5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Pritchardia affinis* (loulu)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2018. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 156 species in Oregon, Washington, Hawaii, Palau, Guam, and the Northern Mariana Islands. Federal Register 88(83): 20088–20092, May 7, 2018.

Lead Region/Field Office:

Interior Region 12/Pacific Islands Fish and Wildlife Office (PIFWO), Honolulu, Hawai‘i

Name of Reviewer:

Cheryl Phillipson, Biologist, PIFWO
Lauren Weisenberger, Plant Recovery Coordinator, PIFWO
Megan Laut, Conservation & Restoration Team Manager, PIFWO

Methodology used to complete this 5-year review:

This review was conducted by staff of the Pacific Islands Fish and Wildlife Office (PIFWO) of the U.S. Fish and Wildlife Service (Service) beginning in October 2019. The review was based on a review of current, available information since the last 5-year review for *Pritchardia affinis* (USFWS 2012). The evaluation by Cheryl Phillipson, Biologist, was reviewed by Lauren Weisenberger, Plant Recovery Coordinator, and Megan Laut, Conservation and Restoration Team Manager.

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*).

Review Analysis:

Please refer to the previous 5-year review for *Pritchardia affinis* published in the Federal Register on August 28, 2012 (available at *https://ecos.fws.gov/docs/five_year_review/doc4061.pdf*) for a complete review of the species' status, threats, management efforts, and references cited. We are not aware of any significant new information regarding the species' biological status since listing to warrant a change in the Federal listing status of *P. affinis*.

This long-lived perennial tree in the Arecaceae (palm) family is endangered and found on the island of Hawai‘i. The current status and trends for *Pritchardia affinis* are provided in the tables below.

New Status Information:

- At the time of the 5-year review in 2012 there were an estimated 50 individuals in four populations of *Pritchardia affinis* on the island of Hawai‘i. Hodel (2012, p. 116) also published that there were approximately 50 wild plants in seven populations. In 2014, the Plant Extinction Prevention Program (PEPP) upgraded the status of the species from “POP” (more than 50 wild plants) to “PEP” (fewer than 50 wild plants) as there were only 30 wild plants known (PEPP 2014). Populations at Miloli‘i and Punalu‘u were observed to have some recruitment (Hodel 2012, p. 116). Currently, a summary of survey data indicates approximately nine mature wild plants known in seven locations, with almost 80 immature plants counted (PEPP 2019).
- The Smithsonian Institution adopted the name *P. maideniana* after Hodel (2012) (Smithsonian 2020). Molecular analysis confirms that *P. affinis* and *P. maideniana* are well supported as sister taxa, consistent with the recent nomenclatural change (Bacon *et al.* 2012, p. 5). This taxonomic change does not affect the range or endangered status of this species. Therefore, we will refer to this species as *Pritchardia maideniana* throughout the following sections of this document and make the taxonomic change in the *Federal Register* in a future technical correction.

New Threats:

- Climate change loss or degradation of habitat—Climate change may pose a threat to this species. Fortini *et al.* (2013) conducted a landscape-based assessment of climate change vulnerability for native plants of Hawai‘i using high resolution climate change projections. Climate change vulnerability is defined as the relative inability of a species to display the possible responses necessary for persistence under climate change. The assessment by Fortini *et al.* (2013) concluded that *Pritchardia maideniana* is vulnerable to the impacts of climate change, with a vulnerability score of 0.437 (on a scale of 0 being not vulnerable to 1 being extremely vulnerable to climate change). Therefore, additional management actions may be needed to conserve this taxon into the future, such as locating key microsites that overlap with current and future climate envelopes for outplanting efforts.
- Invertebrate predation—In 2013, the nonnative coconut rhinoceros beetle (CRB, *Oryctes rhinoceros*) was discovered on O‘ahu and spread across the island within a few months (OISC 2018 in litt.). The CRB, a large scarab beetle about two inches long, is considered one of the most damaging insects to coconut and African oil palm trees in southern and southeast Asia, as well as to the western Pacific Islands, and could devastate populations of native and nonnative palm trees in Hawai‘i (OISC 2018, in litt.). The CRB bore into the crowns of palms where they feed on sap. When a beetle bores through developing leaves, those leaves grow out with distinctive V-shaped cuts. Adult beetles are active at night and can fly. Eggs are laid inside rotting coconut logs, mulch, or compost, and larvae develop to adults within four months, continuing the cycle. A rapid response team headed by Hawai‘i Department of Agriculture (with the USDA, University of Hawai‘i, U.S. Navy, and other partners) has set up pheromone traps

island-wide, and capture and range delineation efforts are ongoing, along with funding for support services to control the CRB. If the CRB should be transported to the island of Hawai‘i, effects on the remaining endangered palms could be devastating.

New Management Actions:

- Surveys and inventories—PEPP continues to survey and monitor populations of *Pritchardia maideniana* (PEPP 2017, 2018).
- Ecosystem-altering nonnative plant control—PEPP placed weed control mat at one location (PEPP 2018).
- Captive propagation for genetic storage and reintroduction—
    - Between 2013 and 2019, the Volcano Rare Plant Facility (VRPF) reported propagation of 560 plants representing nine founders from five locations. Currently, there is only one plant in refugia (VRPF 2013-2019).
    - In 2019, Lyon Arboretum reported storage of 3 explants representing one wild individual at Keālia (South Kona) (Lyon Arboretum 2019).
    - In 2019, the National Tropical Botanical Garden (NTBG) reported 55 plants (representing at least seven individuals at seven locations) in a living collection at the Southshore Garden and three plants (representing an unknown number of individuals) in a living collection at Kahanu (NTBG 2019).
- Reintroduction and translocation—
    - In 2019, Hawai‘i Volcanoes National Park (HVNP) reported that seven years post-planting of 59 plants at Keauhou Landing in 2008, two individuals survive (HVNP 2019a, p. 20; HVNP 2019b; HVNP 2020). No activity was conducted between 2016 and 2019.
    - PEPP provided a summary of current reintroductions of *P. maideniana* totaling 87 individuals at five locations (PEPP 2019).
    - From 2013 to 2019, the VRPF reintroduced 120 plants to Manukā and Kiolaka‘a representing five founders from two locations, 78 plants representing five founders from two locations were sent to Future Forests Nursery (VRPF 2013-2019). Survival is unknown.
- Seed storage research—A study by Walters (2015, in litt.) was conducted to determine optimal seed bank storage methods for Hawaiian plants including the palm species *Pritchardia remota* and *P. aylmer-robinsonii*. The results of this study may also apply to *Pritchardia maideniana.* The highest viability after stress challenges were achieved from embryos excised from fruits that are dark brown (older and drier) rather than green. Coloration of maturing fruits appears to be linked to the water content of the embryo, a measure of maturity in freshly harvested fruits. Embryos with more water are less likely to survive freezing temperatures associated with preparation for storage. Embryos kept within whole fruits can survive the initial stress of freezing if methods used for drying and use of liquid nitrogen are optimal, with 80 to 100 percent viability. Embryos are excised from larger fruits for better temperature control. In addition, removal of embryos saves on the storage space required and maintenance costs. Studies using fruit from *P. hillebrandia* are ongoing.

Table 1. Status and trends of *Pritchardia maideniana* from listing through current 5-year review.

Date	No. wild individuals	No. outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization Criteria Completed?
1994 (listing)	50–65	Unknown	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 25 mature individuals each	No
1996 (recovery plan)	50–65	Unknown	All threats managed in all 3 populations	No
			Complete genetic storage	Partially
			3 populations with 25 mature individuals each	No
2003 (critical habitat, not designated, not prudent)	Unknown	0	All threats managed in all 3 populations	No
			Complete genetic storage	Partially
			3 populations with 25 mature individuals each	No
2012 (5-year review)	>50	ca 76	All threats managed in all 3 populations	No
			Complete genetic storage	Partially
			3 populations with 25 mature individuals each	No

Date	No. wild individuals	No. outplanted	*Preventing Extinction Criteria identified by HPPRCC	*Preventing Extinction Criteria Completed?
2020 (5-year review)	9 mature ca 80 immature	Unknown (<120 survive; ca 180 outplanted)	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			Reproduction (i.e. viable seeds, seedlings) at all 3 populations	Partially
			3 populations with 25 mature individuals each	No

* The Preventing Extinction Stage was established in 2011. Prior to 2011, the Interim Stabilization Stage was the first stage towards recovery (now it is the second stage after Preventing Extinction).

Table 2. Threats to *Pritchardia maideniana* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Established ecosystem altering invasive plant species degradation of habitat and competition	A, E	Ongoing	Partial, nonnative plant control 1 reintroduction site
Agriculture and urban development	A	Ongoing	None
Lava flows destruction and degradation of habitat	A	Ongoing	None
Fire destruction and degradation of habitat	A	Ongoing	Partial, fire management plans for HVNP
Climate change degradation and loss of habitat	A	Ongoing	None
Vandalism and collection	B	Ongoing	None

Ungulate predation and herbivory	C	Ongoing	None
Rodent predation and herbivory	C	Ongoing	None
Invertebrate predation and herbivory	C	Potential	None
Lack of adequate hunting regulations	D	Ongoing	None
Wind damage	E	Ongoing	None
Low numbers and small, fragmented populations	E	Ongoing	Partial, collection, propagation and reintroduction

Synthesis:
Currently, nine mature and approximately 80 immature wild individuals of *Pritchardia maideniana* occur at seven locations on the island of Hawai‘i. A landscape-based assessment of climate change vulnerability for native plants of Hawai‘i using high resolution climate change projections was made by Fortini *et al.* (2013) and their analysis showed that *P. maideniana* is vulnerable to the effects of climate change. Seed and cuttings collections from wild and reintroduced individuals, propagation, and reintroduction are ongoing. Research on optimal seed storage techniques is ongoing. Approximately 180 individuals have been reintroduced since the last 5-year review with variable or unknown success. Recruitment of seedlings has been reported at one location. The introduction of the nonnative coconut rhinoceros beetle to O‘ahu poses a threat to this species if the beetle is transported to the island of Hawai‘i.

Stabilizing (interim), downlisting, and delisting objectives were provided in the Recovery Plan for the Big Island Plant Cluster (USFWS 1996), and have been updated according to the draft revised recovery objective guidelines developed by the Hawai‘i and Pacific Plants Recovery Coordinating Committee (HPPRCC 2011). The HPPRCC identifies an additional initial objective, the Preventing Extinction Stage, in addition to the Interim Stabilization, Delisting, and Downlisting objectives. Furthermore, life history traits such as breeding system, population size fluctuation or decline, and reproduction type (sexual or vegetative), have been included in the calculation of goals for the number of populations and reproducing individuals for each stage. The goals for each stage remain grouped by life span defined as annual, short-lived perennial (fewer than 10 years), or long-lived perennial.

Pritchardia maideniana is a long-lived perennial tree. To prevent extinction, which is the first milestone in recovering the species, the taxon must be managed to control threats (e.g., fenced) and have 50 individuals (or the total number of individuals if fewer than 50 exist) from each of three populations represented in *ex situ* (secured off-site, such as a

nursery or seed bank) collections. In addition, a minimum of three populations should be documented on the island of Hawai‘i where they now occur or occurred historically and each of these populations must be naturally reproducing (i.e., viable seeds, seedlings, saplings), with a minimum of 25 mature, reproducing individuals per population.

The preventing extinction goals for this species have not been met. Numbers of known wild individuals continues to decline. Currently, there are nine mature wild individuals in seven different locations, with approximately 80 immature plants at one location. Genetic storage goals are almost complete for the nine founders (Table 1). However, all threats are not being managed with the addition of the potential threat of predation by a nonnative invertebrate (Table 1, Table 2). Therefore, *Pritchardia maideniana* meets the definition of Endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:
The introduction of the coconut rhinoceros beetle to O‘ahu is a potential threat should it be transported to the island of Hawai‘i; however, we are not aware of any significant new information regarding the species’ biological status since the last 5-year review in 2012. Thus, the following recommendations for future actions are reiterated for the 5-year review for 2020.

- Surveys and inventories—Continue to conduct thorough surveys of all historical and suitable habitat for new occurrences.
- Established ecosystem-altering invasive plant monitoring and control—Control established ecosystem-altering nonnative invasive plant species, and those that compete with *P. maideniana* at all populations.
- Drought protection—Determine best reintroduction sites to reduce the impacts of drought.
- Fire protection—
    - Implement fire management plans for HVNP.
    - Develop fire management plans for other wild and reintroduced populations of *P. maideniana*.
- Climate change adaptation strategy—Assess the modeled effects of climate change on this species and use to determine future landscape needed for the recovery of the species.
- Predation and herbivore control—
    - Implement effective control methods for rodents at all wild and reintroduced populations.
    - Implement effective control methods for the coconut rhinoceros beetle if this invertebrate is transported to the island of Hawai‘i.
    - Construct exclosures at wild and reintroduced populations to prevent seedling predation by feral pigs and other ungulates.
- Captive propagation for genetic storage and reintroduction—
    - Continue collection and propagation efforts for maintenance of genetic stock and for reintroduction.
    - Increase the number of propagules for reintroductions.

    - Continue to utilize at least three different facilities for seed storage and propagation.
- Reintroduction and translocation—
    - Determine optimal sites reintroduction and recruitment success and continue to reintroduce individuals into these areas that are managed for known threats, including urban and agricultural development.
    - Select reintroduction areas with least exposure to strong winds and lava flows.
- Biosecurity legislation—
    - Develop and enforce effective regulations to prevent vandalism and collection.
    - Develop and enforce effective regulations to prevent deleterious effects of yellow lethal disease facilitated by the banana moth.
    - Develop and enforce effective regulations to prevent predation and habitat destruction by feral ungulates.
    - Develop and enforce effective regulations to prevent transport of the coconut rhinoceros beetle to the island of Hawai‘i.
- Population biology research—Continue seed storage techniques investigations.
- Climate change adaptation strategy—Assess the modeled effects of climate change on this species and use to determine future landscape needed for its recovery.
- Federal Register updates—Update 50 CFR 17 to reflect the revised taxonomy.
- Alliance and partnership development—Continue to work with the Hawai‘i Division of Forestry and Wildlife, Hawai‘i Volcanoes National Park, and other partners and land managers in planning and implementation of ecosystem-level restoration and management to benefit this species.

References:

Bacon, C.D., M.J. McKenna, M.P. Simmons, and W.L. Wagner. 2012. Evaluating multiple criteria for species delimitation: an empirical example using Hawaiian palms (Arecaceae: *Pritchardia*). BMC Evolutionary Biology 12: 23, *http://www.biomedcentral.com/1471-2148/12/23*.

Fortini, L., J. Price, J. Jacobi, A. Vorsino, J. Burgett, K. Brinck, F. Amidon, S. Miller, S. Gon II, G. Koob, and E. Paxton. 2013. A landscape-based assessment of climate change vulnerability for all native Hawaiian plants. Technical report HCSU-044. Hawaii Cooperative Studies Unit, University of Hawaii at Hilo, Hawaii. 134 pp.

[HPPRCC] Hawai‘i and Pacific Plants Recovery Coordinating Committee. 2011. Revised recovery objective guidelines. 8 pp.

[HVNP] Hawai‘i Volcanoes National Park. 2019a. Annual report to the U.S. Fish and Wildlife Service threatened and endangered plants, Hawaii Volcanoes National Park TE-018078-21, 2019, 26 pp.

[HVNP] 2019b. Report on controlled propagation of listed species, as designated under the U.S. Endangered Species Act. Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawai‘i.

[HVNP] 2020. Report on controlled propagation of listed species, as designated under the U.S. Endangered Species Act. Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawai‘i.

Hodel, D.R. 2012. Loulu, the Hawaiian Palm. University of Hawai‘i Press, Honolulu. 190 pp.

Lyon Arboretum. 2019. Report on controlled propagation of listed species, as designated under the U.S. Endangered Species Act. Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawai‘i.

[NTBG] National Tropical Botanical Garden. 2019. Report on controlled propagation of listed species, as designated under the U.S. Endangered Species Act. Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawai‘i.

[OISC] Oahu Invasive Species Committee. 2018, in litt. Coconut rhinoceros beetle fact sheet, *https://www.oahuisc.org/coconut-rhinoceros-beetle/*.

[PEPP] Plant Extinction Prevention Program. 2014. PEPP annual report fiscal year 2014 (July 1, 2013-June 30, 2014). 185 pp.

[PEPP] 2017. Plant Extinction Prevention Program FY 2017 annual report (Oct 1, 2016-Sep 30, 2017), US FWS CFDA program #15.657; Endangered species conservation-recovery implementation funds, Cooperative Agreement F14AC00174, December 12, 2017, UH Manoa, PCSU, PEPP. 235 pp.

[PEPP] 2018. Plant Extinction Prevention Program, annual recovery subpermit FWSPIFWO-26 report (January 1st, 2018–December 31st 2018), as designated under the U.S. Endangered Species Act. Unpublished report submitted to U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii. 192 pp.

[PEPP] 2019. Plant Extinction Prevention Program, annual recovery subpermit FWSPIFWO-26 report (January 1st, 2018–December 31st 2018), as designated under the U.S. Endangered Species Act. Unpublished report submitted to U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii. 569 pp.

Smithsonian Institution. 2020. Flora of the Hawaiian Islands Checklist. *https://naturalhistory2.si.edu/botany/hawaiianflora/.*

[USFWS] U.S. Fish and Wildlife Service. 1996. Recovery plan for the Big Island plant cluster, 1998. Portland. 201 pp. + appendices.

[USFWS] 2012. *Pritchardia affinis* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. *https://ecos.fws.gov/docs/five_year_review/doc4061.pdf.*

[USFWS] 2018. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 156 species in Oregon, Washington, Hawaii, Palau, Guam, and the Northern Mariana Islands. 88 FR 20088, May 7, 2018.

[VRPF] Volcano Rare Plant Facility. 2013-2019. Summary of reports on controlled propagation of listed species, as designated under the U.S. Endangered Species Act. Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawai‘i.

Walters, C. 2015, in litt. Optimizing seed bank methods for Hawaiian plants—summary of results as of 9/15/2015. Interagency agreement with US Fish & Wildlife Service, Pacific Islands, #60-5402-3-009. 8 pp.

U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of *Pritchardia maideniana* (loulu)

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

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

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