Anchialine Pools

Climate Vulnerability Assessment and Adaptation Strategies for Hawai'i

HABITAT DESCRIPTION

Anchialine pools are landlocked bodies of water found in young lava flows and limestone. These pools are characterized by subsurface hydrological connectivity, but lacking surface connection to the ocean. Pools vary in salinity, dissolved oxygen levels, and water level depending on distance to the sea, tidal fluctuations, groundwater input, and rainfall. The Hawaiian Islands have the largest concentration of anchialine pools in the world. The island of Hawai'i supports 80% of the world's known anchialine pools.

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HABITAT VULNERABILITY

Anchialine pools are sensitive to climatic factors that reduce groundwater levels and surface runoff, which impacts pool depth and salinity. Sea level rise and saltwater intrusion may also change pool size and salinity, as well as influence pool abundance and landscape distribution. Shifts in pools salinity, depth, distribution, and temperature will impact anchialine pool fauna. Non-climate stressors further impact anchialine pool biotic communities and structure by affecting water quality, water depth, competition and predation, and elevating disturbance. Development and roads will reduce opportunities for new pool formation as sea levels rise. Anchialine pools are abundant on Hawai'i and pristine habitat areas still remain, but managers have limited funding, and these habitats will continue to compete with coastal development pressures.

PROJECTED FUTURE CHANGES	POTENTIAL IMPACTS ON ANCHIALINE POOL HABITATS
Changes in **precipitation**; increased **drought risk** in low-elevation leeward areas	• Drier conditions restrict pool distribution and lower water levels, potentially increasing salinity and impacting community composition and structure
Increased frequency and strength of **tropical storms/ hurricanes**; uncertain change in **extreme precipitation events**	• Altered water levels, impacting salinity and pool community structure and composition • Storm surge may introduce marine fauna • Storm waves may temporarily increase pool salinity and sedimentation
Sea level rise (SLR); increased **coastal flooding** & **saltwater intrusion** *+0.4 m (1.3 ft) to +3.3 m (10.8 ft) of SLR by 2100*	• <1 m (3.28 ft) of SLR will increase pool size; 1 m or more of SLR will cause pool loss to inundation and potential pool creation in low-lying areas with appropriate substrate • Increased surface connectivity between pools and man-made water features, which may increase vulnerability invasion • Increased sub-surface salinity, particularly if groundwater levels decline
Increased **sea surface temperature** *+1.3°C (2.3°F) to +2.7°C (4.9°F) by 2100*	• Two shrimp species (*Halocaridina rubra*, *Metabetaeus lohena*) are adapted to variable and high temperatures; other shrimp species may be more vulnerable

Drivers of Habitat Vulnerability

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

ADAPTIVE CAPACITY

Factors that enhance adaptive capacity:

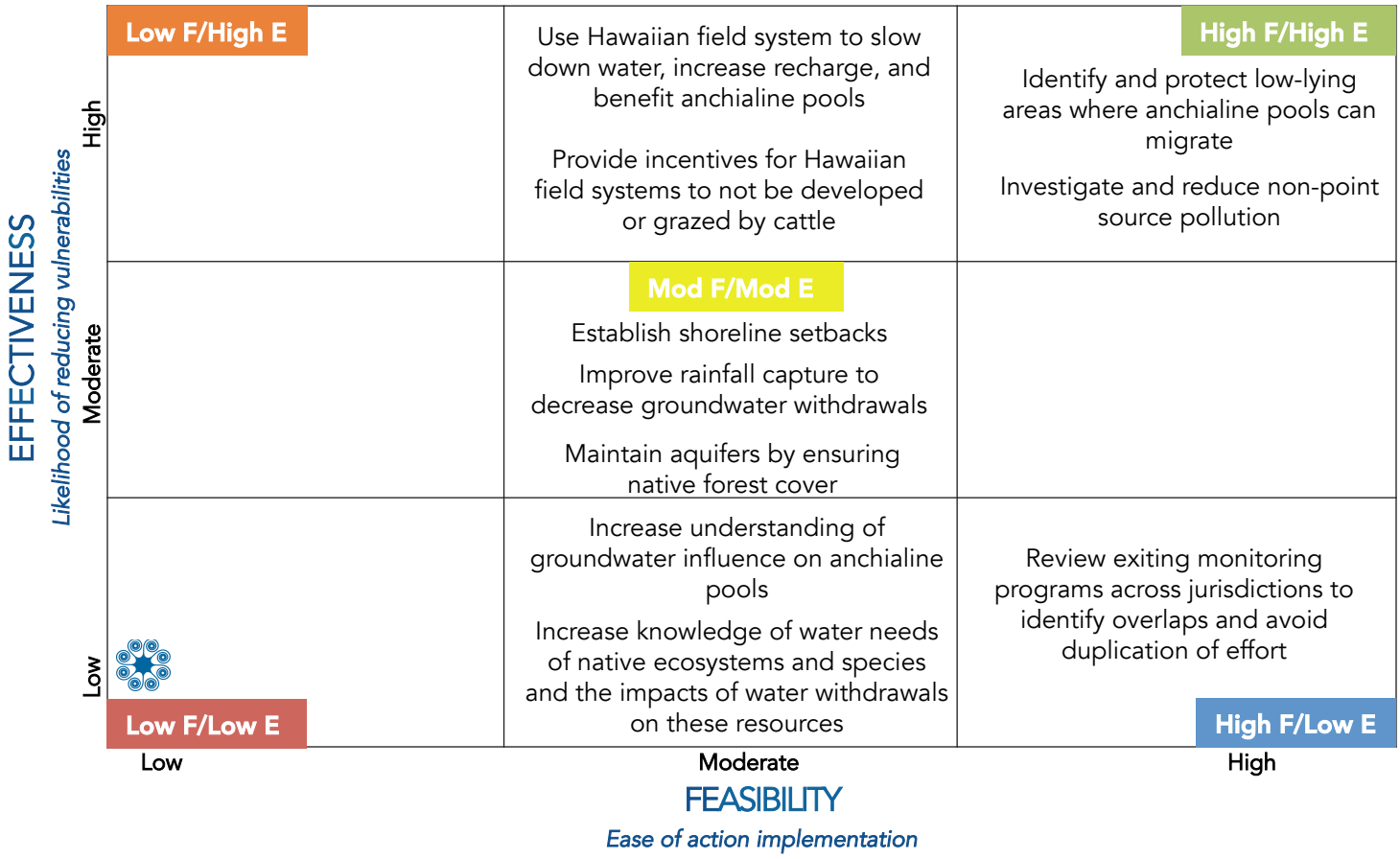
+ High habitat extent
+ Some pristine habitat areas remain (e.g., Manukā coastline)
+ High subsurface pool connectivity may promote wildlife colonization of new or restored pools
+ Moderate-high public value
+ Some habitats are protected
+ Restoration and pool creation efforts have been successful

Factors that undermine adaptive capacity:

– Variable habitat integrity (e.g., some pools have been lost on western coast)
– Some human-driven ecological changes may be irreversible
– Low diversity and presence of threatened and endangered species increases vulnerability to impacts
– Managers need more funding to manage climate change impacts
– Face competing interests with coastal development

ADAPTATION STRATEGIES FOR ANCHIALINE POOLS

Types of Adaptation Approaches	Adaptation Strategy	Specific Action
Resistance: Prevent climate change from affecting a resource. *Near-term approach*	Maintain/improve water quantity and quality	• Provide incentives for Hawaiian field systems to not be developed or grazed by cattle • Investigate and reduce non-point source pollution • Maintain aquifers by ensuring native forest cover
Resilience: Help resources weather climate change by avoiding the effects of or recovering from changes *Near- to mid-term approach*	Preserve water supplies by increasing water use efficiency	• Use Hawaiian field system to slow water, increase recharge, and benefit anchialine pools • Improve rainfall capture to decrease groundwater withdrawals
Response: Intentionally accommodate change and adaptively respond to variable conditions *Long-term approach*	Protect current and future habitat	• Establish shoreline setbacks • Identify and protect low-lying areas where anchialine pools can migrate
Knowledge: Gather information about climate impacts and/or management effectiveness in addressing climate challenges *Near- to long-term approach*	Increase understanding of water resources and their values	• Increase understanding of groundwater influence on anchialine pools • Increase knowledge of water needs of native ecosystems and species and the impacts of water withdrawals on these resources
Collaboration: Coordinate efforts and capacity across landscapes and agencies *Near- to long-term approach*	Create new/improve partnerships to increase capacity	• Review existing monitoring programs across jurisdictions to identify overlaps and avoid duplication of effort



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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