Dry Forests

Climate Vulnerability Assessment and Adaptation Strategies for Maui, Lāna'i, and Kaho'olawe

HABITAT DESCRIPTION

Dry forests and mesic lowland shrublands are typically found in low-elevation areas and on leeward slopes (up to 2,000 m [6,560 ft]). These areas receive the majority of their moisture from cloud/fog drip and intermittent rain. 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 forest habitats are dominated by a variety of species, including lama (*Diospyros sandwicensis*), 'ōhi'a lehua (*Metrosideros polymorpha*), koa (*Acacia koa*), wiliwili (*Erythrina sandwicensis*), 'a'ali'i (*Dodonaea viscosa*), olopua (*Nestegis sandwicensis*), 'āla'a (*Pouteria sandwicensis*), and alahe'e (*Canthium odoratum*).

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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, disease) may damage forest areas, reducing cover and canopy integrity while increasing vulnerability to invasion. Non-climate stressors further reduce habitat extent, integrity, and continuity, limiting species dispersal and recruitment; these include invasive species, which impair recruitment and recovery by competing with native species, altering ecosystem processes, and causing direct plant damage or mortality. The majority of historical dry forest area has already been lost, and remaining areas are highly fragmented and degraded; these are typically unable to recover without active management.

PROJECTED FUTURE CHANGES	POTENTIAL IMPACTS ON DRY FOREST HABITATS
Increased **drought** risk	• Reduced plant germination and survival to maturity • Increased risk of wildfire during drought periods
Increased frequency and strength of **tropical storms/ hurricanes**, uncertain changes in **extreme precipitation events**, & increasingly variable **riverine flooding**	• Increased colonization and establishment of invasive plants in canopy openings • Extirpation of highly localized/ endemic populations or species • Increased water availability due to heavy rainfall, benefitting native plants • Vegetation damage and removal due to flooding and erosion
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 • Expanded distribution and range of invasive plant species
Reduced **precipitation** and **soil moisture** *Except on windward slopes*	• Increased water stress in native vegetation, limiting growth, seed production, and regeneration
Increased **wildfire**	• Mortality in native species, with potential conversion to non-native grasslands
Increased **insects** & **disease**	• Damage and mortality within native species, especially those already stressed by drought

Drivers of Habitat Vulnerability

- **Climatic factors and disturbance regimes:** Drought, tropical cyclones/ hurricanes, air temperature, soil moisture, precipitation, wildfire, disease, insects, flooding
- **Non-climate factors:** Agriculture, residential & commercial development, invasive species (trees/shrubs, social insects, pathogens/parasites, mammalian predators, ungulates), pollution/poisons

ADAPTIVE CAPACITY

Factors that enhance adaptive capacity:

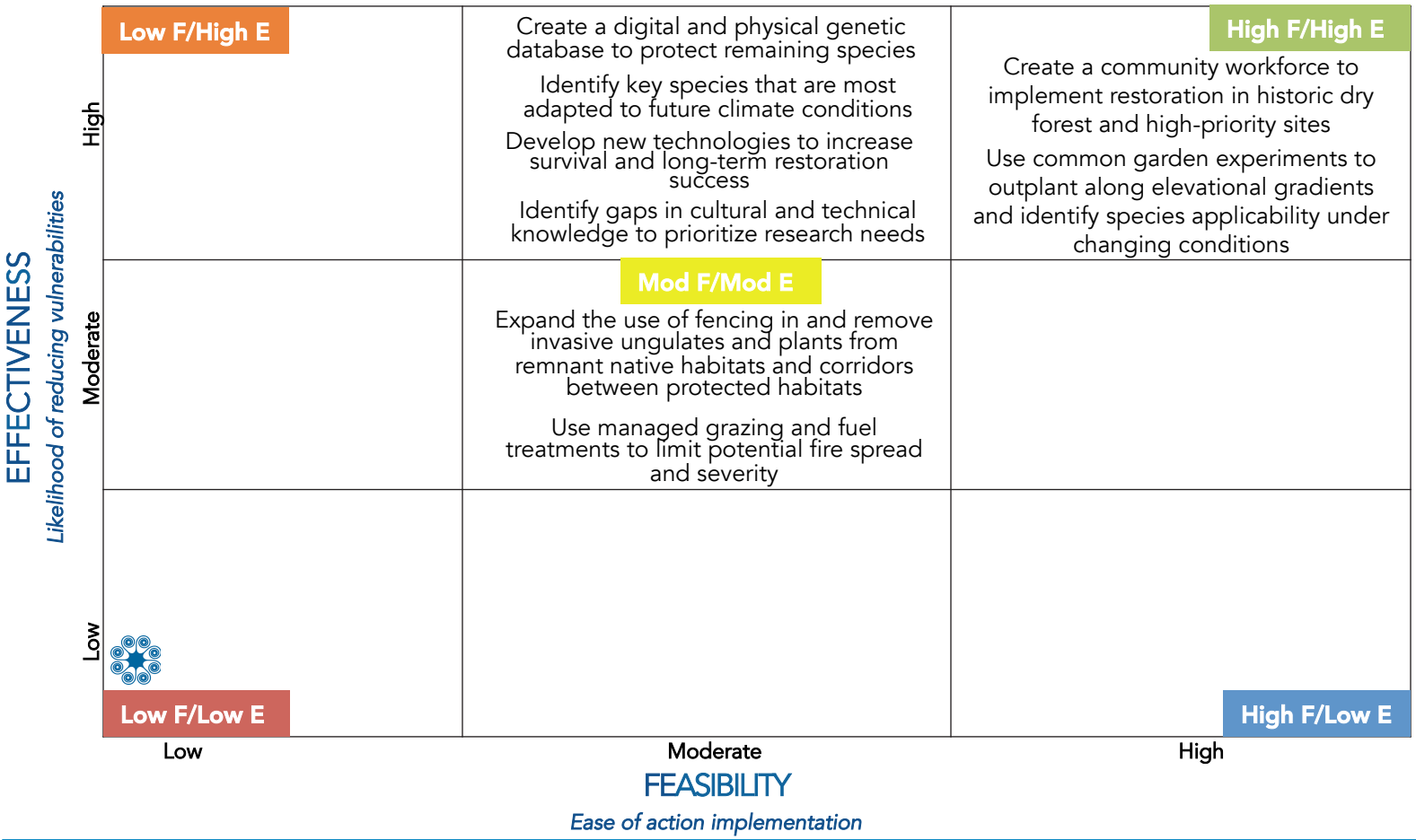
+ Very high diversity, including many rare, endemic, and culturally-valuable species
+ Dry forests may offer refugia for endemic forest birds
+ Successful restoration has occurred in Auwahi dry forest, demonstrating potential for recovery
+ Supports many ecosystem services, including flood/erosion control and cultural heritage

Factors that undermine adaptive capacity:

– 90% of historical dry forest already lost across the Hawaiian Islands; remaining areas are highly fragmented and degraded
– Slow to recover from disturbances and may be unable to regenerate within active management
– Low-moderate societal support for management

ADAPTATION STRATEGIES FOR DRY FORESTS

Types of Adaptation Approaches	Adaptation Strategy	Specific Action
Resistance: Prevent climate change from affecting a resource *Near-term approach*	Manage invasive species	• Expand the use of fencing in and remove invasive species from remnant native habitats and corridors between protected habitats
	Improve fire prevention and response	• Use managed grazing and fuel treatments to limit potential fire spread and severity
Resilience: Help resources weather climate change by avoiding the effects of or recovering from changes *Near- to mid-term approach*	Improve resilience of key dry forest species/ communities	• Identify key species that are most adapted to future climate conditions • Create a digital and physical genetic database to protect remaining 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	• Prioritize the planting of native species that thrive in a wide variety of conditions (e.g., generalists) • Use common garden experiments to outplant along elevational gradients and identify species applicability under changing conditions
Knowledge: Gather information about climate impacts and/or management effectiveness in addressing climate challenges *Near- to long-term approach*	Increase knowledge to improve dry forest restoration	• Identify gaps in cultural and technical knowledge to prioritize research needs • Develop new technologies to increase survival and long-term restoration success (e.g., fog drip capture and irrigation)
Collaboration: Coordinate efforts across landscapes and agencies *Near- to long-term approach*	Increase capacity for dry forest restoration	• Create a community workforce to implement restoration in historic dry forest and high-priority sites in a timely manner



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.

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