Authors: D.A. Burney, D. Bender, S. Perlman, C. Salvador and C. Wichman

The National Tropical Botanical Garden: creating a Genetic Safety Net for Hawaii's vanishing flora

The Hawaiian Islands are the most isolated high islands in the world, located over 2,000 miles from the nearest continental land mass. Their isolation, together with a high diversity of habitat types, makes the Hawaiian flora one of the most unique in the world. Approximately 1,500 plant species are indigenous to the Hawaiian Islands, with perhaps the highest rate of endemism in the world at over 90%. Nearly half of the 114 species known to have become extinct in the U.S. in the first 20 years of the Endangered Species Act are in Hawaii. Humans have precipitated these extinctions through the introduction of exotic plants, animals and diseases and the transformation of the land with fire, livestock and deforestation.

To try to stem the tide of extinction in the Islands, the National Tropical Botanical Garden (NTBG) Conservation Department has an integrated strategy that addresses threats and recovery needs at the species and landscape levels. The Genetic Safety Net (GSN) program provides a seamless sequence of conservation strategies through collection, curation, native plant nursery operation and a rapidly growing ecological restoration and reserve management program that creates, enhances and manages habitats for rare plants in perpetuity.

The GSN list consists of 118 Hawaiian species that have fewer than 50 individuals remaining in the wild. NTBG has developed strict protocols for GSN collecting which include genetic sampling of populations, accurate GPS locations for individual plants and populations and the creation of high quality species distribution and survey maps. Over the past 20 years, roughly two dozen species have been rediscovered by NTBG botanists that were thought to be extinct and about 20 new species have been discovered that were previously unknown to science.

The Native Plant Nursery Operation has developed techniques for nursery propagation of native plants from storage of propagules, appropriate germination techniques and other means of propagation to the organization of climate-controlled growth environments for large-scale plant stock production. This native plant nursery operation has produced thousands of plants that are well-established in the NTBG reserve and restoration area system and gardens. Capacity has greatly expanded with an extended native plant nursery facility now coming on-line.

Left: With the spectacular Limahuli Preserve for a backdrop, NTBG Acting Director Chipper Wichman "talks story" with visitors, explaining the need for conservation of native plants through Hawaiian legends

Restoration and Natural Area Management

The overall strategy is to establish or enhance a sufficiently large area of habitat dominated by native species to provide suitable conditions within these native plant communities for new populations of GSN species and to monitor, protect and enhance existing populations on NTBG properties.

Limahuli Preserve

Limahuli Preserve is the largest preserve in the system (990 acres). The 400-acre Upper Valley of Limahuli is mostly intact and is home to a great abundance and exceptionally high diversity of native plants and animals. Since 1992, the NTBG has actively managed Limahuli Preserve to protect and enhance the populations of native plants that are threatened by hurricanes, alien plants and feral ungulates. Among these are extant populations of 10 Federally Listed Threatened or Endangered plant species, a large nesting colony of Newell's Shearwater (a pelagic seabird), Hawaiian honeycreepers, Hawaiian owls and the endemic hoary bat. Since 1998, Limahuli Preserve has developed 10 acres of lowland wet and mesic forest restoration outplanting sites. Within these sites the restoration team has planted ca. 5,000 native, nursery-grown trees and shrubs, ca. 720 of which are specimens of Federally Listed Threatened or Endangered species and other at-risk species. A second major element crucial to the long-term protection of Limahuli is the construction of an ungulate-proof fence enclosing the entire Upper Valley of Limahuli to keep feral pigs and goats from the Preserve. The NTBG has received a sizeable grant from the US Fish & Wildlife Service to undertake the fencing project in 2005.

Lawai Kai Coastal Restoration

The Lawai Kai coastal project is a 3-acre native plant restoration site located at the mouth of Lawai Stream, on the south shore of Kaua'i. It is near paleoecological and archaeological sites, which provide information on the local ecological history and guided the restoration plan. A goal of this project is to improve coastal and lowland forest habitat for more than 20 rare native plant species and to remove a thick mat of alien grass from the beach strand to enable sea turtle to nest. Several at-risk species are being planted within this site – including *Sesbania tomentosa, Munroidendron racemosum, Hibiscadelphus distans, Pritchardia aylmer-robinsonii* and others.

Ka`upulehu Preserve, Kona, Hawaii

Ka`upulehu is a 6-acre dry forest preserve located in North Kona on the Big Island, Hawaii. Though small in size, this preserve has been fenced continuously since the 1950's and unlike much of the surrounding forest, Ka`upulehu contains an extraordinarily rich native dryland flora that is exceptionally intact. Maintenance of firebreaks around the preserve and replacement of the perimeter fence which keeps feral goats from entering are pressing management needs for this small preserve.

Kahanu Gardens, Maui

At Kahanu Gardens, NTBG manages an extensive native *hala* woodland (*Pandanus tectorius*) and ethnobotanical plants, as well as the largest pre-contact Hawaiian *heiau* or stone temple.

McBryde Gardens on Kaua`i

Under support from the NTBG Fellows Program, NTBG's McBryde Gardens on Kaua`i has initiated a dry forest restoration project designed to support 20 or more plants on the US Endangered Species List and dozens of other rare dry-adapted plants.

Under contractual collaborations, NTBG staff assist large landowners with restoration projects (e.g. Grove Farm, Inc., the Bette Midler Trust) and the Federal-State collaborations to restore the sea-bird colonies on tiny Lehua Islet off Ni`ihau.

NTBG staff fervently hope that, with the continued application of a multi-faceted approach to native plant conservation, many of the 118 species of GSN-designated rare plants will soon be firmly back on the road to permanent recovery.

D.A. Burney, D. Bender, S. Perlman, C. Salvador and C. Wichman
National Tropical Botanical Garden, 3530 Papalina Rd., Kalaheo, HI 96741, U.S.A.
Tel: +1 (808) 332-7324
Fax: +1 (808) 332-9765
E-mail: dburney@mail.ntbg.org
Internet: www.ntbg.org

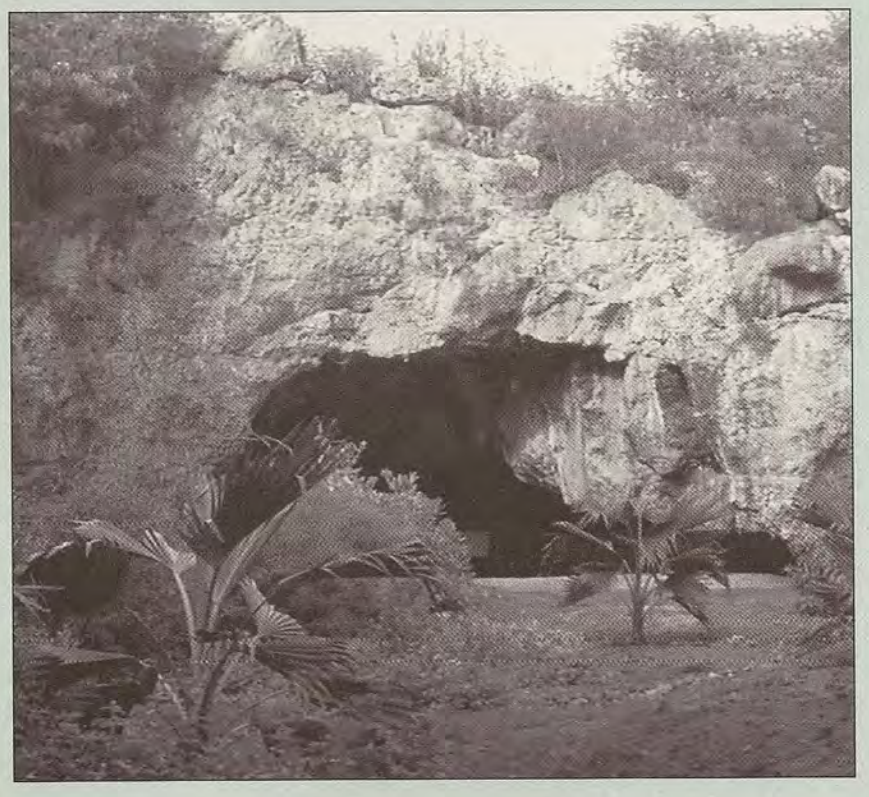
Right: Participants in the Horticultural Intern program at NTBG have worked hard in recent months on the Lawai Kai coastal restoration project and other restorations in the McBryde and Limahuli Gardens on Kaua`i, as well as at Kahanu Gardens on Maui

Providing a home for *Pritchardia aylmer-robinsonii*

NTBG draws from all available scientific sources in choosing the right plants for its ecological restorations. If a native plant is growing already on the site to be restored, or nearby in similar habitats, it may be included in the project. But sometimes, less direct clues must be employed, especially in highly degraded sites. Then botanists and ecologists at NTBG may employ oral and written histories or information from the pollen, seeds, and fossil leaves that may occur in adjacent paleoecological sites.

The case of Hawaii's endemic loulu palms (*Pritchardia* spp.) are a good example. Limahuli still has an endemic palm, *P. limahuliensis*. But at Lawai Kai and throughout Kaua`i's south coast, no loulu palms have survived in the wild to modern times. Yet thousands of fossil seeds from the sediments of Makauwahi Cave show that these stately native palms were a key element in coastal plant communities throughout the millennia leading up to human settlement (Burney *et al.*, 2001, *Ecological Monographs* **71**:615-641). Most of these fossils are an unusually small, spherical type of *Pritchardia* seed unlike that of most Kaua`i species of the genus. One exception is *P. napaliensis*, which grows on steep wet slopes along the island's western Napali Coast, a very different habitat from the low, sandy, seasonally dry south coast.

P. napaliensis has close cousins on other islands that are clearly dry-adapted. The most common of these is *P. remota*, on the distant island of Nihoa in the Northwestern Hawaiian Islands chain. Much closer at hand is *P. aylmer-robinsonii*, a stately palm endemic to the adjacent island of Ni`ihau, a few miles offshore from Kaua`i's south coast, a species that is nearly extinct in the wild. Botanists believe there are only two mature specimens remaining on Ni`ihau. Although species from off-island would not normally be used in NTBG restorations, staff at NTBG have opted to use this rare species in their south shore restorations, as it is adapted to dry lowland conditions, has no current opportunity for restoration on its home island, and may well be a species formerly found in adjacent coastal forests of Kaua`i, or the closest living relative of one that did. In any case, the decision has paid off, as more than 30 large specimens of *P. aylmer-robinsonii* are now thriving and growing rapidly in NTBG restorations at Lawai Kai in the Allerton Gardens and the Makauwahi Cave Reserve, a joint project with Grove Farm, Inc.



The very rare endemic Loulu palm, Pritchardia aylmer-robinsonii, *thrives in NTBG's restoration sites on Kaua`i's south coast. These rapidly growing specimens are inside the limestone sinkhole at Makauwahi Cave, a joint project with landowner Grove Farm, Inc. Sediments excavated here by NTBG staff and volunteers yielded thousands of seeds identical to those of this stately palm.*