# 5-YEAR REVIEW

Short Form Summary

**Species Reviewed**: *Pritchardia munroi* (lo‘ulu)

**Current Classification**: Endangered

**Federal Register Notice announcing initiation of this review**:

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

**Lead Region/Field Office**:

Region 1/Pacific Islands Fish and Wildlife Office (PIFWO), Honolulu, Hawaii

**Name of Reviewer(s)**:

Marie Bruegmann, Plant Recovery Coordinator, PIFWO
Jess Newton, Recovery Program Lead, PIFWO
Assistant Field Supervisor for Endangered Species, PIFWO

**Methodology used to complete this 5-year review**:

This review was conducted by staff of the Pacific Islands Fish and Wildlife Office of the U.S. Fish and Wildlife Service (USFWS), beginning on March 16, 2009. The review was based on final critical habitat designation for plant species from the island of Molokai (USFWS 2003), as well as a review of current, available information. The National Tropical Botanical Garden provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The evaluation of Tamara Sherrill, biological consultant, was reviewed by the Plant Recovery Coordinator. The document was then reviewed by the Recovery Program Lead and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**Background:**

For information regarding the species listing history and other facts, please refer to the Fish and Wildlife Service’s Environmental Conservation On-line System (ECOS) database for threatened and endangered species (http://ecos.fws.gov/tess_public).

**Application of the 1996 Distinct Population Segment (DPS) Policy**:

This Policy does not apply to plants.

**Review Analysis**:

Please refer to the final critical habitat designation for *Pritchardia munroi* published in the Federal Register on March 18, 2003 (USFWS 2003) for a complete review of the species’ status (including biology and habitat), threats, and management efforts. No new threats and no significant new information regarding the species biological status have come to light since listing to warrant a change in the Federal listing status of *P. munroi*.

*Pritchardia munroi* was originally listed as endangered in 1992 (USFWS 1992). It is also listed as critically endangered on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (Gemmill 1998).

A number of researchers have found fossil evidence, including pollen, seeds, fruits, and trunks indicating that *Pritchardia* palms represented a larger percentage of the flora in coastal to mid-elevation habitats in the Hawaiian Islands during pre-Polynesian times. Remaining populations of *Pritchardia* palms today are remnants of a once much more continuous and widespread distribution of the past (Burney *et al*. 2001; Athens *et al* 2002; Chapin *et al.* 2007).

At the time of listing in 1992, during the writing of the recovery plan in 1996, and when critical habitat was not designated in 2003, *Pritchardia munroi* was only known from a single individual on the leeward side of east Molokai (USFWS 1992, 1996, 2003). This single individual was the only known tree until 2007, however all other observations of this species stills need to be verified taxonomically. The species is currently known from two locations on the island of Molokai and three on West Maui. On Molokai, a single tree is located west of Kamalo at Ka Puaokoolau at 866 meters (2,840 feet) elevation and was visited in1991, and most recently visited in 2009 (Perlman 2010). At Wawaia Gulch on Molokai a single healthy immature individual, which appears to be *Pritchardia munroi*, has been observed at 777 to 823 meters (2,550 to 2,700 feet) elevation in the period of 2007 to 2009, (Perlman 2010; Wood 2010).

On West Maui, a species that may be *Pritchardia munroi* is known from three occurrences: Pohakea Gulch, Ukumehame, and south of Waikapu Gulch (Perlman 2010). A single tree was observed at Pohakea Gulch at 969 meters (3,180 feet) elevation in 1998, and again in 2007 (Perlman 2010). A few scattered trees were seen on the cliffs at Ukumehame Gulch in 1990 at 1,018 meters (3,340 feet) elevation, which was also visited by Oppenheimer in 1998. Perlman and Oppenheimer visited a single accessible tree in October 2007; two other trees, located on an inaccessible cliff, were observed in 2008, and a fourth tree was observed in the back of the valley in an inaccessible area in 2005 (Oppenheimer 2010; Perlman 2010). In 2000, 18 trees were spotted by helicopter on the cliffs above Kahili Golf Course, between Hanaula and Waikapu, and were seen again in 2007 (Oppenheimer 2010; Perlman 2010). Additional taxonomic research is needed to determine if these individuals are *Pritchardia munroi* or another species of *Pritchardia* (USFWS 2010).

The occurrences of *Pritchardia munroi* on Maui has not been verified or published, despite the collection of voucher specimens and material for genetic analysis. Therefore the recorded occurrences of *P. munroi* on Maui remain tentative. However, Hodel (2007) recognizes *P. munroi* as occurring on both Molokai and West Maui. A genetic study is in progress by Christine Bacon of Colorado State University (Oppenheimer 2010) which may resolve the identity of the West Maui individuals.

At Ka Puaokoolau, Molokai, the habitat is *Metrosideros polymorpha* (ohia) – *Leptecophylla tameiameiae* (pukiawe) shrubland with *Bidens menziesii* (kookoolau),

*Diospyros sandwicensis* (lama), *Dodonaea viscosa* (aalii), *Kadua affinis* (manono), *Melicope hawaiiensis* (mokihana), *Myoporum sandwicense* (naio), *Nestegis sandwicensis* (olopua), *Osteomeles anthyllidifolia* (ulei), *Pittosporum* sp. (hoawa), *Pleomele auwahiensis* (hala pepe), *Pseudognaphalium sandwicensium* (ena ena), *Scaevola chamissoniana* (naupaka kuahiwi), *Sida fallax* (ilima), and *Wikstroemia forbesii* (akia) (National Tropical Botanical Garden 2009; Perlman 2010). At Wawaia, the habitat is *Metrosideros waialealae* var. *fauriei – Diospyros sandwicensis – Dicranopteris linearis* (uluhe) lowland mesic to wet forest, characterized by steep drainage walls with associated native species such as *Artemisia* sp. (hinahina), *Diplopterygium pinnatum* (uluhe lau nui), *Dodonaea viscosa*, *Labordia triflora* (kamakahala), *L. waiolani* (kamakahala), *Leptecophylla tameiameiae*, *Myrsine lessertiana* (kolea lau nui), *Nephrolepis exaltata* (nianiau), *Nestegis sandwicensis*, *Osteomeles anthyllidifolia*, *Pipturus* sp. (mamake), *Pleomele auwahiensis*, *Psychotria mariniana* (kopiko), *Sadleria cyatheoides* (amau), *Sida fallax*, *Sophora chrysophylla* (mamane), *Streblus pendulinus* (aiai), and *Wikstroemia forbesii* (Perlman 2010; Wood 2010).

On West Maui, the habitat at Pohakea Gulch and Ukumehame Gulch is *Metrosideros polymorpha – Dicranopteris linearis* wet forest with *Alyxia stellata* (maile), *Antidesma* sp. (hame), *Carex* sp. (no common name [NCN]), *Claoxylon sandwicense* (poola), *Coprosma foliosa* (pilo), *C. ternata* (pilo), *Cyrtandra grayi* (keokeo haiwale), *Cyrtomium caryotideum* (ka ape ape), *Dodonaea viscosa, Doodia* sp. (okupukupu), *Freycinetia arborea* (ie ie), *Kadua* sp., *Melicope molokaiensis* (alani), *Microlepia strigosa* var. *mauiensis* (palapalai), *Myrsine lessertiana*, *Nesoluma polynesicum* (keahi), *Perrottetia sandwicensis* (olomea), *Pipturus* sp., *Pouteria sandwicensis* (alaa), *Psychotria mariniana* (kopiko), *Sadleria* sp. (amau or apuu), *Schiedea* sp., *Selaginella* sp. (lepelepe a moa), *Stenogyne calycosa* (NCN), *Tectaria gaudichaudii* (iwa iwa lau nui), *Urera glabra* (opuhe), and *Xylosma* sp. (Oppenheimer 2010; Perlman 2010).

Threats at Ka Puaokoolau include habitat degradation and competition with invasive introduced plant species such as *Lantana camara* (lantana), *Melinis minutiflora* (molasses grass), *Schinus terebinthifolius* (Christmas berry), *Pinus* sp. (pine), *Grevillea robusta* (silk oak), *Nephrolepis* sp., *Oplismenus* sp. (NCN) (Listing Factors A and E); habitat degradation by feral pigs (*Sus scrofa*) (Listing Factors A and D) and feral goats (*Capra hircus*) (Listing Factors A, C, D); and fire (Listing Factor E) (National Tropical Botanical Garden 2009; Perlman 2010). At Wawaia, the major threats are invasive introduced plants including *Ageratina adenophora* (sticky snakeroot), *Lantana camara*, *Melinis minutiflora* (molasses grass), *Rubus rosifolius* (thimble berry), and *Schinus terebinthifolius* (Christmas berry) (Listing Factors A and E); habitat degradation by feral goats and pigs (Listing Factors A, C, and D), landslides (Listing Factor E), and fires (Chapin *et al.* 2007; Perlman 2010; Wood 2010).

On Maui, the threats to *Pritchardia munroi* include habitat degradation and competition with invasive introduced plants including *Lantana camara*, *Rubus rosifolius*, *Erigeron karvinskianus*, *Adiantum hispidulum*, *Macaranga tanarius*, and *Tibouchina herbacea* (glorybush) (Listing Factors A and E). Feral pigs disturb the soil and uproot seedlings (Listing Factors A, C, and D) (Oppenheimer 2010; Perlman 2010).

Unauthorized collection of seeds is a threat (Listing Factor B) (Oppenheimer 2010). Rats (*Rattus* spp.) eat the seeds of *Pritchardia* species and are a threat on both islands where *P. munroi* occurs (Listing Factor C) (Chapin *et al.* 2007; Perlman 2010).

Climate change may also pose a threat to *Pritchardia munroi* (Listing Factors A and E). However, current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

In addition to all of the other threats, species like *Pritchardia munroi* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations and localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks (Listing Factor E). The extent of these natural processes on this single island endemic are exacerbated by anthropogenic threats, such as habitat loss for human development or predation by introduced species (Listing Factor E) (USFWS 1996).

The single *Pritchardia munroi* individual located above Kamalo is fenced and protected against the negative impacts of feral ungulates. In 2009, one million dollars in funds from the federal Department of Interior's Cooperative Endangered Species Conservation Fund was designated for use on Molokai, to help acquire a perpetual conservation easement over 248 hectares (614 acres) of strategic watershed on the eastern end of the island. The property has several federally listed threatened or endangered species as well as critical habitat in and around the proposed easement area. Among federally listed species that will benefit from this protection are *Bidens wiebkei* (kookoolau), *Canavalia molokaiensis* (awikiwiki), *Hibiscus arnottianus* subsp. *immaculatus* (kokio keokeo), *Brighamia rockii* (puaala), *Cyanea dunbariae* (haha), *Gardenia brighamii* (nanu), *Pritchardia munroi* (lo'ulu), and *Phyllostegia hispida* (NCN) (USFWS 2009; C. Rowland, USFWS, pers. comm. 2010).

*Pritchardia munroi* has been reintroduced on private lands at Kainalu Ranch, Molokai. It is also represented in various botanical gardens (Oppenheimer 2010). This includes 12 trees on Oahu at the Waimea Valley Arboretum and a single tree on Maui at the Maui Nui Botanical Gardens (Maui Nui Botanical Gardens 2009; Waimea Valley Arboretum 2009). However, there is some concern that cultivated plants may not be suitable sources for restoration material. Hawaiian *Pritchardia* species are long-lived often living for more than 100 years (Gemmill 1996) and for many years seeds have been collected from wild plants and used in landscapes and in botanical gardens across Hawaii.

*Pritchardia* species have been observed to be pollinated by introduced bees and wasps (Gemmill 1996), and the common honeybee can forage as far away as 6.1 kilometers (3.8 miles) (Beekman and Ratnieks 2000). *Pritchardia* are primarily outcrossers in nature,

but at least in the case of an isolated *Pritchardia munroi* individual it has been observed to self-pollinate and was able to produce viable seeds. The remaining individuals of this genus are mostly found in isolated, small single-island endemic groups that are probably only mating among themselves. In addition, cultivated plants of the more common *Pritchardia* species were shown to have less genetic variability than wild plants (Gemmil 1996). This suggests that in cultivation, unless only one species of *Pritchardia* is intensively collected and the planting is isolated enough to prevent bee pollination with another species (such as one growing in a nearby landscape planting), the seeds that result may be hybrids of two species. Further research is needed to confirm or disprove the idea that different *Pritchardia* species in close proximity may be able to form hybrid seedlings.

On Oahu, Lyon Arboretum has 15 seeds in long-term storage (Center for Conservation Research and Training Seed Storage Facility 2009).

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for the Molokai plant cluster (USFWS 1996), based on whether the species is an annual, a short-lived perennial (fewer than 10 years), or a long-lived perennial. *Pritchardia munroi* is a long-lived perennial, and to be considered stable, the taxon must be managed to control threats (*e.g*., fenced) and be represented in an *ex situ* (at other than the plant's natural location, such as a nursery or arboretum) collection. In addition, a minimum of three populations should be documented on the island of Molokai. Each of these populations must be naturally reproducing and increasing in number, with a minimum of 25 mature individuals per population.

The interim stabilization goals for this species have not been met, as there is still only a single individual and four additional populations require genetic analysis to confirm the identity of the species (Table 1). In addition, all threats are not being managed (Table 2). Therefore, *Pritchardia munroi* meets the definition of endangered as it remains in danger of extinction throughout its range.

**Recommendations for Future Actions:**

- Determine taxonomy of West Maui populations through genetic analysis.
- Continue to monitor the immature individual in Wawaia Gulch, Molokai, for seeds as it matures.
- Collect a voucher of the individual in Wawaia Gulch for taxonomic verification when it is in flower and/or fruiting.
- Determine whether cultivated plants form hybrid seed when they are near other *Pritchardia* species.
- Collect material for genetic storage and propagation for reintroduction.

- Collect fruit from any reintroduced individuals that set seed to add to the genetic diversity of *ex situ* material.

- Continue reintroducing individuals into protected suitable habitat within historical range.

- Control rats in the vicinity of all plants.

- Control introduced invasive plant species around all populations.

- Construct large-scale fences around all naturally occurring and reintroduced individuals to control feral ungulates.

- Investigate techniques to improve natural recruitment.

- Develop and implement a wildfire management plan.

- Assess the modeled effects of climate change on this species, and use to determine future landscape needed for the recovery of the species.

- Work with Hawaii Division of Forestry and Wildlife and other land managers to initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this species.

**References:**

Athens, J.S., H.D. Tuggle, J.V. Ward, and D.J. Welch. 2002. Avifaunal extinctions, vegetation change, and Polynesian impacts in prehistoric Hawaii. Archaeology Oceania 37:57-78.

Beekman, M. and F.L.W. Ratnieks. 2000. Long-range foraging by the honey-bee, *Apis mellifera* L. Functional Ecology 14:490-496.

Burney, D.A., H.F. James, L.P. Burney, S.L. Olson, W. Kikuchi, W.L. Wagner, M. Burney, D. McCloskey, D. Kikuchi, F.V. Grady, R. Gage, and R. Nishek. 2001. Fossil evidence for a diverse biota from Kauai and its transformation since human arrival. Ecological Monographs 71(4):615-641.

Center for Conservation Research and Training Seed Storage Facility. 2009. Seed storage lab database report. University of Hawaii at Manoa, Honolulu, Hawaii. Unpublished.

Chapin, M., N. Maunder, and K.E. Horak. 2007. A preliminary study of regeneration in wild populations of threatened endemic Hawaiian palms (*Pritchardia*, Arecaceae). Pacific Conservation Biology 13(1):20-28.

Gemmill, C.E.C. 1996. Population genetics and systematics of the Hawaiian taxa *Pritchardia* (Arecaceae) and *Brighamia* (Campanulaceae). Doctorate thesis submitted to the Department of Environmental, Population, and Organismic Biology, University of Colorado, Boulder, Colorado. 271 pages.

Gemmill, C. 1998. *Pritchardia munroi*. In: IUCN red list of threatened species. Version 2009.2. Available online at <http://www.iucnredlist.org/apps/redlist/details/38650/0>. Accessed 9 February 2010.

Hodel, D.R. 2007. A review of the genus *Pritchardia*, Special Supplement S-1-53. Palms 51(4):S1-S52.

Maui Nui Botanical Gardens. 2009. Controlled propagation report to U.S. Fish and Wildlife Service. Maui Nui Botanical Gardens, Kahului, Hawaii. 15 pages. Unpublished.

National Tropical Botanical Garden. 2009. Records from living collections database for *Pritchardia munroi*. National Tropical Botanical Garden, Kalaheo, Hawaii. Unpublished.

Oppenheimer, H.L. 2010. *Pritchardia munroi* 5 year review edits and comments. Plant Extinction Prevention Program, Lahaina, Hawaii. 6 pages. Unpublished.

Perlman, S. 2010. *Pritchardia munroi*. National Tropical Botanical Garden, Kalaheo, Hawaii. 4 pages. Unpublished.

[USFWS] U.S. Fish and Wildlife Service. 1992. Endangered and threatened wildlife and plants; determination of endangered or threatened status for 16 plants from the island of Molokai, Hawaii. Federal Register 57(196):46325-46340.

[USFWS] U.S. Fish and Wildlife Service. 1996. Recovery plan for the Molokai plant cluster. U.S. Fish and Wildlife Service, Portland, Oregon. 153 pages. Available online at <http://www.fws.gov/pacificislands/recoveryplans.html>.

[USFWS] U.S. Fish and Wildlife Service. 2003. Endangered and threatened wildlife and plants; final designations and nondesignations of critical habitat for 42 plant species from the island of Molokai, Hawaii; final rule. Federal Register 68(52):12982-13141.

[USFWS] U.S. Fish and Wildlife Service. 2009. Press release: Fish and Wildlife Service provides $1 million in land acquisition funds to Hawaii. April 17, 2009. Honolulu, Hawaii. 1 page.

[USFWS] U.S. Fish and Wildlife Service. 2010. Notes from the February 4, 2010, Maui Nui Task Force Meeting. Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii. 15 pages. Unpublished.

Waimea Valley Arboretum. 2009. Controlled propagation report to U.S. Fish and Wildlife Service. Waimea Valley Arboretum, Waimea, Hawaii. 16 pages. Unpublished.

Wood, K.R. 2010. Notes on *Pritchardia munroi*. National Tropical Botanical Garden, Kalaheo, Hawaii. 1 page. Unpublished.

**Personal Communications**

Rowland, Craig. 2010. Conservation Partnerships Program Coordinator, USFWS, Honolulu, Hawaii. E-mail to Marie Bruegmann, USFWS, dated April 16, 2010. Subject: Additional information on status of Molokai easement.

**Table 1. Status of *Pritchardia munroi* from listing through 5-year review**.

| Date | No. wild indivs | No. outplanted | Stability Criteria identified in Recovery Plan | Stability Criteria Completed? |
|---|---|---|---|---|
| 1992 (listing) | 1 | | All threats managed in all 3 populations | No |
| | | | Complete genetic storage | Unknown |
| | | | 3 populations with 25 mature individuals each | No |
| 1996 (recovery plan) | 1 | | All threats managed in all 3 populations | No |
| | | | Complete genetic storage | Unknown |
| | | | 3 populations with 25 mature individuals each | No |
| 2003 (critical habitat) | 1 | | All threats managed in all 3 populations | No |
| | | | Complete genetic storage | Unknown |
| | | | 3 populations with 25 mature individuals each | No |
| 2010 (5-year review) | 1 | Unknown | All threats managed in all 3 populations | No (Table 2) |
| | | | Complete genetic storage | Yes |
| | | | 3 populations with 25 mature individuals each | No: 1 individual, four other populations still need to be confirmed genetically |

**Table 2. Threats to *Pritchardia munroi*.**

| Threat | Listing factor | Current Status | Conservation/ Management Efforts |
|---|---|---|---|
| Ungulates – habitat modification and herbivory | A, C, D | Ongoing | Partially: single individual fenced at Kamalo |
| Rats – predation | C | Ongoing | No |
| Fire | E | Ongoing | No |
| Unauthorized collection and vandalism | B | Ongoing | No |
| Small population size | E | Ongoing | Yes: seeds collected and propagules growing in nurseries |
| Landslides | A, E | Ongoing | No |
| Invasive introduced plants | A, E | Ongoing | No |
| Climate change | A, E | Increasing | No |

**U.S. FISH AND WILDLIFE SERVICE**
SIGNATURE PAGE for 5-YEAR REVIEW of *Pritchardia munroi* (lo'ulu)

**Pre-1996 DPS listing still considered a listable entity?** N/A

**Recommendation resulting from the 5-year review**:

_____ Delisting
_____ Reclassify from Endangered to Threatened status
_____ Reclassify from Threatened to Endangered status
__X__ No Change in listing status

**Field Supervisor, Pacific Islands Fish and Wildlife Office**

Acting

Date 8/29/11