Approved by Submittal by Executive Director DN

December 9, 2020

FOR ACTION

I. REQUEST

Support the Commission on Water Resources Management's Consideration of Amending the Instream Flow Standard for Heeia Stream.

II. BACKGROUND

In June 2020, the Commission on Water Resources Management (CWRM) made the Instream Flow Standard Assessment Report for Hydrological Unit 3028, Heeia (Report) available for public review. In October 2020 CWRM held a public fact gathering meeting to receive testimony and any additional information to be compiled as part of the Report. The Report is expected to serve as the primary reference of best available information for subsequent amendments to the interim instream flow standards for the surface water hydrological unit of Heeia.

III. DISCUSSION

Heeia stream flows through the approximately 400 acres of the Heeia Community Development District (HCDD), which was established by the Legislature in July 2011 and is located within the surface water hydrological unit of Heeia. Increased stream flow will contribute to HCDA's ability to fulfill the purpose of the district *"to facilitate culturally appropriate agriculture, education, and natural-resource restoration and management of the Heeia wetlands..."*
Specifically, increased stream flow within the HCDD will:

- contribute to restoring the wetlands;
- support sustainable agriculture, particularly loi kalo;
- protect and support native species habitats and ecosystems; and
- increase resilience of the wetland by partially mitigating effects of climate change on the ecosystem.

Staff is recommending that the Authority support CWRM's consideration of amending the instream flow standards of Heeia Stream to increase available water.

IV. RECOMMENDATION

Staff recommends that the Authority support CWRM's consideration of amending the instream flow standard for Heeia stream and authorize the Executive Director to transmit a letter of support to the CWRM.

Prepared By: Deepak Neupane, P.E., AIA, Executive Director DN

Reviewed By: Deepak Neupane, P.E., AIA, Executive Director DN

Date: November 30, 2020

To: Suzanne D. Case, Chairperson
Commission on Water Resource Management
State of Hawai'i Department of Land and Natural Resources
Kalanimoku Building 1151 Punchbowl Street, Room 227 Honolulu, Hawaii 96813
Email: dlnr.cwrm@hawaii.gov
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From: Dr. Kawika Winter, Reserve Manager
Dr. Yoshimi Rii, Research Coordinator
Frederick Reppun, Eduacation Coordinator
He'eia National Estuarine Reserach Reserve

Re: Testimony in support of the amending the of instream flow standards of He'eia Stream (Ko'olaupoko, O'ahu, hydrologic unit 3028) to increase the available water in support of ahupua'a restoration

Aloha to Chair Case and Commissioners,

Thank you for the opportunity to provide testimony, on behalf of the He'eia National Estuarine Research Reserve. We ask the Commission to establish an Interim Instream Flow Standard for He'eia Stream that would increase the available water in support of ahupua'a restoration. Increasing the baseflow of He'eia stream is likely to have positive effects on biodiversity, and will also facilitate the perpetuation of Native Hawaiian traditional and customary practices that are being used to restore the ahupua'a. An intact biocultural system in He'eia will increase the resilience of the community—within and beyond Ko'olaupoko—to the economic, ecological, and social shocks and stressors that are on our doorstep.

The He'eia National Estuarine Researve Reserve (NERR) covers 1,385 acres of the lower reaches of the ahupua'a of He'eia. It was established in 2017 as a collaborative management agreement among government agencies (National Oceanic and Atmospheric Administration, Department of Land and Natural Resources, Hawai'i Community Development Authority), the University of Hawai'i at Mānoa (Hawai'i Institute of Marine Biology), and Native Hawaiian-led non-profit organizations in the community (Ko'olaupoko Hawaiian Civic Club, Ko'olau Foundation, Kāko'o 'Ōiwi, Paepae o He'eia). The goals of the He'eia NERR are to support and conduct research to understand the ecological effects of ahupua'a restoration using Indigenous resource management practices – including Indigenous agro-ecology and aquaculture. Our research includes collaborations with several labs and institutions, as well as a water quality monitoring program that adheres to the highest national standards.

The restoration of the ahupua'a is conducted using Native Hawaiian traditional and customary practices, and is very much informed by archival maps and images and oral histories of

living and past kūpuna, which speak to the abundance that once existed and sustainably fed the people of Koʻolaupoko. An image of this is conveyed through an aerial photograph from 1928 (Figure 1). This allows us to see the Native Hawaiian forms of agro-ecology and aquaculture (loʻi kalo, loko kalo, loko wai, loko iʻa) that were documented in the land claim awards (LCAs) of the 1850s. These agro-ecology and aquaculture systems were developed to manage, and depended on, a substantial flow of water and nutrients through the stream and the wetlands, and out into the estuary. These systems also provide habitat for native species. This image and the associated information provide the template for restoration activities that are currently underway.

Figure 1. An aerial image from 1928 that captures the Native Hawaiian agro-ecology and aquaculture systems in Heʻeia that depended on and managed a substantial flow of water and nutrients through the stream and wetlands, and out into the estuary.

Restoring Native Hawaiian agro-ecology and aquaculture systems (loʻi kalo, loko kalo, loko wai, loko iʻa), and the habitat they provide for native species, is challenging today given the multiple stressors, historical and current: invasive species, fishing pressure, urban pollution, and climate change, to name a few. It is ultimately impossible, however, without a sufficient amount of water. We know from kamaʻāina testimonies that there was once much more water in the stream, which contributed an abundance of food on land and in the ocean, while maintaining key ecosystem services. We know from our co-management partners in the Reserve that there is not enough water for the loʻi and the loko iʻa to function properly. Given the current base flow in Heʻeia stream, our co-management partners are not able to restore the agro-ecosystems and aquaculture systems that have been documented to exist. We therefore support an increased base flow to the fullest extent possible that will allow for the full restoration of those systems, as well as the habitat they provide for native species. The Heʻeia NERR's research and monitoring program is uniquely positioned to collect long-term data that will give us detailed insight into the effects of restoring base flow in the stream. Please find attached a summary of our current understanding of the need for stream restoration in Heʻeia. We would be happy to collaborate with CWRM to document the effects of stream restoration to inform adaptive management here and in other areas.

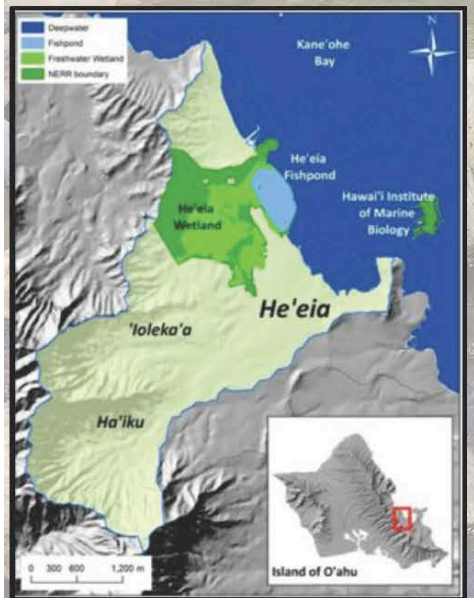
Thank you for your consideration,

Kawika Winter Ph.D.
Reserve Manager, Heʻeia NERR

Yoshimi Rii, Ph.D.
Research Coordinator, Heʻeia NERR

Frederick Reppun, M.S.
Education Coordinator, Heʻeia NERR

Comments on He‘eia Stream Instream Flow Standard (IFS) Assessment Report



Provided by the He‘eia National Estuarine Research Reserve

November 2020

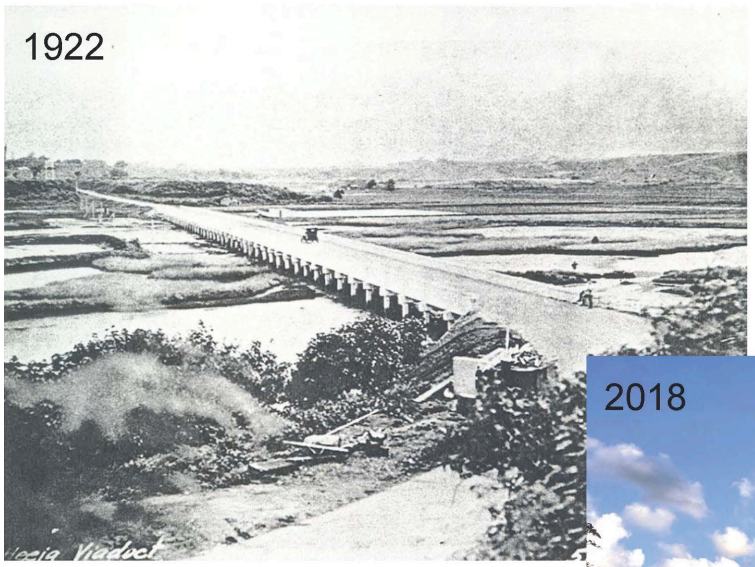
He‘eia Ahupua‘a - Then and Now

1928

2005

2019

He‘eia Ahupua‘a - Then and Now



Why restore water to He‘eia Stream?

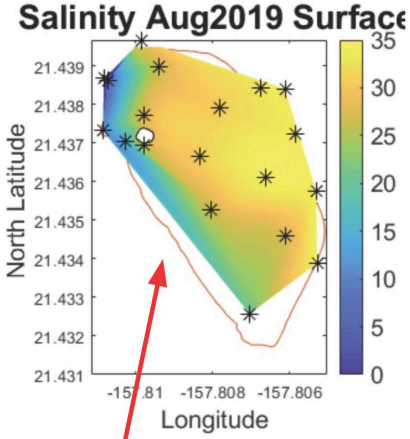
1. Functional lo‘i kalo and loko i‘a depend on, and are currently limited by, the flow of fresh water.
2. Native species and ecosystems, important culturally and for economic and food security, would benefit directly by increased streamflow, and indirectly through the ecosystem services provided by lo‘i and loko i‘a
3. Increased streamflow can help to control growth of invasive wetland vegetation.
4. More freshwater would help to offset the effects of climate change.

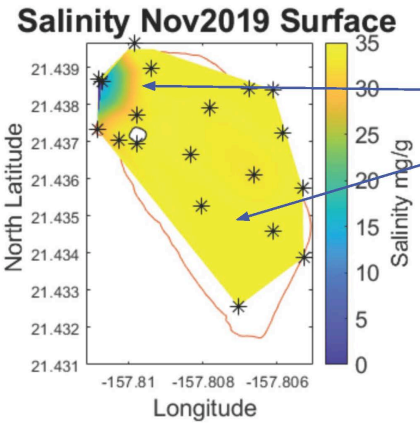
Increasing streamflow would enable expansion of restored loʻi kalo at Kākoʻo ʻŌiwi

- Currently the restoration of loʻi kalo is limited by water flow, particularly during the dry season
- In addition to the 14 acres already restored, 10 additional acres are ready for immediate reopening pending water availability
- Approximately 100 acres of land is suitable for loʻi within the wetland
- Increased flow would lower water temperatures, contributing to less kalo rot, higher yields, and lower incidence of water-borne diseases (e.g. swimmer's itch) that affect farmers

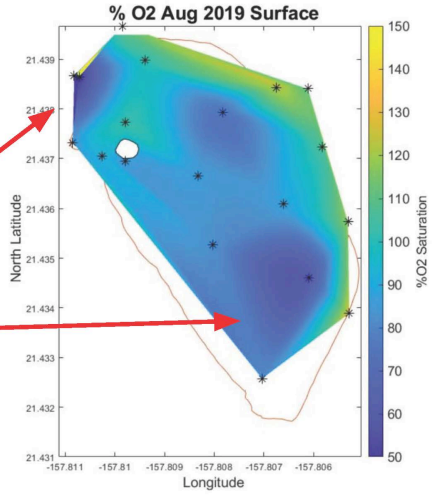
Map showing current loʻi and wetlands (light green) and areas available for immediate expansion (dark green) by K. Falinsky

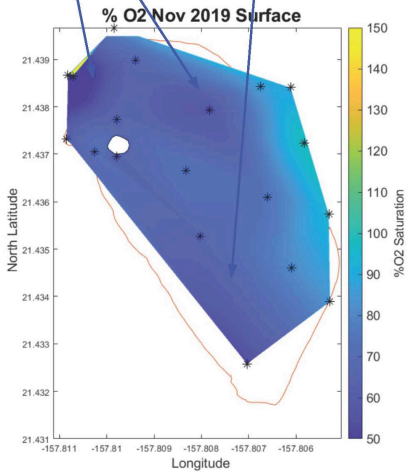
He‘eia Fishpond would benefit from more fresh water, which increases oxygen levels and decreases water residence time





After a dry, low wind period, the pond is mostly salty, with greater areas of low oxygen waters. Freshwater flow into the pond is minimal, with freshwater concentrated at the northwest area of the pond

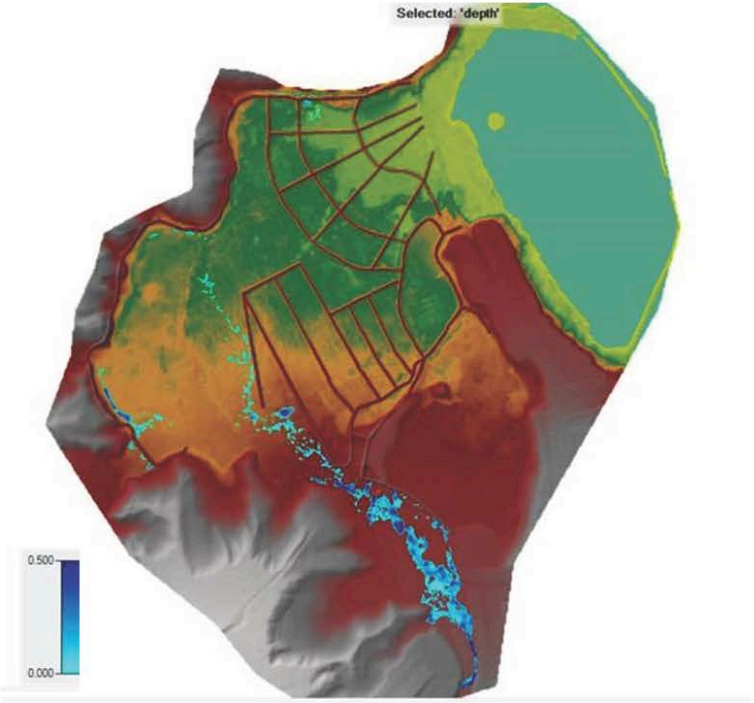




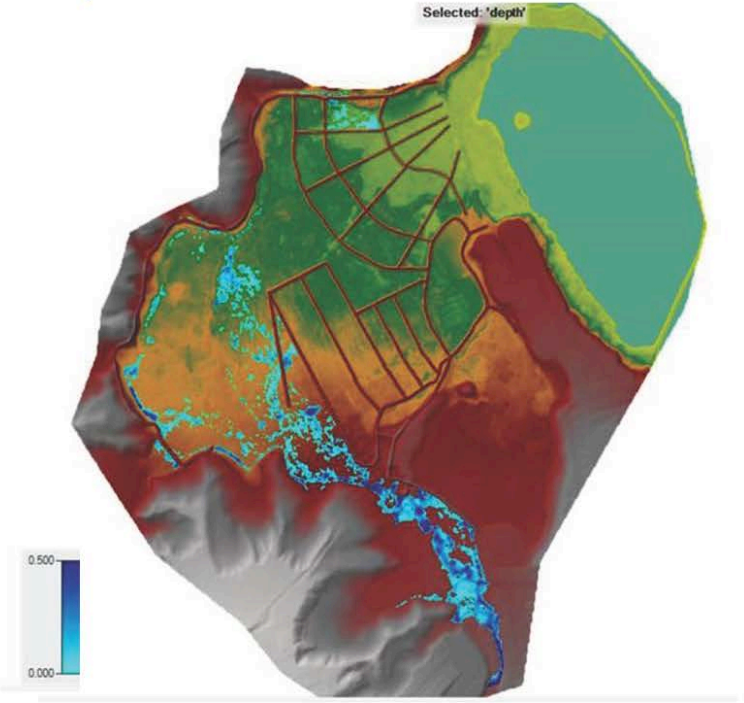
The water at the mauka bank of the pond has a longer residence time, due to less clear path for freshwater flow into the pond → **drawdown of oxygen → unfavorable conditions for fish**

Data by Evan Lechner, Ph.D. candidate, UH Mānoa

Flood models indicate possible increase in natural wetland habitat if stream baseflow restored to pre-1940 levels



CURRENT average baseflow (3.99 cfs)
→ inundation of **8 acres**



RESTORED average baseflow (7.98 cfs)
→ inundation of **19 acres**

Flood models (constructed by USFS and Division of Aquatic Resources) indicates expanded natural wetlands with restored flow. While loʻi would temporarily divert water from some areas, the loʻi themselves would expand wetland habitat.

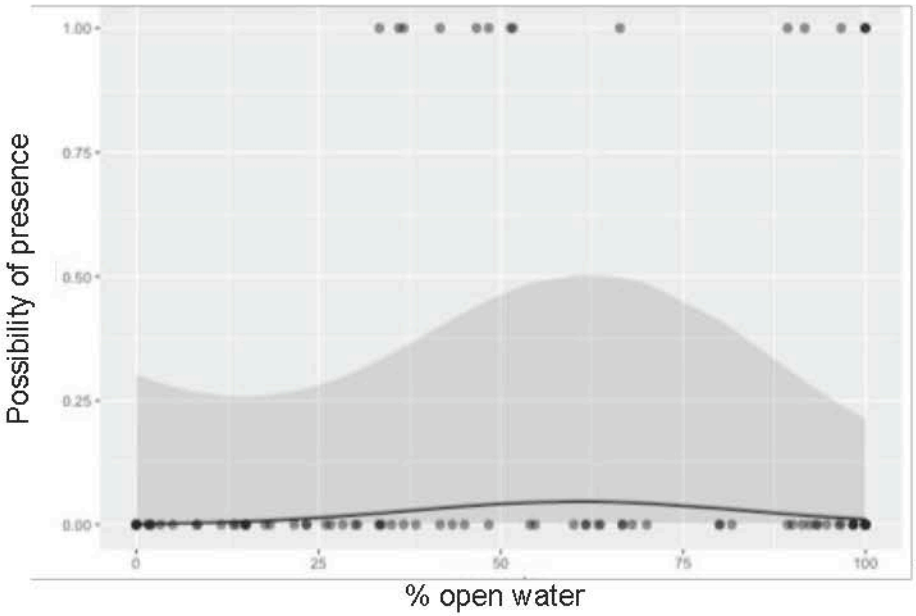
Endangered Hawaiian waterbirds use natural wetland and loʻi habitat in Heʻeia

- ʻAlae ʻula (Hawaiian gallinule, *Gallinula galeata sandvicensis*) - 1,000 individuals on Oʻahu and Kauaʻi (Sonsthagen et al. 2018)

Initial studies demonstrate that ʻalae ʻula utilize all stages of loʻi cultivation for foraging and nesting (Eryn Opie, M.S. candidate, UH Mānoa, personal communication).

Endangered Hawaiian waterbirds use natural wetland and loʻi habitat in Heʻeia

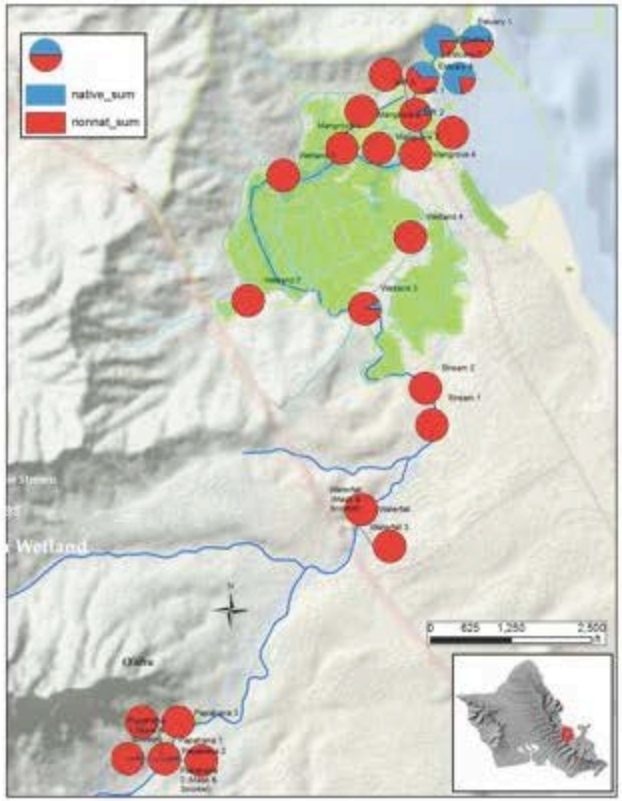
- ʻAeʻo (Hawaiian stilt, *Himantopus mexicanus knudseni*) - 1,700 individuals statewide



Initial studies in restored Heʻeia loʻi areas show that ʻaeʻo may prefer with **50-75% open water** and water depths around 5-10 cm. Areas fitting this description would increase under restored streamflow scenario due to increase in naturally inundated area and ability to open more loʻi.

Data contributed by Eryn Opie, M.S. candiate, UH Mānoa

Decreased water quality correlates with fewer native fish



Data contributed by The Nature Conservancy, He'eia NERR, and Division of Aquatic Resources

Recent fish monitoring in He‘eia shows native populations only at the stream mouth, with almost 100% invasive aquarium fish detected through the wetland and He‘eia Stream.

Native fish, such as ‘āholehole and ‘ama‘ama, were once found throughout the wetland.

Juvenile mullet (‘ama‘ama) in He‘eia would benefit from increased stream connectivity and water quality

- ‘Ama‘ama, an important food fish in the Kāne‘ohe Bay area, move between estuary and stream habitats on a daily basis in places where conditions allow.
- **An increase in streamflow would likely lead to more well-formed channels connecting the stream and estuary.**
- Mullet prefer deeper, wider channels that improve their ability to evade predators, and provide better temperature and dissolved oxygen conditions.
- In the estuary and fishpond, fresh water and the nutrients it carries lead to growth of algae on which mullet feed.

Kauoa Fraiola, Ph.D., personal communication

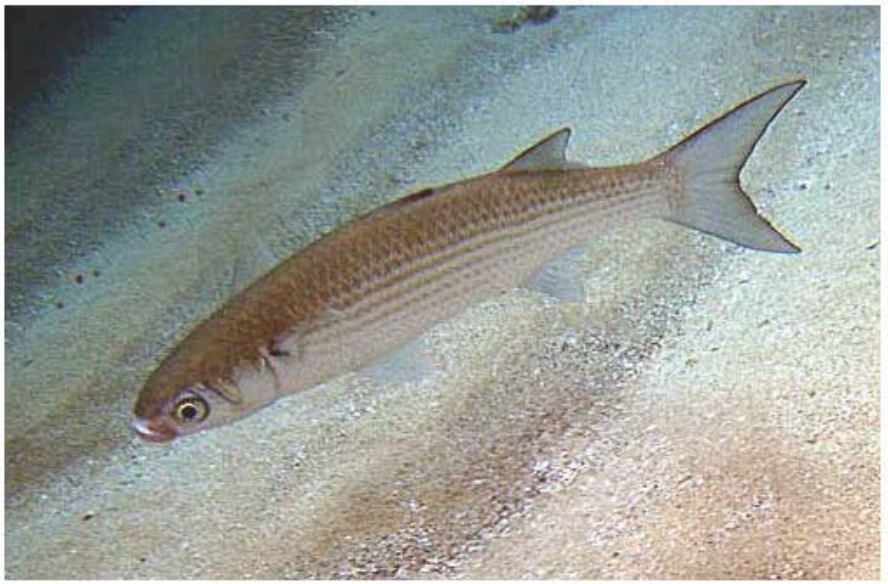


Photo: Bryan Harry. http://www.botany.hawaii.edu

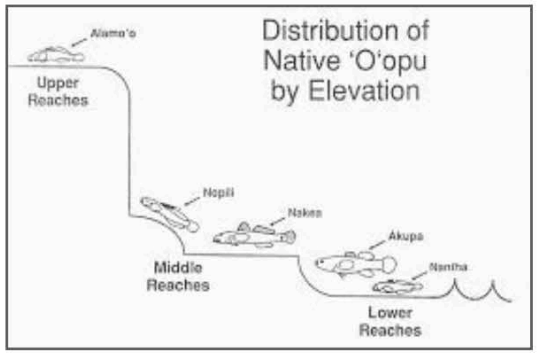
‘O‘opu would benefit from increased stream connectivity and water quality

- 3 ‘o‘opu species (nākea, ‘akupa, & naniha) have been observed in He’eia, in low abundances. They are listed under Hawaii’s Department of Natural Resources Species of Greatest Conservation Need (SGCN), which are species identified in need of conservation action from key threats potentially affecting their future survival.
- These native (endemic except for nakea) freshwater species utilize both brackish and freshwater habitats. Their distribution provides insight into fish passage and habitat health
- **‘O‘opu naniha, previously undocumented, have been observed returning to areas within He‘eia wetlands due to mangrove removal and restoration of habitat (TNC, DAR, He‘eia NERR).**
- **These species would directly benefit from restoration of natural baseflow by creating more well-defined channels, increasing habitat connectivity necessary for their growth, reproduction, and survival (K. Fraiola, pers. comm., DAR)**

O’opu nakea (*Awaous guamensis)*

O’opu akupa (*Eleotris sandwicensis)*

O’opu naniha (*Stenogobius hawaiiensis)*



http://www.nanfa.org/ac/native-stream-fishes-hawaii.pdf

Forage Fish (Mid-Trophic Level Species)

Two Hawaiian endemic forage fish species known as nehu (*Encrasicholina purpurea*) and ʻiao (*Atherinomorus insularum*) utilize estuary habitats for survival. While ʻiao are capable of inhabiting a range of nearshore marine habitats, nehu are exclusively found in estuaries. According to Heʻeia fishermen, Kāneʻohe Bay in general and the Heʻeia stream mouth and estuary specifically were important habitat for nehu (Greg Miranda and Fred Takebayashi, personal communication).

Economic importance: Both species were historically important as bait in the pole and line skipjack tuna fishery. Nehu were the preferred species and were highly sought after by subsistence and commercial fishermen.

Ecological importance: Forage fish occupy an important ecological role in Hawaiʻi estuaries by preying on lower trophic levels (i.e. zooplankton) and providing food for higher trophic level organisms (i.e. predatory fish, wetland birds) (Nakoa Goo, Ph.D. candidate, UH Mānoa, personal communication).

Nehu (Encrasicholina purpurea)


ʻIao (Atherinomorus insularum)

Nehu would directly benefit from restoration of streamflow

Nehu populations have declined throughout their entire range, in part due to habitat loss, and are infrequently seen at the mouth of He‘eia stream. When sighted, nehu are often observed being actively preyed upon by a variety of predatory fish and bird species. Restoring stream flow in He‘eia would promote enhanced biological productivity and habitat suitable for supporting the replenishment and persistence of nehu and ‘iao populations in He‘eia .

Nakoa Goo, Ph.D. candidate, UH Mānoa, personal communication and Uchida, Richard “The fishery for Nehu, *Stolephorus purpureus*, a live bait used for Skipjack Tuna Fishing in Hawai‘i” (US Dep. Commerce, NOAA Technical Rep, NMFS Circ. 408)

Other federally listed endangered species in He‘eia wetlands

Blackline Hawaiian damselfly *(Megalagrion nigrohamatum nigrolineatum)*

- Found in the slow sections or pools along mid-reach and headwater sections of perennial streams and in seep-fed pools along overflow channels bordering the stream.
- Critical habitat exists in the middle upper reaches of the He‘eia watershed.
- **Reductions in streamflow likely limit the available habitat for Megalagrion**, particularly during drought periods and in the middle and upper stream reaches that are more prone to drying.

‘Ope‘ape‘a or Hawaiian hoary bat *(Lasiurus cinereus semotus)*

- Hawaii’s only native terrestrial mammal
- **Water courses and stream edges are important foraging areas**
- Food source tied to aquatic dependant invertebrates

Low flow impact on native vegetation

Changes in vegetation in the He'eia wetland after mangrove removal indicate preference for terrestrial plant species. This is likely due to low water levels restricting habitat for native wetland vegetation species. More fresh water would help to control growth of invasive vegetation.

According to vegetation data collected by TNC and He'eia NERR

Effects of climate change: storms and runoff

Hawai‘i trends:

- Increase in consecutive days with rainfall
- Increase in extreme precipitation events, leading to increased flooding, runoff, and erosion.

USGCRP, 2018: *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II. doi: 10.7930/NCA4.2018*

Lo‘i kalo act as sediment traps during storm events. Some lo‘i have recorded an accumulation of 15-30 mm of sediment per year (K. Falinsky). Increased stream base flow would enable expansion of lo‘i, preventing sediment from reaching the fishpond and bay during floods.

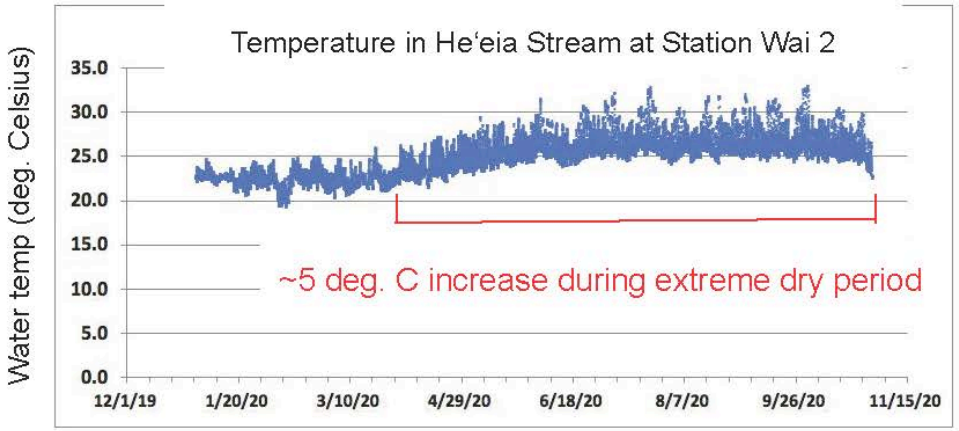
Data by TNC

Effects of climate change: water temperature

O‘ahu trends:

- Increase in air temperatures
- Decrease in rainfall
- Decrease in streamflows
- Increase in consecutive dry days and drought frequency

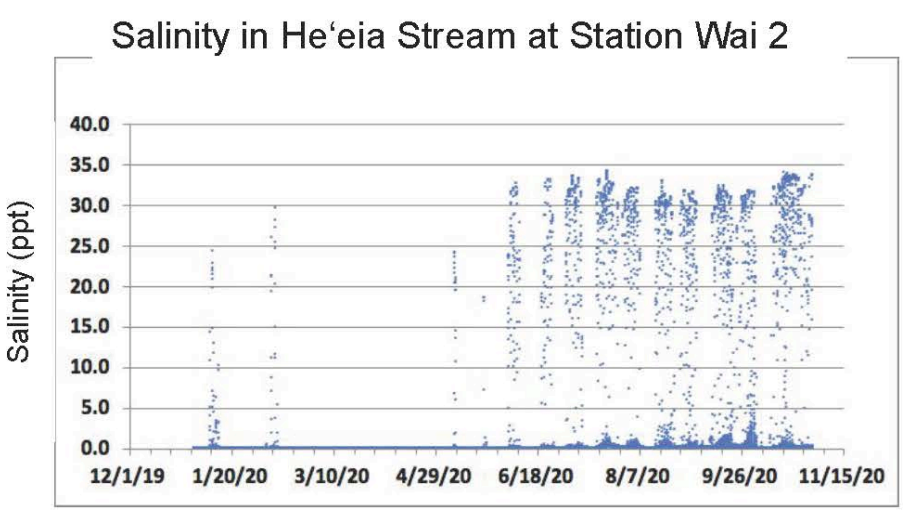
USGCRP, 2018: *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume IIdoi: 10.7930/NCA4.2018*

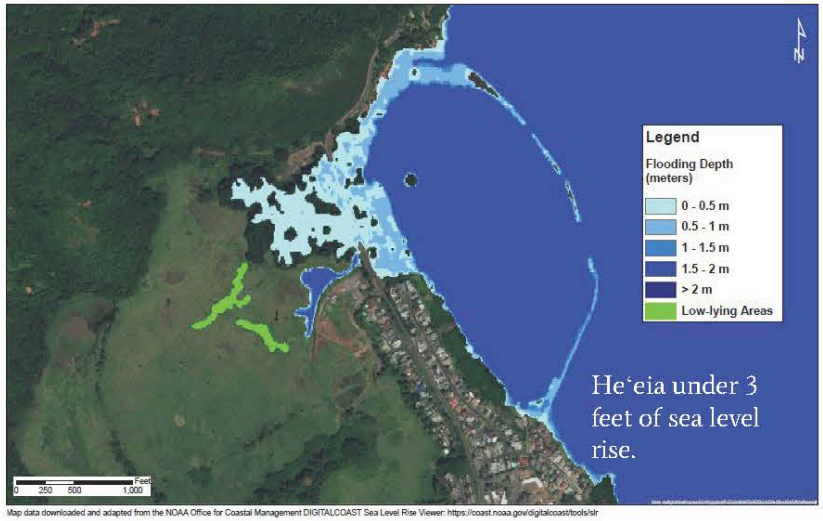


Low flow and high air temperatures **increase water temperature in He‘eia Stream**, which is detrimental to kalo production and native fish species. Climate change will further lower stream volume and increase air temperatures.

Data by He‘eia NERR

Effects of climate change: saltwater intrusion





Low "dry period" flow resulted in **increased saltwater intrusion during high tide events**. As these events increase they may lead to compression of habitat for freshwater and estuarine organisms. **More freshwater would increase resilience of the wetland to sea level rise.**

Data at Wai 2 by He'eia NERR