Stream Habitats

Climate Vulnerability Assessment and Adaptation Strategies for Maui, Lānaʻi, and Kahoʻolawe

HABITAT DESCRIPTION

Perennial and intermittent streams typically have high flow variability due to small catchment basins, steep slopes, and limited channel storage. Perennial streams are critically important for native aquatic fauna, and occur in areas with higher precipitation and persistent groundwater discharge. Intermittent and some diverted streams only connect to the ocean during high precipitation periods, and provide lower habitat quality and reduced biodiversity relative to perennial streams. Maui has 90 perennial streams, while Kahoʻolawe and Lānaʻi have only intermittent streams.

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HABITAT VULNERABILITY

Streams are sensitive to climatic changes that reduce water availability or alter streamflow volume, including precipitation changes, drought, tropical storms, flooding, and air temperature. Stream fauna are also sensitive to changes that impair water quality, including warmer stream temperature and wildfire. Non-climate stressors (e.g., agriculture, development) further reduce water quality by introducing contaminants or increasing stream temperatures. Additionally, water diversions compound streamflow reductions. Streams are able to recover with flow restoration, but compete for water with human uses. Low biodiversity (relative to mainland systems) and high endemism increase vulnerability to climate impacts.

Low | Moderate | High

Drivers of Habitat Vulnerability

- **Climatic factors and disturbance regimes:** Precipitation amount & timing, stream temperature, tropical storms/hurricanes, drought, air temperature, wildfire, riverine flooding, disease
- **Non-climate factors:** Residential & commercial development, water diversions, pollution & poisons, agriculture & aquaculture

PROJECTED FUTURE CHANGES	POTENTIAL IMPACTS ON STREAM HABITATS
Changes in **precipitation**; variable **drought risk** *(increased for low- and mid-elevation leeward areas; decreased for mid-elevation windward slopes)*	• Reduced/eliminated streamflow, reducing mauka to makai connectivity • Reduced habitat availability and connectivity for aquatic fauna, impacting migration, reproduction, recruitment, and survival
Increased **stream temperatures**	• Altered growth, abundance, distribution, and survival of species • Increased vulnerability to invasive species establishment and dominance
Increased **air temperatures** *+2.0°C (3.6°F) to +3.5°C (6.3°F), with greater increases at high elevations*	• Reduced streamflow due to increased evaporation, particularly when paired with precipitation declines • Contributes to warmer stream temperatures
Increased frequency and strength of **tropical storms/hurricanes**; increasingly variable **riverine flooding**	• Increased flooding and sedimentation due to heavy precipitation, especially in areas without vegetation • Flooding provides a signal for native larval recruitment • Flooding may reduce invasive species establishment/dominance and parasitism
Increased **wildfire**	• Increased erosion and sediment delivery to streams
Increased **disease**	• Reduced fitness and increased mortality in native aquatic species

ADAPTIVE CAPACITY

Factors that enhance adaptive capacity:

+ A majority of Maui's perennial streams connect to the ocean despite presence of water diversions
+ Flow restoration allows significant recovery, increasing habitat availability for native species
+ Stream management and restoration are supported by watershed partnerships
+ Streams are considered a public trust
+ Native forest restoration may help maintain higher streamflow in a warmer, drier climate

Factors that undermine adaptive capacity:

– Most streams have some type of water diversion
– Streams have naturally low diversity (relative to mainland systems) and high levels of endemism
– Relatively little is known about aquatic systems
– Streams compete for water with a variety of other uses (i.e., development, agriculture); conflicts are highest during dry conditions and will increase if climate change reduces water supply

ADAPTATION STRATEGIES FOR STREAM HABITATS

Types of Adaptation Approaches	Adaptation Strategy	Specific Action
Resistance: Prevent climate change from affecting a resource *Near-term approach*	Manage invasive species	• Use fencing in critical watersheds to exclude ungulates from upland forest areas • Remove invasive plants (e.g., Miconia)
Resilience: Help resources weather climate change by avoiding the effects of or recovering from changes *Near- to mid-term approach*	Increase streamflow to protect habitat and water supply	• Encourage non-extractive water uses • Modify culverts to accommodate extreme flooding
	Protect forests to increase recharge and water retention	• Support healthy native forests through land acquisition and plant restoration
Response: Intentionally accommodate change and adaptively respond to variable conditions *Long-term approach*	Use assisted colonization to restore rare species	• Identify and prioritize suitable habitat based on factors that suggest long-term ecological sustainability
Knowledge: Gather information about climate impacts and/or management effectiveness in addressing climate challenges *Near- to long-term approach*	Collect data on stream habitats	• Install automatic sensors that monitor streams 24/7 • Create a flexible monitoring system to track water extraction, including who is withdrawing water and for what purpose • Monitor and regulate salinity and other groundwater quality indicators in wells
Collaboration: Coordinate efforts and capacity across landscapes and agencies *Near- to long-term approach*	Increase collaborative efforts to conserve streams and watersheds	• Conduct place-based education to encourage watershed conservation

EFFECTIVENESS (*Likelihood of reducing vulnerabilities*)	Low	Moderate	High
High	**Low F/High E**	Identify/prioritize suitable habitat based on factors that suggest long-term ecological sustainability Conduct place-based education to encourage water conservation	**High F/High E** Install automatic sensors that monitor steams 24/7
Moderate	Monitor point- and non-point source pollutants associated with agriculture and development Monitor and regulate salinity and other groundwater quality indicators in wells	**Mod F/Mod E** Remove and control invasive species (e.g., ungulate fencing, plant removal) Support healthy native forests through land acquisition and plant restoration Modify culverts to accommodate extreme flooding	
Low	**Low F/Low E**	Encourage non-extractive water uses Create a flexible monitoring system to track water extraction, including who is withdrawing water and for what purpose	**High F/Low E**

FEASIBILITY

Ease of action implementation

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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