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# A review of the conservation status of the endemic *Pritchardia* palms of Hawaii

Melany H. Chapin, Kenneth R. Wood, Steven P. Perlman and Mike Maunder

**Abstract** The conservation status of 23 Hawaiian endemic palms, *Pritchardia* spp., is reviewed. Field survey reports, recovery plans, herbaria holdings and observations have been utilized to assess each taxon's current range and status. Eleven species are categorized as Critically Endangered, nine Endangered, two Vulnerable and one as Data Deficient when subject to the IUCN Red List criteria. Conservation management options are discussed. A large proportion of this genus is on the verge of extinction and will continue to decline in the wild without active conservation management. Recommendations involving long-term management include maintaining and protecting the existing wild populations, establishment of effective *ex situ* populations, reintroduction into the wild, and the establishment of procedures to deal with invasive plants and animals.

**Keywords** Arecaceae, Hawaii, Pacific islands, palms, *Pritchardia,* Red List.

## Introduction

The genus *Pritchardia* (Family Arecaceae) has 28 known species restricted to the Pacific archipelagos of Hawaii, Fiji, the Cook Islands, Tonga, and the Tuamotus, with 23 species endemic to Hawaii (Fig. 1). *Pritchardia* is placed in Sub-family Coryphoideae, Tribe Corypheae and Subtribe Livistoninae, which it shares with 11 genera, five of Asian/Indo-Pacific origin, and six from the New World (Uhl & Dransfield, 1999). The Pacific species, although abundant in cultivation (most notably *P. pacifica* Seem. & H.Wendl. and *P. thurstonii* F. Muell. & Drude), are relatively poorly studied in the wild. The wild populations of *P. mitiaroana* J. Dransfield & Y.Ehrhart from the Cook Islands, *P. vuylstekeana* Hort. from the Tuamotus, *P. pacifica* from Tonga and *P. thurstonii*, from Fiji, require field studies to assess their conservation status and management needs (Smith, 1979; Dowe, 1989; Fosberg, 1998). Another species, *P. maideniana* Becc., known only from cultivation at the Royal Botanic Gardens Sydney, is thought to have been derived from a Hawaiian collection (Riffle & Craft, 2003); this species requires phylogenetic studies to ascertain its taxonomic status and probable origin.

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Hawaiian *Pritchardia* species currently occupy a wide range of habitats, including mesic forests and narrow ravines, wet forests, cliffs and coastal cliff areas, and offshore islets. Wild populations occur between sea level and 1,270 m. Population sizes range from two to over 10,000 individuals. Nine taxa are restricted to single populations and others have up to 10 populations (Table 1). All species are single island endemics. Kauai, approximately 5 million years older than Hawaii, has the highest number of *Pritchardia* taxa (eight), and the youngest and largest island, Hawaii (10,458 km$^2$), has four taxa (Wagner *et al*., 1990).

The dramatic decline of the Hawaiian *Pritchardia* is documented in recent archaeological records. Fossil *Pritchardia* stems found near sea level on Oahu date from 100,000 years ago, suggesting that the genus was widespread prior to human settlement in 400 AD (Carlquist, 1980; Cuddihy & Stone, 1990). Further evidence from both seed and trunk macrofossils and pollen indicates that *Pritchardia* was one of the most abundant trees in pre-settlement times (Burney *et al*., 2001; Rauzon, 2001; Athens *et al*., 2002), comprising up to half of the pollen in soil cores from lowland Hawaiian archaeological sites (Hotchkiss & Juvik, 1999). Athens *et al*. (2002) have found evidence of extensive dry lowland forests containing *Pritchardia* on Oahu that disappeared around 1020 AD.

By the time of Captain Cook's arrival in 1778, the coastal zones of the major Hawaiian Islands were heavily settled and modified (Cuddihy & Stone, 1990) and accounts by early botanists provide few insights into the recent historical status of *Pritchardia*. Jules Remy (1826–1893), after 4 years in Hawaii, mentions *Pritchardia* only once, describing Huelo Islet, "... on a small offshore inaccessible islet he saw charming palm trees

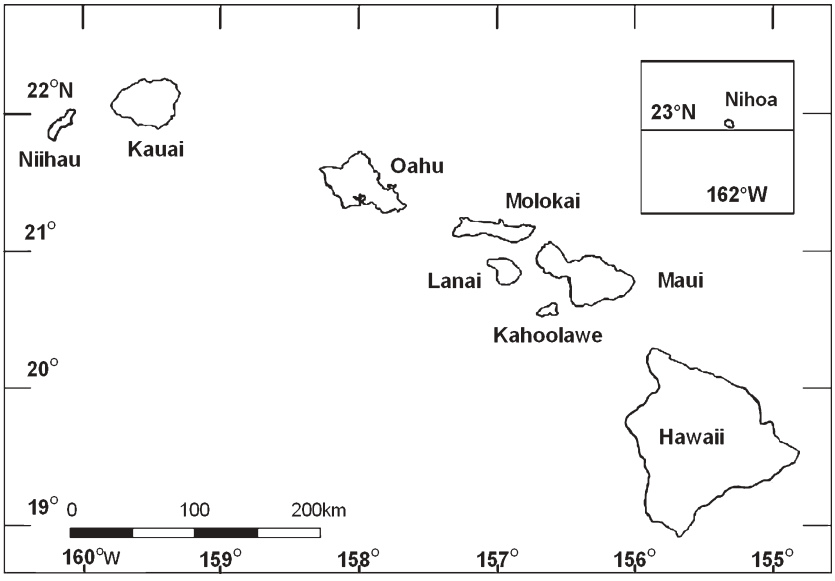


**Fig. 1** The Hawaiian archipelago, where endemic species of *Pritchardia* occur on Nihoa, Niihau, Kauai, Oahu, Molokai, Lanai, Maui and Hawaii (see Table 1).

(*Pritchardia*)" (St. John, undated). Wilhelm Hillebrand (1888) noted that, "... one species of *Pritchardia* in Nuuanu, ... was completely exterminated when natives found that the trees were saleable to amateurs of gardening in Honolulu." Beccari & Rock (1921) note that in south Kona, "... the original forest surrounding this species [*P. affinis*] has practically disappeared"; they add, "... There is no doubt that some of the species are on the verge of extinction."

The major contemporary threats include introduced rats, *Rattus rattus*, *R. exulans*, and *R. norvegicus*, which feed on the seeds and seedlings and damage palm hearts. Introduced goats *Capra hircus* and deer, *Axis axis* and *Odocoileus hemionus columbianus*, graze seedlings. Pigs *Sus scrofa* eat seedlings, and their digging destroys seedlings and habitat. Invasive plants compete with both established trees and seedlings (Cuddihy & Stone, 1990; Staples & Cowie, 2001).

The IUCN recognizes the Hawaiian Islands as a Centre of Plant Diversity (Davis *et al*., 1996) and Myers *et al*. (2000) include Hawaii within the Polynesia/Micronesia Hotspot. The islands have suffered a catastrophic decline in endemic plant diversity (Bruegmann *et al*., 2002). The aim of this paper is to present the first comprehensive assessment of one of Hawaii's most spectacular adaptive radiations and to provide a summary of our knowledge of the conservation status of the Hawaiian *Pritchardia* (Table 1).

## Methods

This study uses three main sources of information: (1) herbarium records, (2) published accounts and recovery plans, and (3) field assessments. The distribution of the Hawaiian *Pritchardia* species was assessed using three major herbarium collections: Bishop Museum, Honolulu (BISH), National Tropical Botanical Garden (PTBG), and United States National Herbarium, Smithsonian Institution (US). The earliest specimens were collected by Joseph Rock in 1910. Most of the herbarium labels lack detailed descriptions of population size, elevation, demography and associated species. Further information was gathered from publications (Rock, 1913; Beccari & Rock, 1921) but these works do not detail population numbers, ecology or phenology. We undertook field surveys of all the *Pritchardia* species on the major Hawaiian Islands, except Niihau and Nihoa, between 1973 and 2002. The results of these surveys and studies, which include community descriptions, number of populations and individuals, demography, altitude and threats, are found within the Hawaiian Natural Heritage Program database (HINHP), the PTBG accessions, Genetic Safety Net reports (that identify the most threatened Hawaiian endemics), US Fish and Wildlife Service (USFWS) Recovery Plans and published and unpublished field studies (Conant, 1985; USFWS, 1996a, b, c, d, e; Wood, 2000; Rauzon, 2001; Wood *et al*., 2001; Chapin *et al*. 2002; HINHP, 2002; PTBG, 2002; Wood & LaGrande, 2002). Conservation assessments were obtained from *Palms, Their Conservation and Sustained Utilization* (Johnson, 1996), USFWS listings, the *1997 IUCN Red List of Threatened Plants* (Walter & Gillett, 1998) and Wagner *et al*. (1999). We made updated conservation status assessments using the IUCN Red List Categories (IUCN, 2001). These should be regarded as provisional assessments and will require verification from both the IUCN-Species



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**Table 1** Distribution, ecology, number of individuals and populations, elevation range, regeneration *in situ* and conservation assessments of the Hawaiian endemic *Pritchardia* organized by island (north to south), and then alphabetically by species.

| | | | | | | | Conservation assessments | | |
|---|---|---|---|---|---|---|---|---|---|
| Taxon | Distribution | Ecology | No. individuals | No. populations | Elevation range (m) | Regeneration *in situ* | IUCN/SSC Palm Action Plan[1] | IUCN Red List of Threatened Plants[2] | USFWS assessment[3] | This study (criteria)[4] |
| *P. remota* Becc. | Nihoa | Coastal forest representing a relatively intact low-elevation dryland ecosystem | 600–700 | 1 | 45–800 | Y | E | EN | E | VU (D1 + 2) |
| *P. aylmer-robinsonii* St. John | Niihau | Kaali Cliff and in Mokouia and Haao Valleys, originally a component of the coastal dry forest | 2 | 1 | 70–270 | N | E | EN | E | CR (D) |
| *P. hardyi* Rock | Kauai | Wide range of habitats on the windward side | 250–300 | 3 | 500–750 | Y | | EN | R | EN (C2) |
| *P. limahuliensis* H. St. John | Kauai | Upper Limahuli Valley, in open and mesic forests | 300 | 2 | 152–914 | Y | | DD | E | CR (B1ab) |
| *P. minor* Becc. | Kauai | Mesic to wet forests, near the Alakai Swamp to the Kokee area to the Na Pali Coast | 500 | 10 | 760–1,220 | N | | DD | AS | EN (B2ab) |
| *P. napaliensis* H. St. John | Kauai | Na Pali coast, and grows in mesic-wet forests to montane wet forests | 160 | 3 | 150–1,160 | N | E | EN | E | CR (C1) |
| *P. perlmanii* C.E.C. Gemmill | Kauai | Waioli Valley, high pocket valley on main waterfall of Namolokama | 500 | 3 | 420–850 | N | | DD | E | EN (B1ab) |
| *P.* sp. A | Kauai | Near the Wahiawa Bog, South Kauai, in the Makaleha Range, and along the Powerline Trail | est. 350–450 | 4 | 914 | N | | DD | | EN (B2a) |
| *P. viscosa* Rock | Kauai | Degraded open mesic forests with clay substrate | 3 | 1 | 500–700 | N | E | EN | E | CR (D) |
| *P. waialealeana* R.W. Read | Kauai | Wet forest habitats, on windward slopes | unknown[5] | 1 | 600 | N | | CR | AS | DD |
| *P. kaalae* Rock | Oahu | Open, windswept mesic forests | 170 | 1 | 450–980 | N | E | EN | E | CR (B1 + 2) |
| *P. martii* H. Wendl. | Oahu | Wet forest slopes and ridges or cliffs | *c.* 10,000 | 1 | 360–762 | N | | DD | AS | VU (A1ce) |
| *P. hillebrandii* Becc. | Molokai | Huelo Rock, only remaining intact lowland palm forest | <200 | ? | 30–750 | Y | | DD | AS | EN (D) |

**Table 1** (Continued)

| Taxon | Distribution | Ecology | No. individuals | No. populations | Elevation range (m) | Regeneration *in situ* | Conservation assessments | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | IUCN/SSC Palm Action Plan[1] | IUCN Red List of Threatened Plants[2] | USFWS assessment[3] | This study (criteria)[4] |
| *P. lowreyana* Rock ex Becc. | Molokai | Mesic valleys and inland cliffs | 2,000 | 1 | 130–920 | N | | EN | AS | CR (B1ab) |
| *P. munroi* Rock | Molokai | Mesic gulch, and in a drainage | 2 | 1 | 610 | N | E | EN | E | CR (D) |
| *P. lanaiensis* Becc. | Lanai | Highly degraded mesic-wet forest habitat | 130–150 | 3 | 550–660 | N | | DD | V | EN (D) |
| *P. arecina* Becc. | Maui | East and north-east slope of Haleakala | 500 | 7 | 600–1,220 | N | | DD | AS | CR (B1+2) |
| *P. forbesiana* Rock | Maui | Western portion of Honokohau drainage basin and north and east slopes of Mt. 'Eke | 170 | 4 | 914–1,220 | N | | VU | R | CR (B1+2) |
| *P. glabrata* Becc. & Rock | Maui | Cliffs and in mesic gulches | *c.* 50 | 2 | 550 | N | | CR | V | CR (D) |
| *P. affinis* Becc. | Hawaii | Leeward coastal sites and inland gulches in mesic forests | >25 | 7 (?) | 0–600 | N | E | EN | E | CR (D) |
| *P. beccariana* Rock | Hawaii | Wet forest, in the region around Kilauea, in the forest near Glenwood on the slopes of Mauna Kea | est. >1,000 | 7 | 610–1,270 | N | | DD | AS | EN (B1+2) |
| *P. lanigera* Becc. | Hawaii | Dense wet forests or flat, boggy plateaus and windward slopes | 150 | 1 | 610–1,220 | N | | EN | R | CR (B1+2) |
| *P. schattaueri* D.R. Hodel | Hawaii | Lowland mesic forests | 13 | 3 | 600–800 | N | E | EN | E | CR (D) |

[1]Johnson, 1996; E Highly Endangered
[2]Walter & Gillett, 1998; CR Critically Endangered, EN Endangered, VU Vulnerable, DD Data Deficient
[3]Wagner *et al.*, 1999; E Endangered, V Vulnerable, R Rare, AS Apparently Secure
[4]Wagner *et al.*, 1990, Chapin *et al.*, 2002, and pers. obs.; CR Critically Endangered, EN Endangered, VU Vulnerable, DD Data Deficient; criteria as per IUCN (2001)
[5]More data needed to make assessment

Survival Commission Hawaiian and Palm Specialist Groups before formal adoption into the IUCN Red List. We have used the IUCN Red List categories because they represent a quantitative and verifiable assessment system that is being widely used internationally to generate national and global Red Lists.

## Results

### Species summaries

*P. remota* is found on Nihoa, which is part of the Hawaiian Islands National Wildlife Refuge and has been designated a Research Natural Area (Clapp *et al.*, 1977; Conant, 1985; Chapin, 1990). Photographs indicate the presence of a native *Pritchardia* on the uninhabited island of Laysan, north-west of Nihoa (Rauzon, 2001), thought most likely to be *P. remota* or a closely related taxon. Although the ecosystem of Nihoa is more intact than other major Hawaiian islands, it is considered vulnerable to threats that could eliminate or greatly reduce its numbers. The USFWS Recovery Plan (USFWS, 1996a) specifically identifies natural disasters, or the introduction of any invasive species, predators or pathogens, as serious potential threats.

*P. aylmer-robinsonii*, on Niihau, was discovered by Harold St. John in 1947 (St. John, 1959; Wichman & St. John, 1990). The two wild trees occur in a rugged and steep cliff area where they receive protection from grazing animals. However, the species is widely cultivated by residents on Niihau and seed production is abundant (USFWS, 1996b).

*P. hardyi*, on Kauai, has the majority of its range managed by the State of Hawaii. We have observed some regeneration in the wild (Chapin *et al.*, 2002). It is near an area accessible to the public and is subject to the impacts of invasive plants and animals.

*P. limahuliensis*, found on Kauai, is benefiting from *in situ* activities such as monitoring and habitat management, including a fenced exclosure. Wild-collected seeds have been catalogued and propagated at PTBG, and reintroduced to PTBG's Limahuli Preserve.

*P. minor* from Kauai is found largely within the boundaries of the Kokee State Park where wild-sourced seedlings have been successfully reintroduced. The Kokee Resource Conservation Program manages invasive weeds and rats within exclosures containing the species. The Department of Land and Natural Resources, Division of Forestry and Wildlife (DLNR-DOFAW), has also planted *P. minor* in protective exclosures. Field studies have recorded poor regeneration, (Chapin *et al.*, 2002; K. Cassell, pers. comm.).

*P. napaliensis* from Kauai, is restricted to the Na Pali coast. It grows on state-owned land: Hoolulu and Waiahuakua valleys in the Hono O Na Pali Natural Area Reserve and Alealau in Kalalau Valley (within or close to the boundaries of the Reserve and Na Pali Coast State Park).

*P. perlmanii* from Kauai was discovered in 1998, at which time about 500 individuals were known from Waioli Valley.

An undescribed species *Pritchardia* sp. A was collected on Kauai in 1987 (D. Lorence, pers. comm.). The State of Hawaii and private land managers, Alexander and Baldwin, manage the majority of its range. There is currently no *in situ* management.

*P. viscosa* from Kauai is managed by the Division of Forestry and Wildlife who contribute to the protection of the population through an exclosure protecting against grazing animals and pigs, and with metal rat guards around the tree stems. Prior to Hurricane Iniki in 1992, 12 trees were known but there are now only three living trees. A seedling was observed by the authors in 1998, but this has since been removed, probably by poachers.

*P. waialealeana* from Kauai requires more research and information on the range of the wild population to make an accurate assessment of its status.

*P. kaalae*, from Oahu, occurs in Kaala, Makaleha, Waianae Kai and Makua. The US Army controls rats and conducts reintroductions. This population is located on state land, including Mount Kaala Natural Area Reserve and land leased to the Department of Defence for Makua Military Reservation, and federal land on Schofield Barracks Military Reservation.

*P. martii* is found in the Koolau Mountains on Oahu. This species has the highest number of individuals yet it occurs on the island with the greatest impacts in terms of human population pressures, pests, diseases and invasive species, and it lacks protective management.

*P. hillebrandii* is found on Molokai and offshore islands. The population at Huelo Rock is one of the few *Pritchardia* populations in Hawaii reproducing in the wild and the islet is currently free from rats and goats. Twelve individuals are also found on the adjacent islet of Mokapu. Kalaupapa National Historical Park is helping to protect and establish additional coastal populations of this species.

*P. lowreyana* from Molokai benefits from protective exclosures provided by The Nature Conservancy of Hawaii.

*P. munroi* from Molokai has one individual with an exclosure surrounding it, provided by The Nature Conservancy of Hawaii. There is a second individual that is not protected. Seeds collected from the one tree in the exclosure that has flowered and fruited are grown in botanical gardens (Chapin & Lorence, 2000; Chapin *et al.*, 2001).

*P. lanaiensis* from Lanai is receiving protection from grazing animals through the installation of fencing provided by the Lanai Company.

*P. arecina* from Maui receives protective management from Haleakala National Park and efforts by the East Maui Watershed Partnership. There is a high degree of fragmentation, low seedling recruitment and low numbers of individuals.

*P. forbesiana* from Maui is protected through the management of West Maui Watershed and Maui Land and Pine, a local private business, through rat and pig control, and fencing.

*P. glabrata* is endemic to Maui. Read (in Wagner *et al.*, 1990) considers it a miniature palm because it characteristically reaches 1–2 m in height and has a slender trunk *c.* 15–20 cm in diameter. Beccari & Rock (1921) describe it as one of the smallest *Pritchardia* species.

*P. affinis* from Hawaii is widely cultivated. Read (undated) noted that it occurs naturally within areas of early Polynesian settlements. He suggests that it has an ecology similar to *Washingtonia* from California and *Livistona* from Australia, which also occur in natural seepages in xeric habitats.

*P. beccariana* from Hawaii benefits from DLNR-DOFAW protection through fencing and pig control. The narrow range and high fragmentation makes the palms highly susceptible to single events such as hurricanes or the introduction of a disease.

*P. lanigera* from Hawaii is a robust tree with a trunk of 30–50 cm diameter. Its fruits are larger than most *Pritchardia* and measure *c.* $40 \times 35$ mm. The Division of Forestry and Wildlife Big Island has 12 *P. lanigera* that are protected within Puu O Umi bog unit, and three at Kaukini, Hawaii.

*P. schattaueri* from Hawaii has benefited from Division of Forestry and Wildlife activities where individuals are planted in protective exclosures in addition to the reintroduction of seedlings to another site. A private landowner, in collaboration with the US Fish and Wildlife Service, is also taking measures to protect the species.

## Conservation management

With respect to *in situ* conservation, 14 of the 23 Hawaiian *Pritchardia* species are represented in preserves or are subject to some form of conservation management, as outlined above.

The *ex situ* collections of Hawaiian *Pritchardia* are an incomplete and limited representation of species. The majority of cultivated stocks lack basic data on the origin, quality or genetic diversity of each collection and it is therefore difficult to assess their conservation value. The largest cultivated collections are held by the University of Hawaii (UH), Lyon Arboretum, the Waimea Arboretum and PTBG. The UH Lyon Arboretum Tissue Culture Laboratory propagates many species of Hawaiian *Pritchardia*, often from immature seeds, and is conducting research on seed storage techniques. The PTBG has a comprehensive collection with all but two Hawaiian species in cultivation (Chapin *et al.*, 2001). The Division of Forestry and Wildlife has an array of nurseries and reintroduction sites throughout the state. For instance, the Kiolakaa Ranger Station has over 30 *P. affinis* and 30 *P. beccariana* planted out. The US Army on Oahu has a nursery and reintroduction sites for *P. kaalae,* and is also working with the University of Hawaii on seed viability studies.

*Pritchardia* is one of the most widely cultivated ornamental palms (Maunder *et al.*, 2001); 33 botanic gardens in 10 countries cultivate 25 species of *Pritchardia* (BGCI, 2000). The distribution of *Pritchardia* reflects the pattern of cultivation for many threatened species, with a few easily cultivated species dominating the *ex situ* representation (e.g. *P. affinis*, *P. martii*, *P. lanigera* and *P. kaalae*) with others (e.g. *P. hardyi*, *P. hillebrandii*, *P. limahuliensis*, *P. lowreyana*, *P. perlmanii*, *P. remota* and *P. waialealeana*) found only in a single institution (Maunder *et al.*, 2001). Most of the important genetic material in cultivation exists within Hawaii, although it is possible that important material may be found in international collections. For instance, Jardín Botanico Canario Viera y Clavijo, Gran Canaria, Spain, has reproducing trees of *P. munroi* derived from a wild tree (D. Bramwell, pers comm.). Seed was repatriated to Hawaii in 2002.

The cultivated populations of some species exceed wild populations (e.g. *P. aylmer-robinsonii*, *P. munroi* and *P. viscosa*) and may contain genetic diversity lost from wild populations. For instance, it is possible that seed was collected from trees of *P. viscosa* and *P. limahuliensis* prior to Hurricane Iniki in 1992. *Pritchardia* is valued as a garden and landscape species in Hawaii, and accordingly there is a large commercial propagation of species, including some that are highly threatened. Some species are subject to damaging levels of collecting (both of seeds and seedlings) but the extensive horticultural community holds invaluable expertise that can, and sometimes does, support the conservation of wild populations. There is an international trade in *Pritchardia* seeds and commercial seed dealers are offering *P. lowreyana* and *P. remota* for $20–30 per 10 seeds and *P. hillebrandii* for $95 per 100. It is most likely that these originate from cultivated sources but wild collection of threatened species does occur. *Pritchardia* species are being planted outside their known range and on islands from which they have not been recorded. This raises the possibility of hybridization as a result of artificial sympatry.

Until recently, seed banking was considered impractical for palm seeds (T.D. Hong, pers. comm.). However, some palm species demonstrate orthodox or



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intermediate behaviour in seed storage (Hong *et al.*, 1998). Preliminary findings at Fairchild Tropical Garden indicate that many palm species would tolerate desiccation and storage (D. Garvue, pers. comm.). Tests at the National Seed Storage Labortory in Colorado using *Pritchardia* seeds have shown promising results (C. Walters, pers. comm.). Additional research to establish reliable protocols for storage of *Pritchardia* palm seeds is needed (Pritchard *et al.*, 1998). Tissue culture of *Pritchardia* species has been successful. Immature fruits can be effectively germinated if the embryo has sufficiently developed (N. Sugii, pers. comm.).

## Discussion

Hawaiian endemic *Pritchardia* species will not survive without continued conservation management. All species that we reviewed face threats from introduced invasive plants, animals, pests and diseases. Three species have three or fewer individuals left in the wild, and nine species have less than 200 wild individuals. Three species survive with $<10$ individuals and most of the remaining taxa have little or no recorded regeneration *in situ*. To help reduce further loss we make the following recommendations, which can be applied to other threatened island endemic palm floras (e.g. Maunder *et al.*, 2002a).

The first priority should be the retention of the existing wild populations. We propose that rat eradication and control of feral goats and pigs be adopted to allow seed production and regeneration. This will need to be matched by a commitment to control invasive weeds within the managed area. With the increasing practicality of rodent and goat control there are more opportunities for re-establishing *Pritchardia* populations as components of lowland and offshore habitat restoration projects. For instance, the offshore island reserve of Lehua, adjacent to Niihau, offers the opportunity to establish new populations of *P. munroi*. Similarly it is feasible to consider reintroduction of *P. remota* to Laysan, from where it was eradicated. However, for other lowland sites the selection of taxa for planting is problematic. The lowland populations, and possibly lowland taxa or species, were eradicated during Polynesian settlement. Choosing the appropriate taxa presents a challenge due to the unknown identity of the extinct lowland *Pritchardia* populations; it is not known whether the extirpated populations were lowland populations of still extant taxa now known only from upland sites, or extirpated endemic taxa.

Establishing procedures to deal with invasive animals and plants with all conservation partners can protect preservation efforts. Both wild and garden *Pritchardia* populations are prone to introduced and invasive pests and pathogens. Without effective quarantine measures new pests and diseases could become established. *Pritchardia* is known to be particularly susceptible to Lethal Yellowing disease (Broschat & Meerow, 2000). Fortunately, the disease and its known vector, the palm cixiid *Myndus crudus* do not yet occur in Hawaii, but vigilance is essential and quarantine laws should continue to be strictly enforced or strengthened. Another potential threat is the West Indian sugarcane borer *Metamasius hemipterus* known to damage palms in Florida (Broschat & Meerow, 2000). A recent pest introduction that has adversely affected native *Pritchardia* is the two-spotted leaf hopper *Sophonia rufofascia*. It was first discovered in Hawaii in 1987. Findings indicated that this pest attacks a suite of both native and exotic plants including *Pritchardia.* Constant monitoring of both wild and cultivated *Pritchardia* populations will be necessary.

Pre-settlement ranges of *Pritchardia* in Hawaii were more extensive than at present and the genus formed a major component of lowland and interior forests. Today only fragments remain with minimal natural regeneration (Chapin *et al.*, 2002). These surviving populations persist in an ecosystem highly modified since human colonization (see Given, 1995 and Maunder *et al.*, 1995 for discussions on conservation within degraded island ecosystems). We hypothesize that the original forest ecology of Hawaii was very different from today, with an absence of exotic earthworm and ant species, no terrestrial mammals and the presence of large, extinct, frugivorous birds, and huge colonies of nesting seabirds importing marine nutrients to the forest ecosystems. Today the ecology is different in terms of soil conditions and ecological relationships. The Pacific islands, including the Hawaiian archipelago, have been subject to profound human-induced environmental change leading to the catastrophic loss of endemic diversity, most notably the extinction of Pacific avifauna (Steadman, 1997) and endemic plant species, as characterized by Rapa Nui (Maunder *et al.*, 2000) where the endemic palm genus, *Paschalococcus*, was lost (Dransfield *et al.*, 1984).

The decline of *Pritchardia* is not unique. It is parallelled in other island endemic palms such as those found in the Mascarene Islands (Maunder *et al.*, 2002b), the Seychelles (Johnson, 1996), Madagascar (Dransfield & Beentje, 1995) and the Pacific (Given, 1995). However with appropriate management there is no need to dismiss *Pritchardia* as a doomed element from a lost ecology. With management it can and does regenerate within protected habitats.

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