



Drought & Ecological Restoration in Hawai'i

Natural Resource Manager Observations & Considerations

Ecological restoration and conservation efforts in Hawai'i focus on a variety of strategies aimed to improve native ecosystems under a combination of stressors including invasive species and drought. Practices and perspectives shared by land stewards across Hawai'i, summarized here, can guide future drought-minded restoration work.

Optimizing Plant Survival

Pre-Planting

Site selection and preparation for restoration outplanting affect plants' sensitivity to drought and their ability to survive dry periods.

Greenhouse techniques may include:

- Using shorter pots or dibbles to allow roots to "find their own way" once planted
- "Hardening-off" plants, which means gradually exposing them to restoration site conditions (sun, wind, reduced water) prior to outplanting

Field techniques in use:

- Establish a native forest structure prior to outplanting rare species
- Remove non-native and invasive plants to reduce competition for soil moisture
- Selectively keep some non-native plants to provide shade and maintain humidity levels for native outplantings
- Establish fuel breaks around restoration sites to prevent losses from wildfire

"We've been using a selective removal technique where we leave a number of non-native trees in the area for shade and to act as nursery trees. This really increases the survivability of our outplants because in those hot months, they still have some level of protection from the scorching sun."

"We definitely try to avoid planting during the summer months or known drier months unless we really have to. Sometimes despite our best efforts to coordinate and plan accordingly, when the nursery calls and says, 'Your 10,000 plants are ready now', then we have to put them in the ground with as little stress on the plants as possible."



Figure 1: Tree seedlings of endemic *Pouteria sandwicensis* in a greenhouse. Credit: Forest & Kim Starr.

Timing

Restoration outplantings are typically timed to take advantage of wet season rainfall. During extended dry periods, managers may delay planting or take other measures to reduce outplanting mortality. Their actions consider trade-offs in balancing plant survival and their available resources for activities such as:

- Supplemental watering in the field
- Repotting plants in the greenhouse
- Nursery/greenhouse capacity
- Transporting larger pots post-drought

Supplemental Watering

A variety of techniques are used to improve survival of both outplantings and wild endangered plants, especially during extended dry periods:

- Drip irrigation
- Deep pipe irrigation
- Fog/mist catchers
- Ooze tubes
- Backpack sprayers
- Soil polymers to increase water retention



Figure 2: Ooze tubes provide a slow, steady supply of water for endangered A'e (*Zanthoxylum dipetalum* var. *tomentosum*) trees during drought at Pu'u Wa'awa'a.

Credit: Elliott Parsons.

Addressing Other Threats

Other plant stressors may increase during drought so considerations for additional conservation/restoration actions include maintaining fuel breaks for wildfire protection and controlling insect and rodent pests.

“Preparing for me means building the most resilient, [having] the strongest vegetation community that you can so that when the drought comes in, it's able to survive it. When it doesn't, we need to find out what we need to focus our energy on as far as restoration goes, or if we should recognize the shift that is taking place and adjusting in accordance with that change... It's trying to decide if what we're doing is actually going to prolong the vegetation community or if it's just putting a Band-Aid on it.”

Mahalo to 24 anonymous Hawai'i natural resource managers and land stewards whose interview responses on drought provided most of this factsheet's written content.

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Planning for the Future

Seed Collection and Seed Zones

- Drought may disrupt fruiting and seeding, further challenging seed collection and new plant recruitment especially for threatened and endangered species.
- During drought managers may make seed collection a higher priority in response to the increased risk of native plant losses from water stress and wildfire.
- Greater development and use of seed zones (areas with similar plant habitat) for Hawai'i can guide where seeds are collected and planted so they are better adapted to drought-prone areas.



Figure 3: 'A'ali'i (*Dodonaea viscosa*) seeds prepared for restoration efforts.

Credit: Forest & Kim Starr.

Climate Change

Future warming in Hawai'i due to climate may lead to increased drought occurrence for many areas of Hawai'i. Native species conservation, especially for rare species, may require planting outside of species' historical ranges. Managers are starting to incorporate potential shifts in species ranges into their restoration and conservation plans. More information is needed on the sensitivity of Hawaiian ecosystems to climate change and the environmental response to restoration activities.

Other Sources:

- Bower et al. 2014. *Generalized provisional seed zones for native plants*
- Elison Timm et al. 2015. *Statistical downscaling of rainfall changes in Hawai'i*
- Zhang et al. 2016. *Dynamical Downscaling of the Climate for the Hawaiian Islands. Part II*
- Frazier et al. 2019. *Managing Effects of Drought in Hawai'i and USAPI*

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