Dry Forests

Climate Vulnerability Assessment and Adaptation Strategies for O'ahu

HABITAT DESCRIPTION

Dry forests on O'ahu have extremely limited distribution, occurring in leeward lowland areas, and are commonly limited to steep slopes that have experienced less exposure to development and invasive species. These habitat types are often associated with younger, shallow substrates composed of cinder, ash, and lava flows, and plant succession corresponds to substrate age. Dry forests typically receive less than 1,270 mm (50 inches) of annual rainfall and are characterized by warm to hot conditions and a seasonal dry period. Dominant dry forest canopy species include lama (*Diospyros sandwicensis*), 'ōhi'a (*Metrosideros polymorpha*), koa (*Acacia koa*), and wiliwili (*Erythrina sandwicensis*) trees. Additional dominant vegetation includes 'a'ali'i shrubs (*Dodonaea viscosa*), lovegrass (*Eragrostis atropioides*), and pili grass (*Panicum tenuifolium*), among others.

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HABITAT VULNERABILITY

Dry forests are sensitive to climatic factors that increase water stress, which are likely to impact species recruitment, community composition, and forest distribution. Disturbance events (e.g., wildfire, insects) may also affect forest cover and canopy integrity by increasing vulnerability to invasion and causing tree damage or mortality. Invasive species degrade dry forests by competing with and displacing native vegetation, consuming seeds and fruit needed for recruitment, and/or elevating disturbance and increasing non-native plant establishment. Additional non-climate stressors threaten remnant dry forest habitat by competing for space and increasing disturbance. Most dry forest on O'ahu has already been lost, and remnant patches are highly degraded. However, some restoration efforts have been successful.

Drivers of Habitat Vulnerability

- **Climatic factors and disturbance regimes:** Drought, precipitation, soil moisture, extreme precipitation events, tropical storms/hurricanes, air temperature, wildfire, insects, disease
- **Non-climate factors:** Invasive species (flammable grasses, ungulates, trees/shrubs), agriculture, roads/highways/trails, recreation, residential and commercial development

PROJECTED FUTURE CHANGES	POTENTIAL IMPACTS ON DRY FOREST HABITATS
Increased **drought** risk, reduced **precipitation**, and reduced **soil moisture**	• Increased water stress in native vegetation, limiting growth, seed production, and regeneration • Increased risk of wildfire during drought periods
Uncertain changes in **extreme precipitation events** and increased frequency and strength of **tropical storms/hurricanes**	• Increased colonization and establishment of invasive plants in canopy openings • Increased soil moisture following heavy rainfall • Potential extirpation of highly localized/endemic populations
Increased **air temperature** *+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 vegetation • Upslope expansion of mosquitos that carry avian malaria • Expanded distribution and range of invasive plant species
Increased **wildfire**	• Mortality in native species and increased vulnerability to invasive flammable grasses, perpetuating altered fire regimes
Increased **insects** and **disease**	• Damage and mortality within native species, especially those stressed by drought • Increased erosion and vulnerability to invasive species

ADAPTIVE CAPACITY

Factors that enhance adaptive capacity:

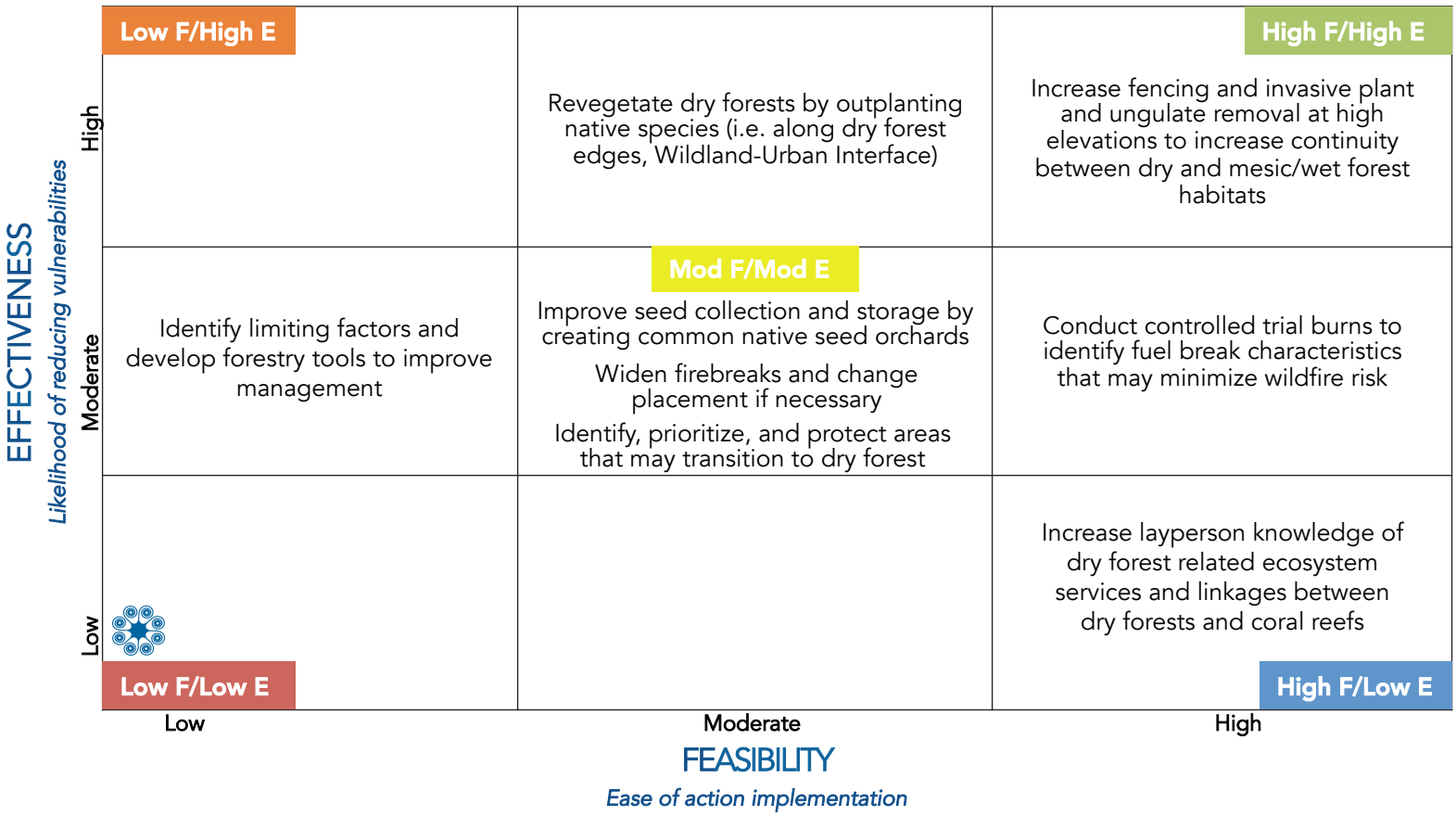
+ Very high diversity, including many rare, endemic, and culturally valuable species
+ Invasive species control in restoration areas allowed reestablishment of native dry forest species
+ Some dry forest species may exhibit faster recovery (e.g., 'a'ali'i shrubs), increasing restoration success
+ Provides critical ecosystem services, including flood/erosion control and cultural materials

Factors that undermine adaptive capacity:

– Very small area of dry forest remains on O'ahu, and remnant habitat patches are highly fragmented and degraded
– Upslope migration would likely take many years and require human assistance
– Slow to recover from disturbances and may be unable to regenerate within active management
– Relatively low public value and societal support

ADAPTATION STRATEGIES FOR DRY FORESTS

Types of Adaptation Approaches	Adaptation Strategy	Specific Action
Resistance: Prevent climate change from affecting a resource. *Near-term approach*	Maintain and protect existing dry forest habitat	• Increase fencing and invasive plant and ungulate removal at high elevations to increase continuity between dry and mesic/wet forest habitats • Widen firebreaks and change placement if necessary to improve fire prevention
Resilience: Help resources weather climate change by avoiding the effects of or recovering from changes *Near- to mid-term approach*	Restore degraded dry forest habitat	• Improve seed collection and storage by creating common native seed orchards • Revegetate dry forests by outplanting native species (i.e. along dry forest edges, Wildland-Urban Interface)
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, prioritize, and protect areas that may transition to dry forest in the future
Knowledge: Gather information about climate impacts and/or management effectiveness in addressing climate challenges *Near- to long-term approach*	Increase research efforts to improve capacity and management tools in dry forest	• Conduct controlled trial burns to identify fuel break characteristics that may minimize wildfire risk • Identify limiting factors and develop forestry tools to improve management
Collaboration: Coordinate efforts and capacity across landscapes and agencies *Near- to long-term approach*	Improve public education on the importance of dry forest habitats	• Increase layperson knowledge of dry forest-related ecosystem services and linkages between dry forests and coral reefs



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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