

Assessing the Status, Capacity, and Needs for Ex Situ Conservation of Native Hawaiian Plants



A project for Lyon Arboretum and the National Tropical Botanical Garden, sponsored by Hau'oli Mau Loa Foundation. Prepared by Matthew Keir and Lauren Weisenberger.

The plants of the Hawaiian Islands comprise one of the most unique and rare floras, with over half of all species at risk of extinction.^{1, 2, 3}

The first step in preventing extinction is to secure and maintain collections in a “genetic safety net” using *ex situ*, or off-site, storage methods. These methods include micropropagation, seed banking, and cultivation in nurseries and gardens, all of which are necessary and available in Hawai‘i. Ex situ collections are vital for research and restoration efforts. The rapid degradation of native ecosystems, recent commencement of recovery efforts and the looming threat from new alien species and climate change all contribute to an urgent situation. Well-maintained ex situ collections insure against extinction if natural populations decline while habitat restoration is proceeding. Germplasm (genetic resource) collections with the highest conservation value are genetically diverse, representative of naturally occurring populations, have been managed to ensure documentation of their provenance and length of time in cultivation, and have been carefully monitored to prevent artificial selection or genetic loss.

A renewed focus is needed to secure collections from taxa of conservation concern. Methods are available to provide a genetically diverse and representative pool of propagules for future recovery efforts. More support, however, is needed to expand ex situ services and strengthen partnerships between conservation groups. A statewide initiative is underway to enhance ongoing programs, identify conservation goals, measure progress, and create a formal partnership to coordinate ex situ collections. Creating a well maintained ex situ collection from each of Hawai‘i’s at risk plants is essential and possible. Once secured, these collections will provide conservation botanists with the plants necessary for creating healthy native plant communities.

Steve Perlman
(National Tropical
Botanical Garden)
collects from
*Platanthera
holochila*.

The conservation of Hawai‘i’s flora is essential and challenging. Preserving our irreplaceable natural heritage is achievable with increased collaboration and resources.



- 89% of flowering plants and 71% of ferns native to Hawai‘i are found nowhere else in the world
- Over 30% of the flora is endangered
- 213 species (of 1,360) have fewer than 50 plants remaining in the wild
- Nearly 10% of the flora is already extinct



Overview



In 2012, an inventory was conducted to assess the state-wide capacity for micropropagation and seed banking in the conservation of the native Hawaiian flora. During this process, local botanists defined taxa of conservation concern (TOC), which include species found on state or federal conservation lists in addition to those currently in some form of ex situ storage. A comprehensive inventory of ex situ facilities across the state combined individual facilities' inventories, determined the optimal ex situ method for each species of TOC, and identified the

major limiting factors to increasing capacity to protect TOC in genetic safety nets.

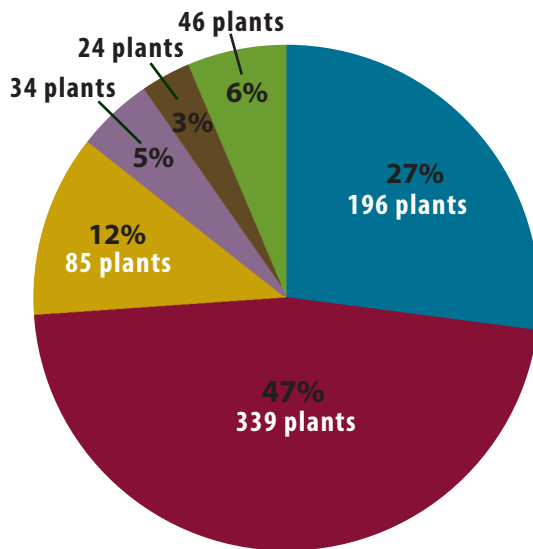
TOC are not exclusively represented by rare plants. More common Hawaiian taxa, such as *Acacia koa*, play a significant ecological role in native habitats.



Results

After interviewing botanists, 15 conservation agencies, and 20 ex situ facilities, the assessment revealed the following figures:

- 724** Total taxa of conservation concern (TOC)
- 528** Total TOC represented in ex situ collections (micropropagation, seed banks, nurseries and gardens) across the state
- 27%** Percentage of unsecured[†] TOC
- 64%** Percentage of secured[‡] taxa (339 plants) represented by collections from ≤10% of the remaining naturally occurring individuals—such small representation does not constitute a “genetic safety net”



Percentage of TOC plants represented in ex situ

- unsecured taxa[†]
- 10% or less
- 11-49%
- 50-84%
- 85-100%, low replication of representation
- 85-100%, high replication of representation



With less than 10 percent of the remaining naturally occurring individuals represented in ex situ storage, *Lobelia niihauensis*, along with 338 other taxa, is not supported by an adequate genetic safety net and therefore at greater risk of extinction.

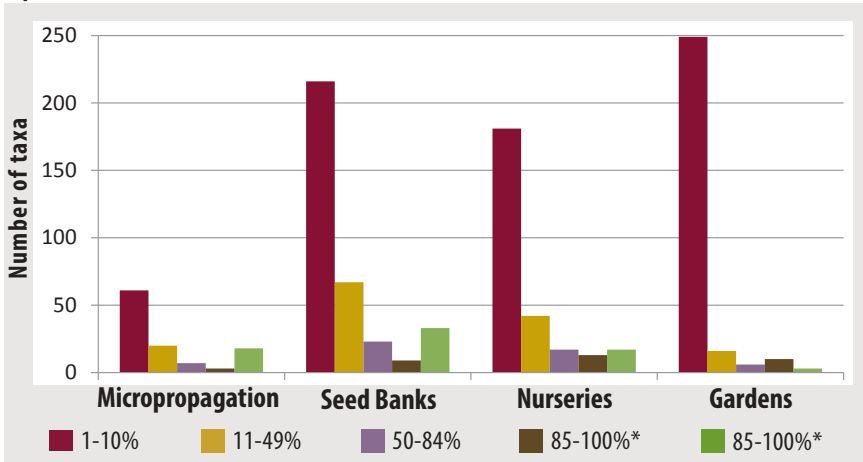
[†]not currently represented in any ex situ facility [‡]represented in at least one ex situ facility

Seed banks store seeds in secure locations in ideal conditions, lengthening the time they remain viable. Seed storage is the optimal ex situ method for most TOC in Hawai'i. Storing seeds is cheaper and captures a higher level of genetic variation in a single collection than other ex situ methods, and collecting fruit is minimally invasive to wild plants. Existing seed storage facilities are currently too small and too few to meet long-term conservation needs. Other ex situ methods, including micropropagation, nursery, and garden facilities, should be expanded and used in conjunction with seed storage for recovery efforts and regeneration of aging seed collections.

"When climate changes and human disturbances bring tremendous threats to vegetation and the environment, it is seeds that confer on us a great hope to maintain a bright future."

Dr. Xingguo Han, Research Ecologist Chair, Institute of Applied Ecology, Chinese Academy of Sciences

Representation of taxa of concern in each ex situ method



*low (brown) and high (green) replication of representation



Hank Oppenheimer (above) and Keahi Bustamente (below) (Maui Plant Extinction Prevention Program) collect for ex situ storage.



What are the limiting factors in securing all TOC?

- ▶ resources to support in situ collections
- ▶ limited coordination among conservation agencies
- ▶ current capacity of ex situ facilities to research, store, and maintain collections

How can Hawai'i overcome these limiting factors?

Creating a unified statewide plant conservation network will most effectively increase the capacity of ex situ facilities and in situ plant monitoring to preserve Hawai'i's flora. An informal network of programs has been working together to share expertise and facilitate plant conservation. To strengthen this network, expedite plant collections, and to build capacity, a formal partnership should be created to achieve shared conservation goals, successful restoration, and rare plant recovery. A formal ex situ plant conservation network will be better positioned to establish a venue for increased collaboration, share successes and obstacles, and standardize conservation goals, propagation techniques and tools for success.



Recommendations

Statewide Plant Conservation Network



- Coordinate collections of underrepresented species
- Initiate improved data recording and sharing capabilities among conservation agencies
- Organize standardized protocols for transportation and storage of propagules
- Draft conservation plans with ex situ goals for TOC
- Coordinate long-term conservation and funding strategies

Seed Banks



- Standardize storage and processing protocols
- Improve access to seed bank services statewide
- Invest funds and support to increase capabilities at the four existing seed banks in the state
- Establish collection of common native species for restoration, including post-fire reforestation
- Identify and conduct research targets in collaboration with industry experts

Micropropagation



- Expand research efforts on taxa that are difficult to establish in micropropagation with industry experts
- Develop protocols for storing TOC that do not store well in seed banks
- Establish a back-up micropropagation location for Lyon Arboretum

Nurseries and Gardens



- Develop a mid-elevation nursery on Moloka'i
- Standardize sanitation protocols to aid in exchange of plants
- Increase support for improving irrigation and facilities' infrastructure
- Support improvement of data management of provenance information

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- Photos courtesy of Matthew Garma, O'ahu Army Natural Resources Program, Plant Extinction Prevention Program, Nellie Sugii (Lyon Arboretum Micropropagation Lab), and Timothy Kroessig. Design by Celeste Ventresca.*

Summary Statistics

The greatest progress has been made with the rarest TOC.

- 18 taxa are extinct in the wild but are secured ex situ
- 169 of 213 taxa with 50 known plants are secured ex situ

Collecting from enough plants to adequately 'secure' TOC is needed.

- Only 9% of secured taxa have adequate ex situ collections that represent most (≥85%) of the known plants

The need for progress is great.

- 64% of secured taxa are represented by less than 10% of the known plants
- 27% of secured taxa are only at one ex situ facility

Gardenia brighamii is well represented on all islands at 13 different facilities and is thus a model of ex situ storage for TOC.



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Find the full assessment online at
<http://hrprg2.webnode.com/ex-situ-assessment/>