Dry Forests

Climate Vulnerability Assessment and Adaptation Strategies for Hawai'i

HABITAT DESCRIPTION

Dry forests are limited by water availability, and are typically found on the leeward side of Hawai'i from sea level up to elevations of about 2,000 m (6,560 ft), although Ka'ū has seasonal sub-montane dry forest area where seasonal rainfall is low enough to limit forest distribution despite higher annual rainfall totals. Dry forests are often associated with younger, shallow substrates, and plant succession corresponds to substrate age, while soil quality determines water retention. Dry forest trees are slow-growing and require at lease 500 mm (20 in) of annual rainfall. Although the canopy can be sparse, dry forests support high tree diversity and functional group diversity; dominant vegetation includes 'ōhi'a lehua (*Metrosideros polymorpha*), lama (*Diospyros sandwicensis*), naio (*Myoporum sandwicense*), māmane (*Sophora chyrsophylla*), and wiliwili (*Erythrina sandwicensis*).

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HABITAT VULNERABILITY

Dry forests are sensitive to climatic factors that increase water stress, which is likely to impact recruitment, species composition, and forest distribution. Disturbance events (e.g., wildfire, disease, insects, volcanic activity) may damage forest areas, reducing forest cover and canopy integrity and increasing vulnerability to invasion. Non-climate stressors (e.g., development) reduce habitat extent and fragment/degrade remaining habitat areas, limiting dispersal and recruitment. Invasive species also impair dry forest recruitment and recovery by competing with and displacing vegetation, altering ecosystem processes, and damaging vegetation. The majority of historical dry forest area has already been lost, and receives little societal or public support. However, some restoration efforts have been successful at restoring native vegetation.

PROJECTED FUTURE CHANGES	POTENTIAL IMPACTS ON DRY FOREST HABITATS
Changes in **precipitation**, reduced **soil moisture**, and increased **drought** risk *Precipitation increase on windward slopes, decrease on leeward slopes*	• Increased water stress in native vegetation, limiting growth, seed production, and regeneration • Increased risk of wildfire during drought periods • Increased plant growth if precipitation increases, including invasive species
Increased **air temperatures** *+2.0°C (3.6°F) to +3.5°C (6.3°F), with greater increases at high elevations*	• Increased evaporative demand, elevating water stress in native vegetation • Upslope expansion of avian malaria which threatens endemic forest birds • Expanded distribution and range of invasive plant species
Changes in **wind and circulation**	• Reduced rainfall and fog/cloud water interception, increasing plant water stress
Increased **wildfire**	• Mortality in native species, with potential conversion to non-native grasslands • Slow recovery in burned areas
Increased **insects** and **disease**	• Native species damage and mortality, especially in those stressed by drought

Drivers of Habitat Vulnerability

- **Climatic factors and disturbance regimes:** Precipitation, soil moisture, drought, air temperature, wind/circulation, wildfire, disease, insects, volcanic activity
- **Non-climate factors:** Residential/commercial development, agriculture, invasive species (flammable grasses, ungulates, trees/shrubs, social insects, pathogens/parasites)

ADAPTIVE CAPACITY

Factors that enhance adaptive capacity:

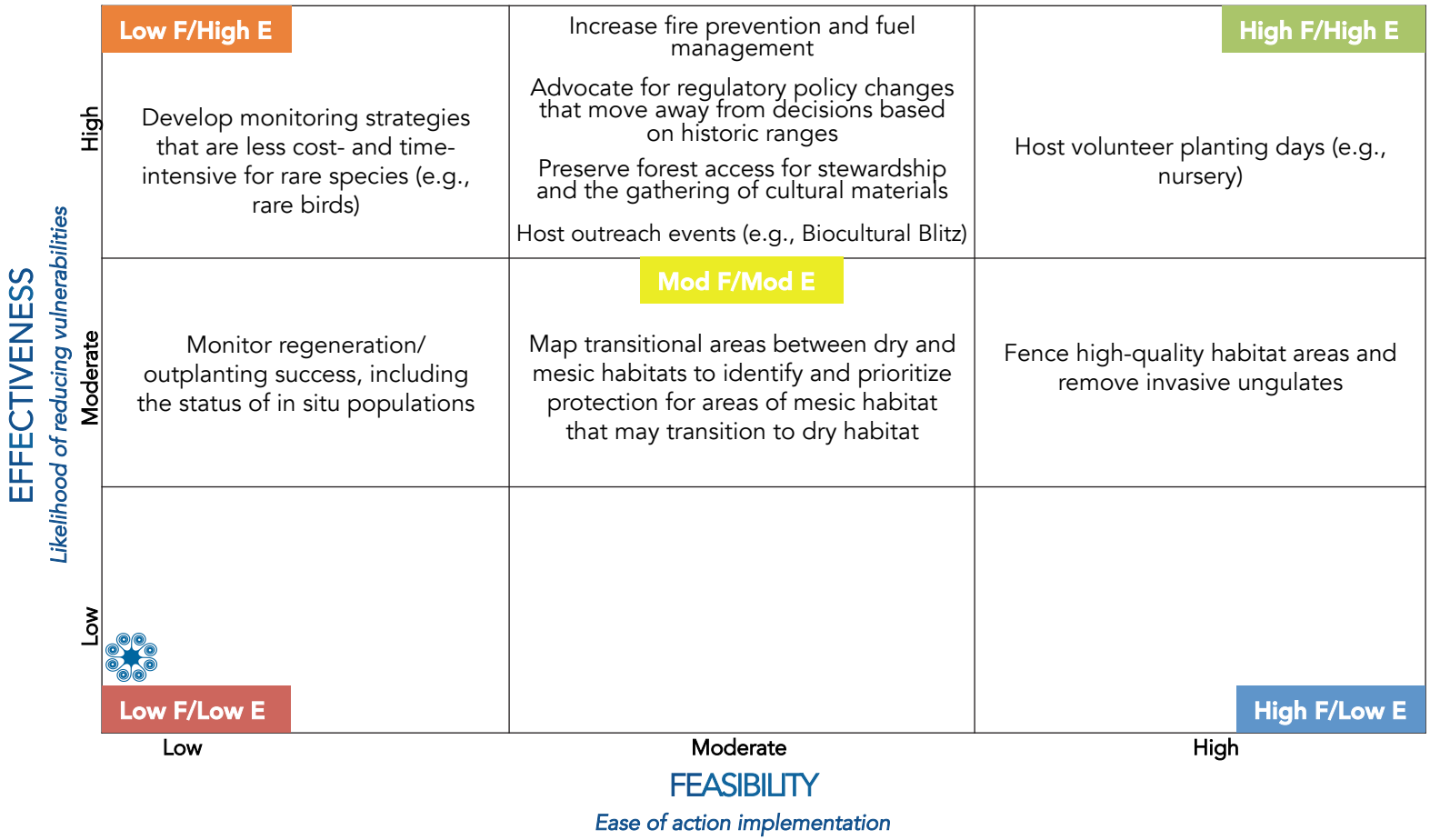
+ Very high diversity, including many rare, endemic, and culturally-valuable species
+ Restoration efforts have successfully restored increased native plant cover, recruitment, and diversity and decreased invasive species
+ May offer refugia for forest birds impacted by mosquito-borne diseases
+ Valued for many uses within Hawaiian culture and support healthy communities

Factors that undermine adaptive capacity:

– 90% of historical dry forest already lost across the Hawaiian Islands; remaining areas are fragmented and degraded
– Slow to recover from disturbances
– Loss of native seed dispersers limits natural regeneration
– Low water availability under future climate conditions undermines restoration
– Little societal support and low public value

ADAPTATION STRATEGIES FOR DRY FORESTS

Types of Adaptation Approaches	Adaptation Strategy	Specific Action
Resistance: Prevent climate change from affecting a resource. *Near-term approach*	Reduce the impacts of non-climate stressors on remnant dry forest	• Fence high-quality habitat areas and remove invasive ungulates • Remove weeds, including invasive grasses • Increase fire prevention and fuel management (e.g., grazing, fuel breaks) in intact forest areas
Resilience: Help resources weather climate change by avoiding the effects of or recovering from changes *Near- to mid-term approach*	Maintain and restore existing dry forest habitat	• Advocate for regulatory policy changes that move away from decisions based on historic ranges and prioritize landscape approaches
Response: Intentionally accommodate change and adaptively respond to variable conditions *Long-term approach*	Identify and promote climate-adapted species composition	• Map transitional areas between dry and mesic habitats to identify and prioritize protection for areas of mesic habitat that may transition to dry habitat
Knowledge: Gather information about climate impacts and/or management effectiveness in addressing climate challenges *Near- to long-term approach*	Enhance long-term monitoring efforts to better understand changes in native and rare species	• Monitor regeneration/outplanting success, including the status of in situ populations • Develop monitoring strategies that are less cost- and time-intensive for rare species (e.g., rare birds)
Collaboration: Coordinate efforts and capacity across landscapes and agencies *Near- to long-term approach*	Increase community and cultural engagement through education and outreach	• Preserve forest access for stewardship and the gathering of important cultural species and materials (e.g., lei materials) • Host outreach events (e.g., Biocultural Blitz) • Host volunteer planting days (e.g., nursery)



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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