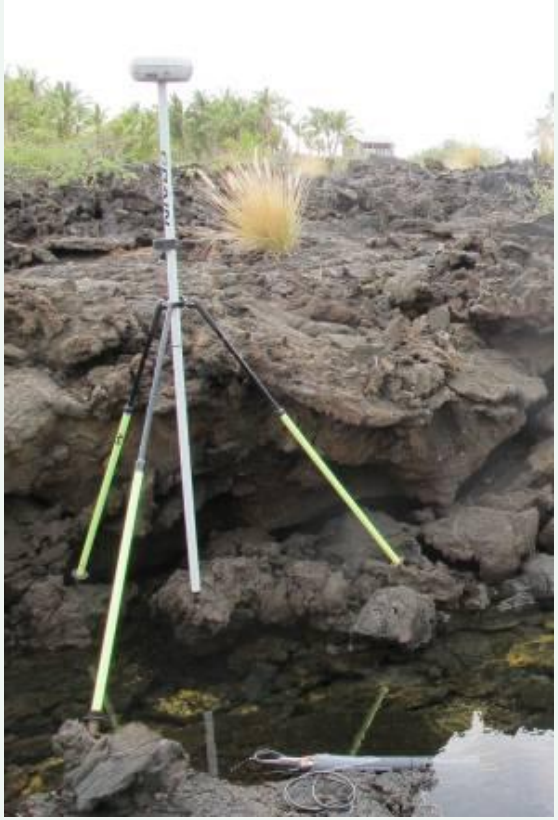


MAPPING WITH GROUNDWATER LEVEL MODELS

Groundwater is perched above local mean sea level



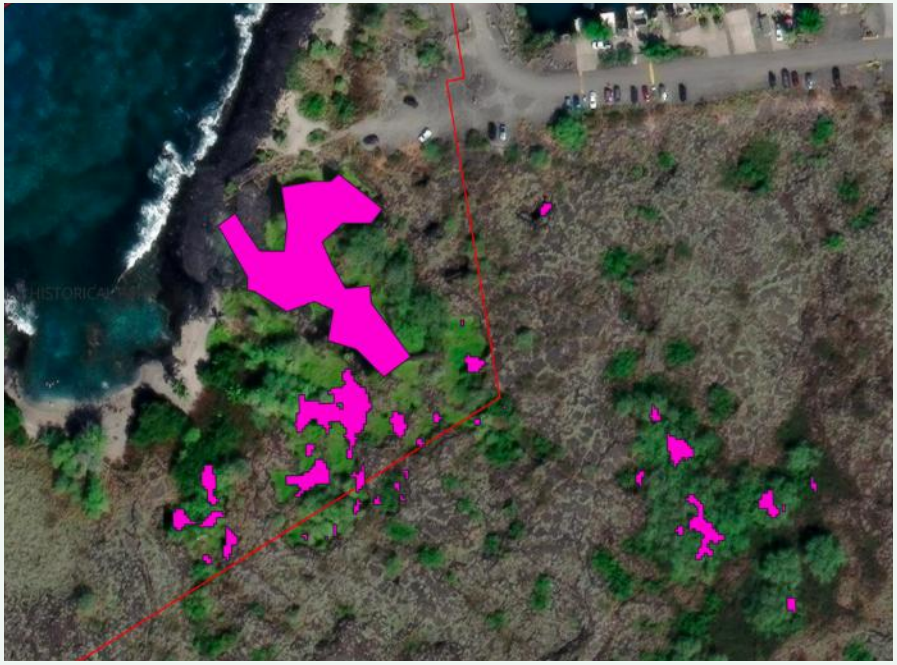
(Marrack et al 2021)



GROUNDWATER ABOVE DEM IS A PREDICTED WETLAND

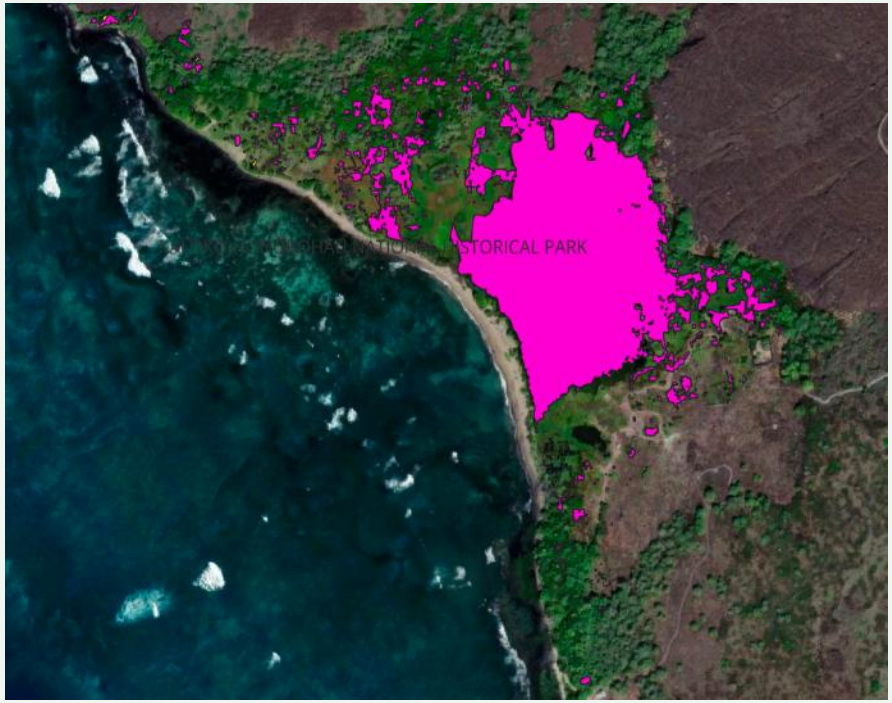
Groundwater model
(Monthly High Tide)

Validated
- ground-truth surveys
- cultural/local ecological knowledge
- satellite imagery (NAIP, etc.)



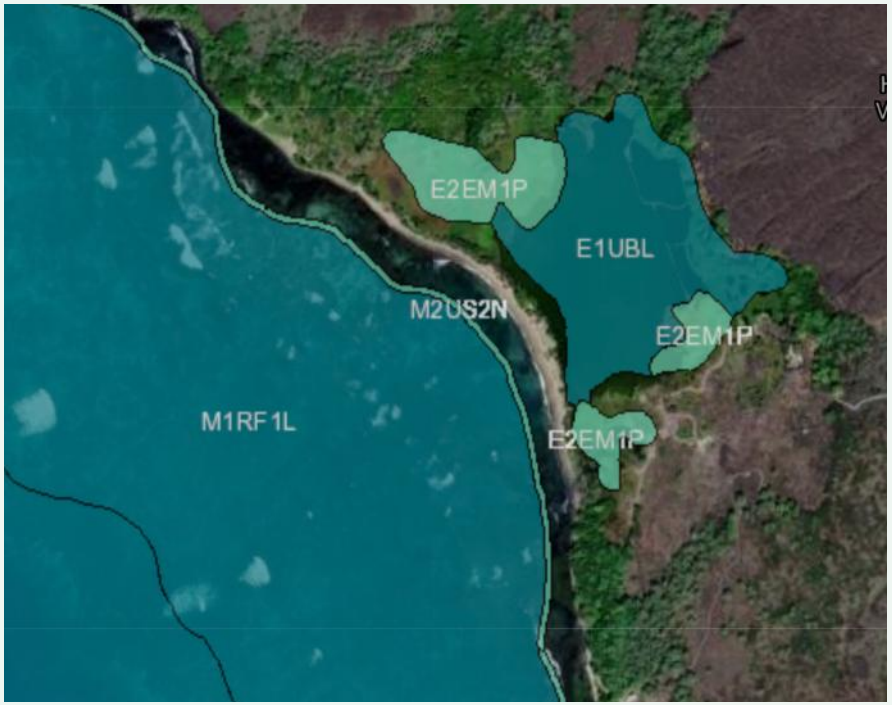
National Wetlands Inventory
surface waters and wetlands

Groundwater model



NWI online map

(note buffers and lower resolution - generalizes pool locations)

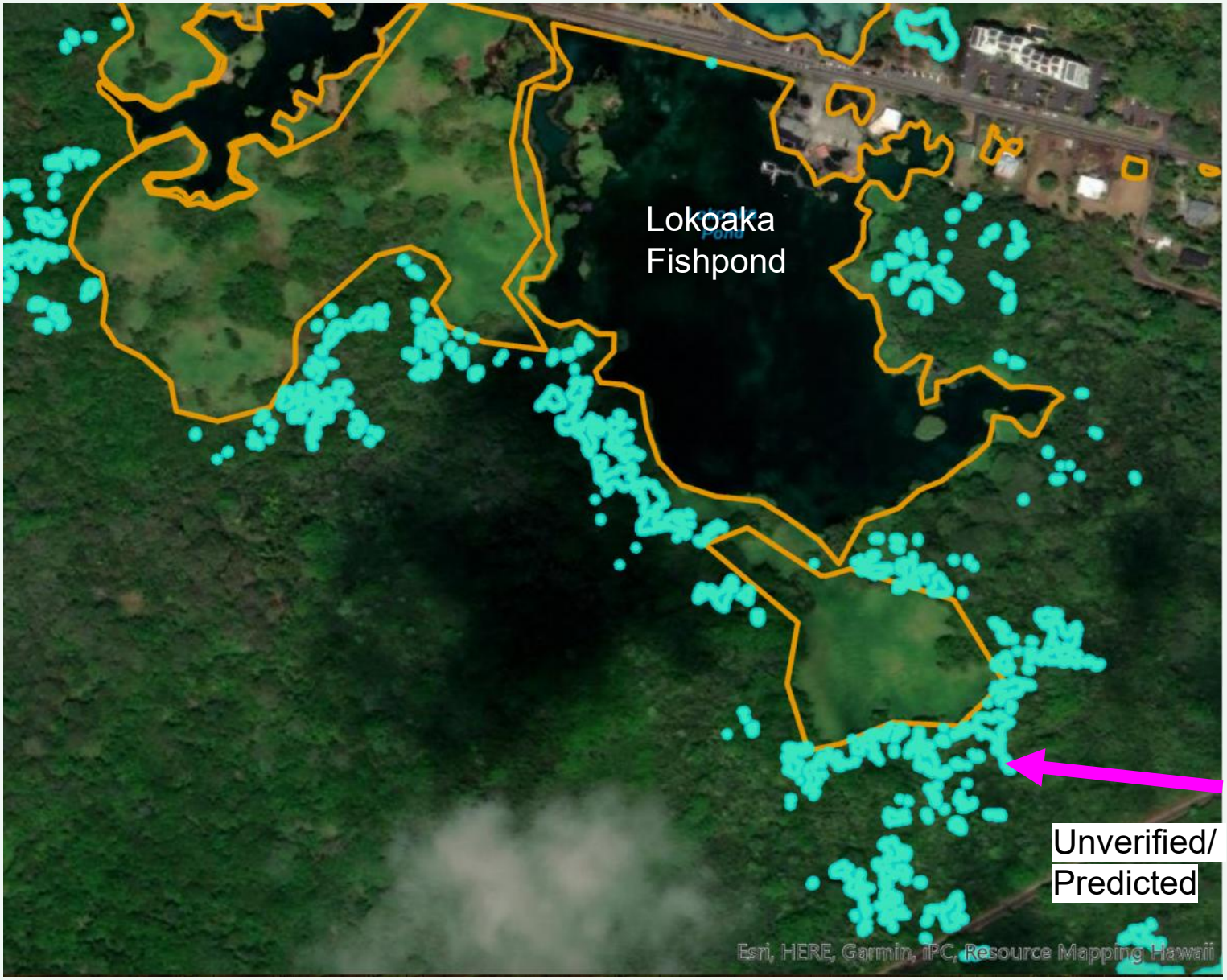


2010 data

RESULTS: COASTAL WETLAND INVENTORY

Anchialine Pool	807
Fishpond (*Loko I'a*)	8
Wetland complex	58
Predicted/ un-verified	>1000

MOST UNVERIFIED WETLANDS in FORESTED, WET AREAS



NEXT STEPS FOR MAPPING & INVENTORY

- NWI layer development
- Continue to verify wetlands in remote locations
- Share Geospatial Data with Conservation and Planning Community

END GOAL IS SMART DEVELOPMENT

Thank you!

State of Hawai‘i Department of Land and Natural Resources
- Division of Aquatic Resources
- Division of Forestry and Wildlife
- Division of State Parks

University of Hawai‘i at Mānoa - Hawai‘i Coral Reef Initiative
University of Hawai‘i Hilo
- Department of Tropical Conservation Biology and Environmental Science
- Pacific Internship Program for Exploring Sciences (PIPES)

County of Hawai‘i Planning Department
USFWS - Alaska Region
Pacific Birds Habitat Joint Venture
Mālama Hulē‘ia
Molokai Land Trust & Hawaiian Islands Conservation Collective
& many more who contributed to our planning, workshops, and protection and regulatory efforts!

Wetland Protection and Restoration Strategy Mapping Support for Hawai‘i Island

Marrack, Lisa, Troy Sakihara, Devon Aguiar, Megan Lamson, Kirsten Moy.

Marrack affiliation:
UH Hilo Department of Tropical Conservation Biology and Environmental Science

Project Summary
In Hawai‘i, coastal wetlands including anchialine pools are key mixohaline habitats that support numerous endemic birds, plants and arthropods, many of which are listed as threatened or endangered under the USFWS Endangered Species Act. Many of these wetlands are also important cultural features, and sites used by the community to perpetuate Hawaiian lifeways and for subsistence. To provide support to the State of Hawai‘i’s Department of Land and Natural Resources (DLNR) in developing the Hawai‘i Wetland Program Plan (HWPP) Protection Restoration Strategy, this project is mapping coastal wetlands on the island of Hawai‘i. Using previously developed groundwater flood models, datasets, and field surveys, we developed a GIS layer inventorying anchialine pools and other coastal wetland habitats. We are currently sharing our results with community members for feedback and using the GIS layer to update the National Wetland Inventory map for Hawai‘i Island. The DLNR Division of Aquatic Resources (DAR) and the County of Hawai‘i Planning Department staff plan to use this layer to prioritize wetlands for protection measures and restoration activities, and to regulate impacts from development and land use. This project was envisioned by an anchialine pool working group that included both government agencies, community members, cultural practitioners, and academics who met regularly from 2024-25 to revise and shape the HWPP.