

# Mesic & Wet Forests

Climate Vulnerability Assessment and Adaptation Strategies for Kaua'i

## HABITAT DESCRIPTION

Mesic and wet forests occur on at mid- and high-elevation sites on Kaua'i, spanning both the leeward and windward sides of the island between 600–1,500 m (2,000–5,000 ft). Wet forests cover the high summit plateau and windward slopes, and receive at least 1,900 mm (75 in) of rainfall each year with no significant dry period. Mesic forests are found on the leeward slopes and receive 1,270–1,900 mm (50–75 in) of precipitation per year, with a seasonal drought period from May to October. Forest structure ranges from closed high canopy cloud forests to open bogs and low-stature forests. Dominant tree species in mesic and wet forest types include 'ōhi'a lehua (*Metrosideros polymorpha*), koa (*Acacia koa*), lama (*Diospyros sandwicensis*), 'ōlapa (*Cheiodendron trigynum*), lapa (*Cheiodendron platyphyllum*), olopuia (*Nestegis sandwicensis*), and mānele (*Sapindus saponaria*), with dense understories comprising shrubs, ferns, and sedges.



## HABITAT VULNERABILITY

Mesic and wet forest habitat types are primarily sensitive to factors that alter moisture gradients and water availability, which impact species composition and forest distribution and potentially reduce habitat extent. Disturbances can damage large areas of forest, resetting succession and increasing the risk of invasive species establishment. Non-climate stressors also facilitate the introduction of invasive plants, increase erosion, and generally exacerbate existing stressors, undermining the ecological integrity and persistence of native forests. Wet forests in remote areas remain relatively intact, but lower-elevation forests are more degraded. Public value and societal support for mesic and wet forests are low, and management and restoration efforts may not alleviate the impacts of climate change.



### Drivers of Habitat Vulnerability

- **Climatic factors and disturbance regimes:** Tropical storms/hurricanes, drought, precipitation, soil moisture, air temperature, wildfire
- **Non-climate factors:** Invasive species (trees/shrubs, flammable grasses, ungulates, mammalian predators, pathogens/parasites, social insects), recreation, water diversions

PROJECTED FUTURE CHANGES	POTENTIAL IMPACTS ON MESIC & WET FOREST HABITATS
Increased <b>drought</b> risk	<ul style="list-style-type: none"> <li>• High shrub mortality and shifts towards herbaceous species</li> <li>• Possible increased establishment of drought-tolerant invasive vegetation</li> </ul>
Changes in <b>precipitation</b> , and reduced <b>soil moisture</b> <i>Precipitation increase on windward slopes, decrease on leeward slopes</i>	<ul style="list-style-type: none"> <li>• Changes in species composition and forest distribution due to higher evaporative demand at high elevations</li> <li>• Limited native tree/shrub recruitment and reduced mature tree survival</li> </ul>
Increased frequency and strength of <b>tropical storms/ hurricanes</b>	<ul style="list-style-type: none"> <li>• Major forest damage and colonization of invasive plants in canopy openings</li> <li>• Possible extirpation of highly localized/endemic species</li> </ul>
Increased <b>air temperatures</b> <i>+2.0°C (3.6°F) to +3.5°C (6.3°F), with greater increases at high elevations</i>	<ul style="list-style-type: none"> <li>• Increased evapotranspiration and associated water loss in plants</li> <li>• Altered distribution and severity of fungal diseases and other pathogens</li> </ul>
Increased <b>wildfire</b>	<ul style="list-style-type: none"> <li>• Increased dominance of invasive grasses, which perpetuate altered fire regimes</li> <li>• Reduced forest recovery following more frequent wildfires</li> <li>• Increased soil erosion</li> </ul>

## ADAPTIVE CAPACITY

### Factors that enhance adaptive capacity:

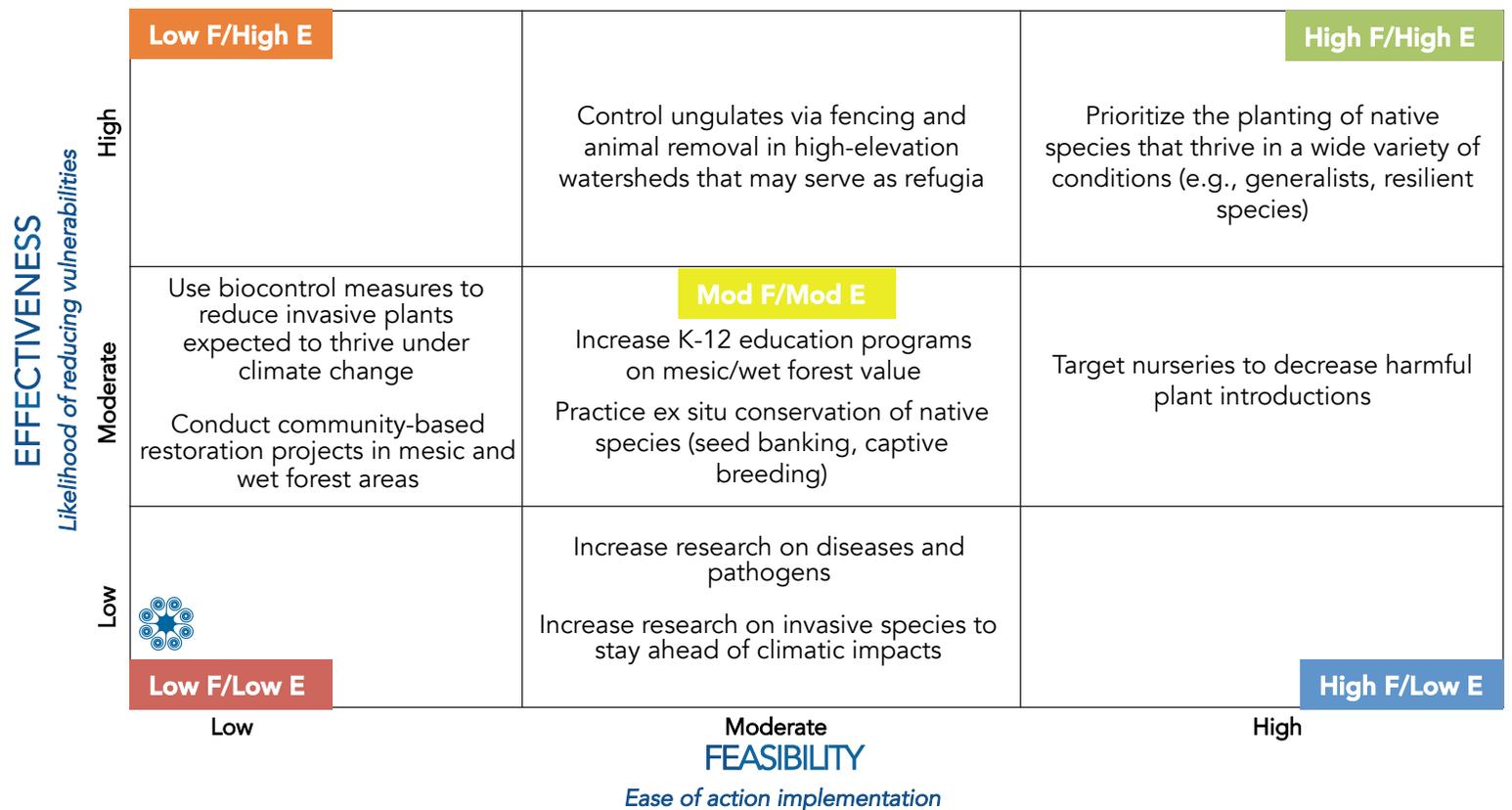
- + Intact wet forest remains in the remote central region
- + Some native species are resilient to disturbances such as disease and wildfire
- + Relatively high species diversity and endemism
- + Biosecurity measures could limit the further introduction and spread of invasive species

### Factors that undermine adaptive capacity:

- Lower-elevation forests are under increased pressure from anthropogenic uses (e.g., development)
- Habitat fragmentation reduces dispersal, inhibiting forest recovery
- Extirpation of seed-dispersing species contributes to native vegetation decline
- Relatively low likelihood of alleviating climate impacts through habitat protection and restoration
- Low public value and societal support

# ADAPTATION STRATEGIES FOR MESIC & WET FORESTS

Types of Adaptation Approaches	Adaptation Strategy	Specific Action
<b>Resistance:</b> Prevent climate change from affecting a resource. <i>Near-term approach</i>	Manage invasive species	<ul style="list-style-type: none"> <li>Control ungulates via fencing and animal removal (trapping, hunting, snares) in high-elevation watersheds that may serve as refugia</li> <li>Use biocontrol measures to reduce invasive plants expected to thrive in a changing climate</li> <li>Target nurseries to decrease harmful plant introductions</li> </ul>
<b>Resilience:</b> Help resources weather climate change by avoiding the effects of or recovering from changes <i>Near- to mid-term approach</i>	Maintain and augment native species populations	<ul style="list-style-type: none"> <li>Practice ex situ conservation of native species (e.g., seed banking, captive breeding) that represent genetic and habitat diversity</li> </ul>
<b>Response:</b> Intentionally accommodate change and adaptively respond to variable conditions <i>Long-term approach</i>	Facilitate transition of species into new areas as climate regimes shift	<ul style="list-style-type: none"> <li>Prioritize the planting of native species that thrive in a wide variety of conditions (e.g., generalists, resilient species)</li> </ul>
<b>Knowledge:</b> Gather information about climate impacts and/or management effectiveness in addressing climate challenges <i>Near- to long-term approach</i>	Conduct research on species, habitat requirements, and threats	<ul style="list-style-type: none"> <li>Increase research on diseases and pathogens</li> <li>Increase research on invasive species to stay ahead of climatic impacts</li> </ul>
<b>Collaboration:</b> Coordinate efforts and capacity across landscapes and agencies <i>Near- to long-term approach</i>	Increase community outreach to elevate public awareness and value of mesic and wet forest habitats	<ul style="list-style-type: none"> <li>Increase K-12 education programs on mesic/wet forest value</li> <li>Conduct community-based restoration projects in mesic and wet forest areas</li> </ul>



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](http://www.bit.ly/HawaiiClimate).

Hilberg LE, Gregg RM. 2018. Mesic and Wet Forests: Vulnerability and Adaptation Brief for Kaua'i. EcoAdapt, Bainbridge Island, WA. Produced in cooperation with the Pacific Islands Climate Change Cooperative, with funding from the U.S. Fish and Wildlife Service.