Estuarine and Fishpond Habitats

Climate Vulnerability Assessment and Adaptation Strategies for Hawai'i

HABITAT DESCRIPTION

Estuarine habitats occur at the fresh and saltwater interface, and are characterized by deep water habitat and brackish water conditions. Salinity, water temperature, water levels, and dissolved oxygen levels vary temporally and spatially according to freshwater input and the extent of tidal influence. Hawaiian fishpond systems (loko i'a) are natural or artificial enclosures used to cultivate fish, plants, and other freshwater and saltwater food sources. There are several different kinds of loko i'a, including saltwater loko kuapa (enclosures built on reefs) and loko 'umeiki (permanent fish trap structures), brackish water loko pu'uone (enclosed by sand, connected to the ocean via ditches or channels), and freshwater loko i'a kalo (irrigated taro ponds) and loko wai (natural ponds) with no connection to the ocean. Estuaries and fishponds support a variety of marine, estuarine, and freshwater species.

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HABITAT VULNERABILITY

Estuaries and fishponds are sensitive to climatic factors and disturbance regimes that affect freshwater, sediment, nutrient, and contaminant delivery because these factors influence species composition, integrity, and overall habitat extent. Biota are also sensitive to water temperature and salinity changes. A variety of non-climate stressors reduce or alter freshwater inflow, degrade water quality by increasing pollutant and sediment delivery, or degrade habitat quality by increasing competition, predation, or disturbance. Habitat resilience is bolstered by high habitat extent, high public value, and the tolerance of component species to variable conditions. However, current degradation of these habitats undermines their ability to resist and recover from impacts.

PROJECTED FUTURE CHANGES	POTENTIAL IMPACTS ON ESTUARINE AND FISHPOND HABITATS
Changes in **precipitation**; increased **drought risk** for low-elevation leeward areas; reduced **soil moisture**	• Drier conditions will alter native vegetation composition and cover, and may increase vulnerability to exotic invasion • Drier conditions may impair fishpond water quality by allowing sediment buildup and reducing flushing
Increased frequency and strength of **tropical storms/ hurricanes**; uncertain change in **extreme precipitation events**	• Generate high streamflows, which moderate temperature and salinity conditions, but also deliver sediment, nutrients, and contaminants which can degrade water quality and reduce native species survival • Storm waves damage fishpond walls and deposit debris, reducing pond depth
Sea level rise; increased **coastal flooding** *+0.4 m (1.3 ft) to +3.3 m (10.8 ft) of sea level rise by 2100*	• Increased salinity, potentially altering species distributions, vegetation composition and cover, and promoting more salt-tolerant species • May increase exotic species introductions and dominance • Altered habitat extent and distribution
Increased **sea surface** and **stream temperatures**	• Altered native species feeding, growth, reproduction, and survival • May promote invasive species
Increased **wildfire** & **disease**	• Fire increases runoff and sediment delivery • Avian disease increases bird mortality

Drivers of Habitat Vulnerability

- **Climatic factors and disturbance regimes:** Drought, precipitation amount & timing, soil moisture, extreme precipitation events, tropical storms/ hurricanes, sea level rise, coastal flooding, sea surface temperature, freshwater temperature, disease, wildfire
- **Non-climate factors:** Invasive species, water diversions, groundwater development, roads/highways/trails, residential & commercial development, pollution & poisons, recreation

ADAPTIVE CAPACITY

Factors that enhance adaptive capacity:

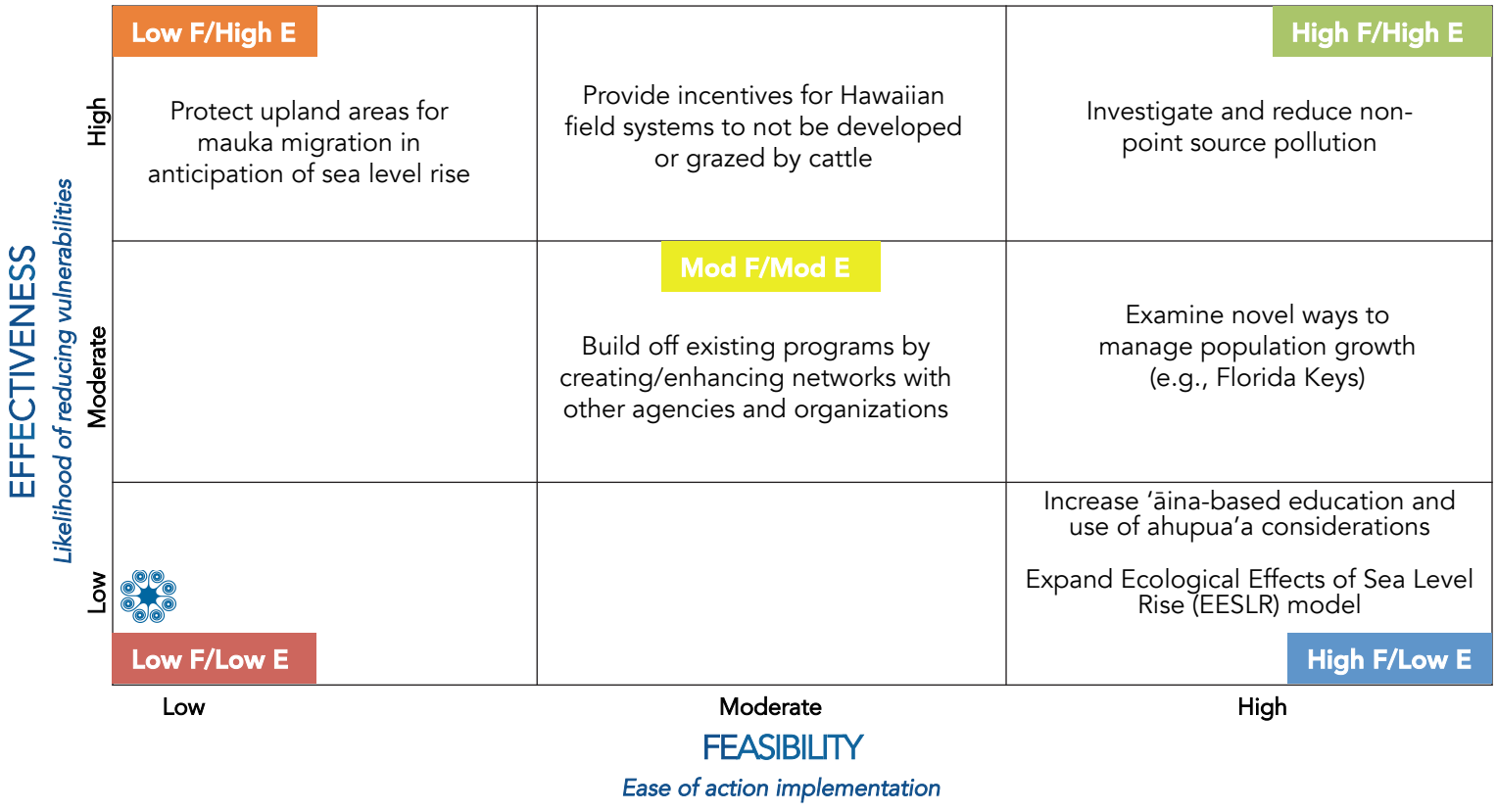
+ High habitat extent
+ Species tolerant of variable and dynamic conditions
+ Moderate-high public value
+ Increasing interest in fishponds for their cultural, economic, and ecological benefits
+ Some habitats are protected and managed

Factors that undermine adaptive capacity:

– Many habitats degraded by invasive species or human activities
– Small tidal ranges limit capacity to accrete sediment and keep pace with sea level rise
– Have many rare, endemic, and endangered species, which are more vulnerable to impacts
– Face competing interests with coastal development

ADAPTATION STRATEGIES FOR ESTUARINE AND FISHPOND HABITATS

Types of Adaptation Approaches	Adaptation Strategy	Specific Action
Resistance: Prevent climate change from affecting a resource. *Near-term approach*	Maintain/improve water quality and quantity	• Provide incentives for Hawaiian field systems to not be developed or grazed by cattle • Investigate and reduce non-point source pollution
Resilience: Help resources weather climate change by avoiding the effects of or recovering from changes *Near- to mid-term approach*	Create a more nimble planning and zoning process that promotes natural landscapes and community values and is adaptable to climate change	• Identify island carrying capacity and examine novel ways to manage population growth (e.g., Florida Keys) • Increase ʻāina-based education and use of ahupuaʻa considerations
Response: Intentionally accommodate change and adaptively respond to variable conditions *Long-term approach*	Anticipate and facilitate habitat migration	• Protect upland areas for mauka migration in anticipation of sea level rise
Knowledge: Gather information about climate impacts and/or management effectiveness in addressing climate challenges *Near- to long-term approach*	Change laws/policies to protect and promote community response to climate change and impacts	• Expand Ecological Effects of Sea Level Rise (EESLR) model to cover the whole island
Collaboration: Coordinate efforts and capacity across landscapes and agencies *Near- to long-term approach*	Create new/improve partnerships to increase capacity	• Build off of existing programs by creating/enhancing networks with other agencies and organizations



Further information and citations can be found in the Hawaiian Islands Climate Vulnerability and Adaptation Synthesis and other products available online at www.bit.ly/HawaiiClimate.

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