

Shoreline Habitats

Climate Vulnerability Assessment and Adaptation Strategies for Kaua'i

HABITAT DESCRIPTION

Kaua'i has 110 miles of shoreline, including rocky shoreline, steep sea cliffs, lava tubes and caves, sandy beach, sand dunes, and lithified sand dune coast. Shoreline habitat structure and community composition are shaped by wind, waves, storms, and precipitation, and conditions can be arid, mesic, or wet. In general, Kaua'i's shorelines provide habitat for a variety of wildlife, including aquatic and terrestrial invertebrates, shorebirds, seabirds, and nesting or basking marine species.



HABITAT VULNERABILITY

Shorelines are sensitive to drivers that alter sediment delivery patterns and increase erosion and inundation (e.g., sea level rise, storms), which can reduce habitat availability. They are also sensitive to precipitation changes and drought, which affect vegetation communities and habitat conditions (e.g., cave humidity). Non-climate stressors (e.g., pollution, invasive species, recreation) further alter vegetative and faunal composition by disturbing and outcompeting native species. Additionally, development and armoring eliminate shoreline habitat, prevent landward migration, and increase erosion. Shorelines are currently degraded and face competing interests with development. However, they are valued by the public, provide many ecosystem services, and some areas are protected and managed.

PROJECTED FUTURE CHANGES	POTENTIAL IMPACTS ON SHORELINE HABITATS
Increased frequency and strength of tropical storms/hurricanes ; uncertain change in extreme precipitation events	<ul style="list-style-type: none">Increased flash flooding, inundation, and erosionWind and waves can kill coastal vegetation or alter coastal vegetative composition by changing soil salinity and moistureWave action alters rocky shoreline community structure (more filter feeders, less macroalgae and grazers)
Sea level rise +0.4 m (1.3 ft) to +3.3 m (10.8 ft) by 2100	<ul style="list-style-type: none">Increased erosion and altered sandy beach sediment delivery from fringing reefsIncreased inundation; potential habitat loss if inland migration is not possibleReduced habitat for seal haul out, turtle nesting and basking, and seabird nesting
Changes in precipitation ; increased drought risk in low elevation leeward areas	<ul style="list-style-type: none">Altered plant community composition and species' distributionsDrier conditions promote exotic speciesDrier conditions increase mortality of cave species, but rain causes cave sedimentation
Reduced baseflows ; increasingly variable riverine flooding	<ul style="list-style-type: none">Delivers sediment to coast, altering shoreline positionIncreased pollutant & contaminant deliveryIncreased cave siltation
Changes in wind and circulation	<ul style="list-style-type: none">Trade wind waves cause beach erosion but also deliver sedimentTrade winds facilitate inland plant dispersal

Sandy Beach and Sand Dunes



Low Moderate High

Rocky Shorelines, Cliffs, and Caves



Low Moderate High

Drivers of Habitat Vulnerability

- **Climatic factors and disturbance regimes:** Tropical storms/hurricanes, extreme precipitation events, sea level rise, precipitation amount & timing, drought, streamflow, riverine flooding, wind & circulation
- **Non-climate factors:** Residential & commercial development, recreation, invasive species (trees & shrubs, parasites & pathogens), seawalls, pollution & poisons

ADAPTIVE CAPACITY

Factors that enhance adaptive capacity:

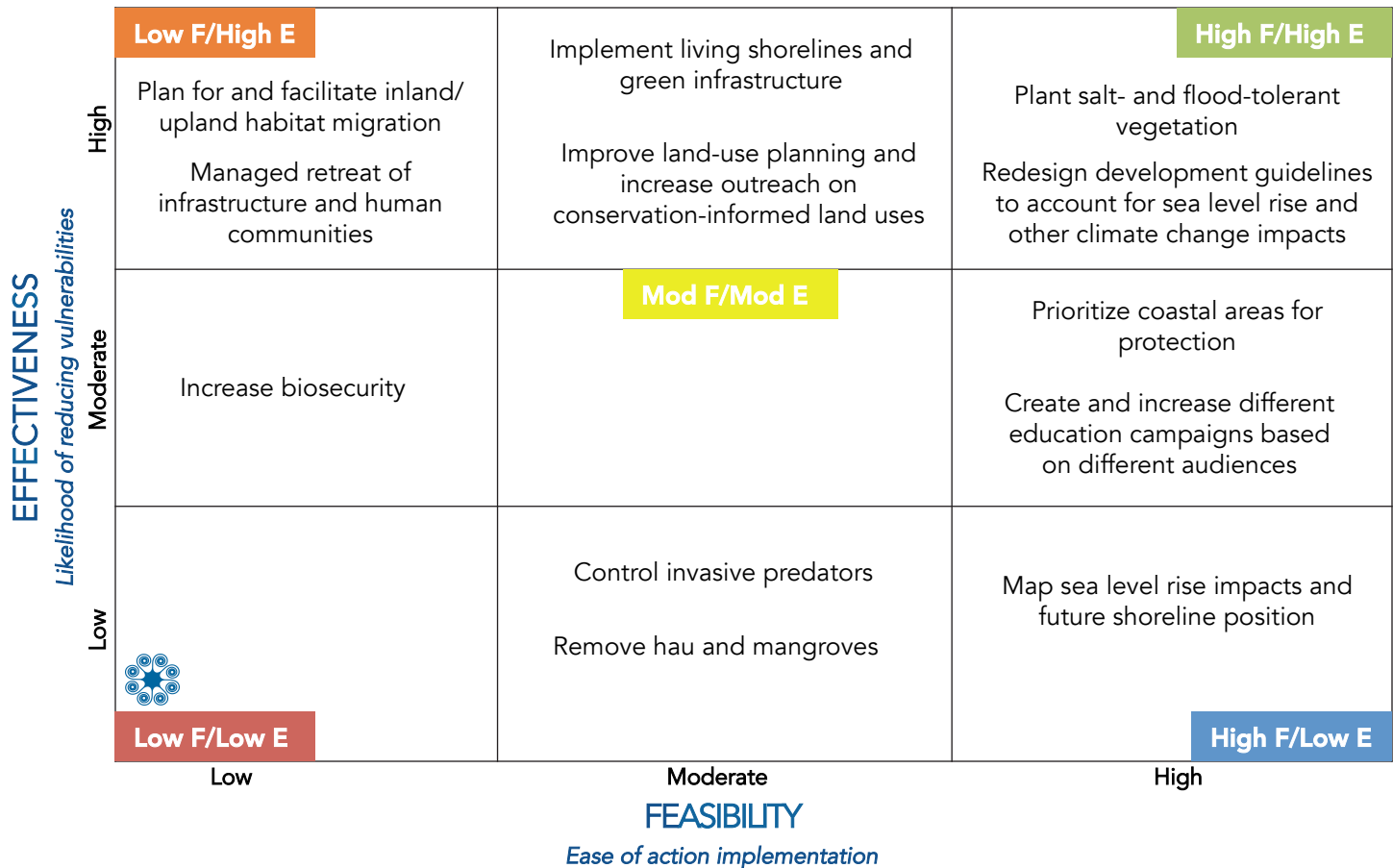
- + Abundant rocky shoreline, cliff, and sandy beach habitat
- + Shoreline species typically adapted to variable and dynamic conditions
- + Rocky shorelines resistant to erosion
- + Cliffs resistant to some stressors due to limited accessibility
- + High public value and provide many ecosystem services
- + Some habitats protected and managed

Factors that undermine adaptive capacity:

- Low sand dune and cave habitat abundance
- Most shoreline habitats degraded
- Sandy beaches have limited capacity to accrete sediment due to small tidal ranges; armoring prevents migration
- Have many rare and endemic species, which are more vulnerable to impacts
- Shorelines face competing interests with development

ADAPTATION STRATEGIES FOR SHORELINE HABITATS

Types of Adaptation Approaches	Adaptation Strategy	Specific Action
Resistance: Prevent climate change from affecting a resource <i>Near-term approach</i>	Manage invasive species	<ul style="list-style-type: none"> • Increase biosecurity • Control invasive predators (e.g., mongoose, cats) • Remove hau and mangroves
Resilience: Help resources weather climate change by avoiding the effects of or recovering from changes <i>Near- to mid-term approach</i>	Prepare for sea level rise impacts	<ul style="list-style-type: none"> • Prioritize coastal areas for protection • Redesign development guidelines to account for sea level rise and other climate change impacts • Plant salt- and flood-tolerant vegetation
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"> • Implement living shorelines and green infrastructure • Plan for and facilitate inland/upland habitat migration • Managed retreat of infrastructure and human communities
Knowledge: Gather information about climate impacts and/or management effectiveness in addressing climate challenges <i>Near- to long-term approach</i>	Prepare for sea level rise impacts	<ul style="list-style-type: none"> • Map sea level rise impacts and future shoreline position
Collaboration: Coordinate efforts and capacity across landscapes and agencies <i>Near- to long-term approach</i>	Reduce human pressure on native ecosystems and species	<ul style="list-style-type: none"> • Improve land-use planning and increase outreach on conservation-informed land uses • Create and increase different education and outreach campaigns based on target audiences (resident vs. tourist, older vs. younger)



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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