Upland Wetland Habitats

Climate Vulnerability Assessment and Adaptation Strategies for Kaua’i

HABITAT DESCRIPTION

Upland wetland habitats (e.g., bogs, swamps, marshes) occur in forest openings above 305 m (1,000 ft) on Kaua’i. They feature a mixture of mud, standing water pockets, and highly endemic and specialized species, including mosses, hummock-forming endemic sedges and grasses, and some dwarf woody plants. Most upland wetlands are small in size, although some are quite sizeable (e.g., Sincock’s Bog). Alaka’i Swamp and Kanaele Bog represent significant upland wetland habitat areas on Kaua’i.

HABITAT VULNERABILITY

Precipitation, soil moisture, and drought alter water table levels. Along with warmer temperatures, these factors can impact vegetative productivity, community composition, and wetland size, persistence, and vulnerability to forest encroachment. Disease and insect pressure affect the health and survival of component species. Invasive species reduce native plant cover and reproduction. Invasive ungulates and recreation facilitate invasive plant spread and establishment. Water diversions can reduce water availability by lowering water tables. Upland wetland adaptive capacity is enhanced by current functional and structural integrity, vegetation resilience to extreme conditions, low levels of disturbance, and protected land status. However, upland wetlands occupy only a small land area and are geographically isolated.

PROJECTED FUTURE CHANGES

<table>
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<tr>
<th>Drivers of Habitat Vulnerability</th>
<th>Potential Impacts on Upland Wetland Habitats</th>
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<tbody>
<tr>
<td>• Climatic factors and disturbance regimes:</td>
<td>• Altered water levels and wetland size, impacting vegetative composition, productivity and peat accumulation</td>
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<td>• Non-climate factors: Invasive species (mammalian predators, slugs, snails, ungulates, trees, shrubs), recreation, water diversions</td>
<td>• Drier conditions may reduce wetland size and/or cause habitat loss</td>
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<td>• Drier conditions increase wetland vegetation dieback and mortality, potentially increasing vulnerability to forest encroachment</td>
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<td>• Drier conditions increase fire risk</td>
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<td>Changes in precipitation; reduced soil moisture; variable drought risk (decreased at higher elevations, static elsewhere)</td>
<td>Increased air temperatures +2.0°C (3.6°F) to +3.5°C (6.3°F), with greater increases at high elevations</td>
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<td>• Altered vegetative composition and increased risk of forest encroachment</td>
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<td>• Accelerated decomposition rates, altering peat accumulation</td>
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<tr>
<td>Increased disease</td>
<td>• May reduce vegetation health and survival</td>
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<tr>
<td>Increased insects</td>
<td>• Expanding ranges of mosquitoes carrying avian malaria may reduce survival of upland birds</td>
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ADAPTIVE CAPACITY

Factors that enhance adaptive capacity:

+ Habitat is structurally and functionally intact
+ Native vegetation is resilient & recovers when disturbance factors are removed
+ Habitat highly valued by the public; there is high societal support for habitat management
+ Some habitat areas have protected status

Factors that undermine adaptive capacity:

− Small existing habitat area (18,780 acres; 76.8 km²)
− High elevation location reduces opportunities for migration in response to climate impacts
− Restricted distribution of specialized and endemic species enhances vulnerability to extirpation
− Vegetation not resilient to repeated disturbance
**ADAPTATION STRATEGIES FOR UPLAND WETLAND HABITATS**

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<tr>
<th>Types of Adaptation Approaches</th>
<th>Adaptation Strategy</th>
<th>Specific Action</th>
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| **Resistance:** Prevent climate change from affecting a resource.  
*Near-term approach* | Manage invasive species | • Control ungulates via fencing and animal removal (e.g., trapping, hunting, snares) in high-elevation watersheds that may serve as refugia  
• Use biocontrol measures to reduce invasive plants that are expected to thrive under climate change |
| **Resilience:** Help resources weather climate change by avoiding the effects of or recovering from changes  
*Near- to mid-term approach* | Restore native habitat | • Restore habitat with resilient common species, as well as rare species |
| **Response:** Intentionally accommodate change and adaptively respond to variable conditions  
*Long-term approach* | Facilitate transition of species into new areas as climate regimes shift | • Identify and protect possible refugia based on precipitation modeling  
• Increase research and modeling on species needs and potential range shifts |
| **Knowledge:** Gather information about climate impacts and/or management effectiveness in addressing climate challenges  
*Near- to long-term approach* | Manage invasive species | • Increase research on novel biocontrol techniques (biotechnology, gene drive to eliminate species) |
| **Collaboration:** Coordinate efforts and capacity across landscapes and agencies  
*Near- to long-term approach* | Reduce human pressure on native ecosystems | • Create and increase different education campaigns based on different audiences (resident vs. tourist, older vs. younger)  
• Improve land-use planning and increase outreach on conservation-informed land uses |

**EFFECTIVENESS**

<table>
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<tr>
<th>Low F/Low E</th>
<th>Mod F/Mod E</th>
<th>High F/High E</th>
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| Identify and protect possible refugia based on precipitation modeling  
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Restore habitat with resilient common species, as well as rare species | Create and increase different education campaigns based on different audiences |
| Use biocontrol measures to reduce invasive plants that are expected to thrive under climate change | Control ungulates via fencing and animal removal (trapping, hunting, snares) in high-elevation watersheds  
Improve land-use planning and increase outreach on conservation-informed land uses | |

**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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