

Estuarine Habitats

Climate Vulnerability Assessment and Adaptation Strategies for O'ahu

HABITAT DESCRIPTION

Estuarine habitats occur at the fresh and saltwater interface, and are characterized by brackish water conditions. Estuarine habitats on O'ahu are considered to include coastal saline wetlands, stream mouths, and anchialine pools. Salinity, water temperature, water levels, and dissolved oxygen levels vary temporally and spatially according to freshwater input and the extent of tidal influence. In general, estuarine habitats are dynamic systems, with complex food webs supported by inputs of terrestrial and marine organic matter that feeds primary (e.g., plankton) and secondary (e.g., invertebrates, fish) producers. These habitats support a variety of wildlife (e.g., shorebirds, waterfowl, aquatic species).



HABITAT VULNERABILITY

Sea level rise, saltwater intrusion, and streamflow affect estuarine salinity, hydrology, and water quality. Along with water temperature, these factors affect overall habitat distribution, availability, and species composition. Non-climate stressors (e.g., invasive species, pollution) will contribute to loss of native species and increased exotic dominance. Agriculture, development, and roads reduce estuarine habitat, may compound climate-driven changes in hydrology and sedimentation, and reduce space for habitat migration. Projected population growth will exacerbate existing stressors. Estuarine habitats are abundant and component species are tolerable of variable conditions. However, many estuaries are degraded, and human land use limits potential for inland migration.



Drivers of Habitat Vulnerability

- **Climatic factors and disturbance regimes:** Sea level rise, coastal flooding, saltwater intrusion, streamflow, sea surface and stream temperatures
- **Non-climate factors:** Invasive species (ungulates, terrestrial and marine species), residential & commercial development, pollution & poisons, agriculture & aquaculture, roads/highways/trails, population growth

| PROJECTED FUTURE CHANGES | POTENTIAL IMPACTS ON ESTUARINE HABITATS |
|--|---|
| Sea level rise; increased coastal flooding and saltwater intrusion +0.4 m (1.3 ft) to +3.3 m (10.8 ft) of sea level rise by 2100 | <ul style="list-style-type: none"> • Increased salinity, potentially causing shifts to more salt-tolerant vegetation, reduced vegetative species richness and cover by reducing seed germination, altered species distributions, and increased aquatic invasive species dominance • Increased flooding depth and duration, potentially affecting species composition • Altered habitat availability (initial increases and potential new habitat and/or eventual overall loss if inland migration is not possible) |
| Reduced base flows and flashier/more variable overall streamflow | <ul style="list-style-type: none"> • Shifts in habitat extent (e.g., upstream expansion of estuarine conditions) • Altered food webs by reducing inputs of upland particulate organic matter • Reduced flushing promotes extreme conditions (e.g., high temperatures and salinities, hypoxic conditions) • Reduced flushing may increase vulnerability to invasion |
| Increased sea surface and stream temperatures | <ul style="list-style-type: none"> • Altered community composition, including potential increase in invasive species and altered growth, recruitment, and survival of native species |

ADAPTIVE CAPACITY

Factors that enhance adaptive capacity:

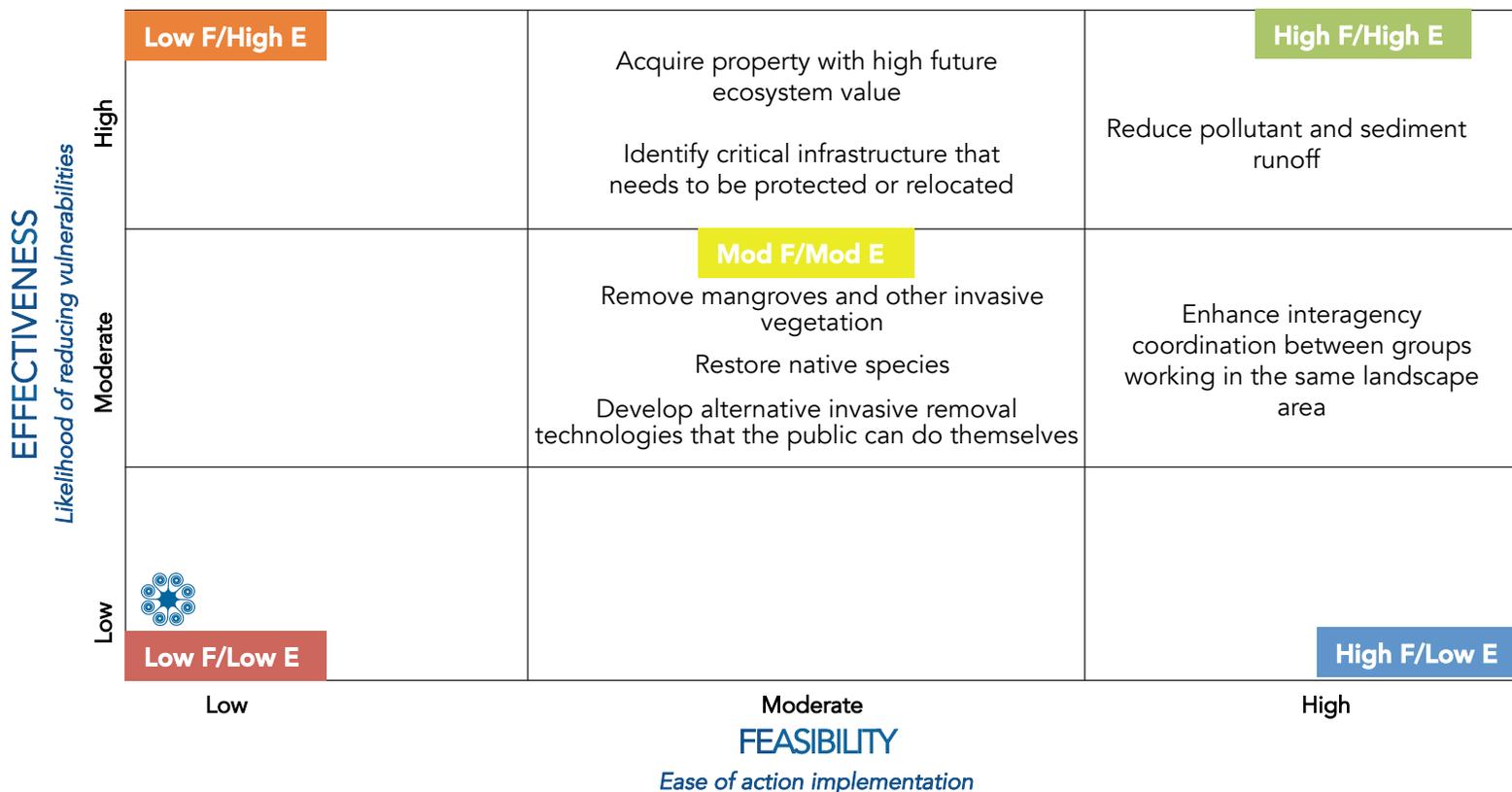
- + Estuarine species typically tolerant of variable conditions
- + Several habitat areas are protected and actively managed, which may help buffer impacts
- + Provide a variety of ecosystem services
- + O'ahu has a high number of estuarine habitats and habitat diversity improves with restoration efforts

Factors that undermine adaptive capacity:

- Many estuaries are dominated by invasive species or degraded by agricultural and urban runoff
- Limited capacity to accrete sediment and keep pace with sea level rise due to small tidal ranges
- Support many rare, endemic, and endangered species, which may be more vulnerable to climate impacts

ADAPTATION STRATEGIES FOR ESTUARINE HABITATS

| Types of Adaptation Approaches | Adaptation Strategy | Specific Action |
|---|--|---|
| Resistance: Prevent climate change from affecting a resource. <i>Near-term approach</i> | Restore and conserve native shoreline and estuary habitat | <ul style="list-style-type: none"> Remove mangroves and other invasive vegetation |
| | Reduce non-climate stressors that affect water quality | <ul style="list-style-type: none"> Reduce pollutant and sediment runoff (e.g., revegetate slopes with native plants, reduce acreage of fallow agricultural land) |
| Resilience: Help resources weather climate change by avoiding the effects of or recovering from changes <i>Near- to mid-term approach</i> | Restore and conserve native shoreline and estuarine habitat | <ul style="list-style-type: none"> Restore native species |
| Response: Intentionally accommodate change and adaptively respond to variable conditions <i>Long-term approach</i> | Anticipate and facilitate habitat migration | <ul style="list-style-type: none"> Acquire property with high future ecosystem value (e.g., less developed, less exposed/vulnerable sites) Identify critical infrastructure that needs to be protected or relocated |
| Knowledge: Gather information about climate impacts and/or management effectiveness in addressing climate challenges <i>Near- to long-term approach</i> | Develop more efficient technologies/tools for habitat restoration and invasive species control | <ul style="list-style-type: none"> Develop alternative removal technologies that the public can do themselves |
| Collaboration: Coordinate efforts and capacity across landscapes and agencies <i>Near- to long-term approach</i> | Develop more efficient technologies/tools for habitat restoration and invasive species control | <ul style="list-style-type: none"> Enhance interagency coordination between groups working in the same landscape area |



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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