5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Charpentiera densiflora* (pāpala)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2020. Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status reviews for 129 Species in Oregon, Washington, Idaho, Hawaii, Montana, California, and Nevada. Federal Register 85(48): 14240–14243, March 11, 2020.

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 2021. The review was based on a review of current, available information since the last 5-year review for *Charpentiera densiflora* (USFWS 2017). 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 (*https://ecos.fws.gov/ecp/species/1296*).

Review Analysis:

Please refer to the previous 5-year review for *Charpentiera densiflora* published in the Federal Register on September 13, 2017 (available at *https://ecos.fws.gov/docs/tess/species_nonpublish/2415.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 *C. densiflora*.

This long-lived perennial tree in the Amaranthaceae (amaranth) family is endangered and is known from the island of Kaua‘i. The status and trends for *Charpentiera densiflora* are provided in the tables below.

New Status Information:

- In 2017, there were six populations totaling 135 individuals on Kauaʻi (Bruegmann et al. 2016). In 2021, a tree was observed in Hanakāpiʻai Valley (NTBG 2022). Currently, it is estimated that approximately 135 individuals remain, however there have been no population estimates since 2017 (Wood 2022, in litt.).

New Threats:

- None reported.

New Management Actions:

- Monitoring and surveys—The National Tropical Botanical Garden (NTBG) continues to monitor living collections of *Charpentiera densiflora* on Kauaʻi (Nagendra et al. 2020, 18 pp).
- Feral ungulate control and management—NTBG received funding for ungulate exclosure maintenance and repairs at the Limahuli Preserve (Nagendra 2020, 18 pp.; Nagendra 2021a, p. 21). Hunts are conducted outside of the exclosure to reduce ungulate pressure on the fencing (Nagendra et al. 2020, 18 pp.).
- Invasive nonnative plant management—NTBG received funding for nonnative plant management and control at Limahuli Preserve (Nagendra et al. 2020, 18 pp.; Nagendra 2021a, pp. 3–5).
- Control of predation and herbivory by rats—NTBG was awarded funding for control of rats at Limahuli Preserve and between 2020 and 2021, more than 100 rats were controlled (Nagendra et al. 2020, 18 pp.; Nagendra 2021a, p. 19).
- Captive propagation for genetic storage and reintroduction—
    - In 2017, NTBG reported collection of 1,500 seeds from Kalalau with one plant propagated in the nursery and 280 seeds collected from Waiahuakua. From 2018 to 2019, NTBG reported collection of 40,500 seeds from Kalalau; 18,114 seeds from Hoʻolulu; 9,550 seeds from Nāpali; and an uncounted number of seeds (likely more than 2,000) from plants in Limahuli. In 2020, NTBG reported collection of 136 seeds from plants in Lower Limahuli Preserve and 12,817 seeds from one plant at Limahuli (Nagendra et al. 2020, pp. 6–8; NTBG 2020). In 2021, NTBG reported collection and storage of 841 seeds from one individual in a living collection and propagation of 11 plants in the nursery from the same plant (NTBG 2021).
    - In 2019, 9 plants representing founders from Nāpali, Lower Limahuli, and Hoʻolulu were added to a living collection at the Southshore Garden (NTBG 2020).
    - In 2020, the Kōkeʻe Mid-Elevation Nursery (KMEN) reported propagation of two individuals representing one founder from Waiahuakua for use in the propagation trials at Lyon Arboretum (KMEN 2020).
    - In 2022, the Lyon Arboretum Seed Laboratory reported storage of 822 seeds representing one founder from Kalalau (collected in 2006), and 15,311 seeds representing two founders from Waiahuakua (collected in 2016) (Lyon Arboretum 2022).
- Reintroduction and augmentation—

- In 2018, NTBG reintroduced 177 plants representing wild founders from Hoʻolulu to Limahuli. From 2018 to 2019, NTBG reported reintroduction of 1,825 plants to Limahuli representing founders from Limahuli, Nāpali, Kalalau, and Hoʻolulu. Also, from 2018 to 2019, 41 plants representing an older reintroduction (50 founders) were reintroduced to Limahuli (NTBG 2020). In 2020, NTBG reported reintroduction of 52 individuals to Lower Limahuli Preserve (Nagendra 2020, pp. 13–15). Also, in 2020, NTBG reintroduced 7 individuals as part of the Lower Limahuli Spring-Fed Stream Project (Nagendra 2020, p. 6). In 2021, NTBG reintroduced 59 individuals as a continuation of the Limahuli Preserve rare plant conservation project (Nagendra 2021a, p. 15; Nagendra 2021b, pp. 6, 8).
- In 2019, the KMEN propagated plants representing two founders and outplanted 40 individuals into the Waiahuakua exclosure; two individuals into the Olokele Robinson Reserve; and 25 individuals into the Hoʻolulu exclosure (Department of Land and Natural Resources-Division of Forestry and Wildlife [DLNR-DOFAW] 2019).

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

Date	No. wild individuals	No. outplanted	*Preventing Extinction Criteria identified by HPPRCC	*Preventing Extinction Criteria Completed?
2010 (listing and critical habitat)	ca 400	160	All threats managed in all 3 populations	No
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Yes
2017 (5-year review)	135–150	458	All threats managed in all 3 populations	No
			Complete genetic storage	Partially
			Reproduction (i.e., viable seeds, seedlings) at all 3 populations	Unknown
			3 populations with 50 mature individuals each	Partially, 1 population of 50

2022 (5-year review)	135–150	1,970, survivorship unknown	All threats managed in all 3 populations	Partially, ungulate, nonnative plant, and rat control at 1 location
			Complete genetic storage	Partially, at least 5 founders from 4
			Natural reproduction at all 3 populations	Partially, 1 population recruiting
			3 populations with 50 mature individuals each	No, success of reintroductions unknown

* 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 *Charpentiera densiflora* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Degradation and destruction of habitat by feral ungulates	A	Ongoing	Partial, fencing at Limahuli
Established ecosystem altering invasive plant species degradation of habitat and competition	A	Ongoing	Partial, some nonnative plant control at Limahuli
Landslide destruction and degradation of habitat	A	Ongoing	None
Destruction and degradation by fire	A	Ongoing	None
Climate change degradation or loss of habitat, including hurricanes	A	Ongoing	None
Predation and herbivory by feral ungulates	C	Ongoing	Partial, some control at reintroduction site
Predation and herbivory by rats	C	Ongoing	Partial, control efforts at Limahuli
Predation and herbivory by invertebrates—black twig borer	C	Ongoing	None
Inadequacy of regulatory mechanisms—Hunting	D	Ongoing	Partial, fencing at Limahuli

Reduced viability due to low numbers	E	Ongoing	Partial, seed storage, propagation, and reintroduction

Synthesis:
Currently there are 135 wild individuals of *Charpentiera densiflora* on Kaua‘i. Seed collections from at least five founders representing four populations are in storage, with with reintroduction of nearly 2,000 plants to *in situ* sites or living collections at Limahuli. Some nonnative invasive plant control is ongoing at historical and reintroduction sites.

Stabilizing (interim), downlisting, and delisting objectives are provided in the Kaua‘i Islandwide Recovery Plan (USFWS 2021) 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.

Charpentiera densiflora is a long-lived perennial tree and an obligate outcrosser. 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 that are well managed. In addition, a minimum of a total of three populations should be documented on Kaua‘i where this species now occurs or occurred historically and each of these populations must be naturally reproducing (i.e., viable seeds, seedlings, saplings) with a minimum of 50 mature, reproducing individuals per population.

The preventing extinction goals for this species have not been met. There is partial genetic representation for the wild populations. Almost 2,000 individuals have been reintroduced; however, survivorship is unknown and there is only one population totaling more than 50 mature reproducing individuals (Table 1). In addition, not all threats are not being managed (Table 1, Table 2). Therefore, *Charpentiera densiflora* meets the definition of Endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:
No new threats and no significant new information regarding the species’ biological status have been reported since the last 5-year review in 2017. Thus, the following recommendations for future actions are reiterated or updated for the 5-year review for 2022.

- Surveys and inventories—Survey for populations of *Charpentiera densiflora* in areas of potentially suitable habitat.
- Ungulate monitoring and control—Continue to construct and maintain ungulate exclosures for all wild and reintroduced populations.
- Control of established ecosystem altering invasive plants and those that compete with *C. densiflora*—Continue to control nonnative invasive plants at all populations.
- Fire monitoring and control—Develop and implement a fire management plan for existing populations.
- Climate change adaptation strategy—Research suitability of habitat for reintroduction of this species in the future due to the impacts of climate change and hurricanes.
- Predator and herbivore monitoring and control—
    - Continue to implement effective control methods for rats at outplanted and wild populations.
    - Assess the level of threat from the black twig borer (*Xylosandrus compactus*) and the need for additional recovery actions.
- Captive propagation for genetic storage and reintroduction—Continue collection and propagation efforts for maintenance of genetic stock and for reintroduction.
- Reintroduction and augmentation—Continue to reintroduce individuals into suitable habitat within historic range that is being managed for known threats to this species to build resiliency and redundancy and to reduce impacts of reduced viability, hurricanes, and landslides.
- Alliance and partnership development—Continue to work with partners and other land managers in planning and implementation of ecosystem-level restoration and management to benefit this species.

References:

Bruegmann, M., V.L. Caraway, and M. Clark. 2016. *Charpentiera densiflora.* The IUCN Red List of Threatened Species 2016: e.T30772A83795719. *http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T30772A83795719.en*.

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[KMEN] Kōke‘e Mid-Elevation Nursery. 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.

[KRPF] Kōke‘e Rare Plant Facility. 2019. DLNR-DOFAW Kōke‘e Rare Plant Facility. 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.

Lyon Arboretum. 2022. 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.

Nagendra, U., A. Ramelb, and K. Jensen. 2020. Limahuli Preserve rare plant conservation collections and habitat restoration project, National Tropical Botanical Garden, FWS Agreement #F18AC00508, October 1, 2019-September 30, 2020. 18 pp.

Nagendra, U. 2020. Lower Limahuli PR spring-fed stream restoration project. National Tropical Botanical Garden, FWS Agreement #F18AC00509, October 1, 2019-September 30, 2020. 13 pp.

Nagendra, U. 2021a. Limahuli Preserve rare plant conservation collections and habitat restoration project. National Tropical Botanical Garden, December 21, 2021. 21 pp.

Nagendra, U. 2021b. Lower Limahuli PR spring-fed stream restoration project. National Tropical Botanical Garden, December 21, 2021. 12 pp.

[NTBG] National Tropical Botanical Garden. 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.

[NTBG] 2021. 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. 2022. NTBG database herbarium record detail for *Charpentiera densiflora*, PTBG 20210418, 9 AUG 2021.

[USFWS] U.S. Fish and Wildlife Service. 2017. *Charpentiera densiflora* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. *https://ecos.fws.gov/docs/five_year_review/doc2415.pdf.*

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[USFWS] 2021. Kaua‘i Islandwide Recovery Plan. U.S. Fish and Wildlife Service, Portland, OR. 65 pp. + appendices.

Wood, K. 2022, in litt., Email regarding estimates for listed species, non-PEPP, on Kaua‘i, 11 MAR 2022.

U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of *Charpentiera densiflora* (pāpala)

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

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

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