5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Delissea undulata* (no common name)

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 *Delissea undulata* (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 *Delissea undulata* published in the Federal Register on August 28, 2012 (available at *https://ecos.fws.gov/docs/five_year_review/doc4083.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 *D. undulata*.

This short-lived perennial shrub in the Campanulaceae (bellflower) family is endangered. The status and trends for *Delissea undulata* (described with the currently accepted taxonomy) are provided in the tables below.

New Status Information:

- There are no wild individuals of *Delissea argutidentata* (listed as *D. undulata*) known on the island of Hawai‘i. There are propagules and reintroduced individuals, as described below. On Kauai, there are currently one individual at Mākaha, six individuals at Mahanaloa (four mature, one immature, one seedling), one individual at Po‘opo‘oiki, and six individuals at the Pa‘aiki exclosure (4 mature, 2 immature) (PEPP 2020). In total, there are 14 wild individuals on Kauai at four locations. As discussed in the previous five-year review, individuals on west Maui (*D. undulata*) and Ni‘ihau (*D. niihauensis*) are extirpated.

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. This assessment concluded that *Delissea undulata* is highly vulnerable to the impacts of climate change, with a vulnerability score of 0.593 (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 *D. undulata* into the future, such as locating key microsites that overlap with current and future climate envelopes for outplanting efforts

New Management Actions:

- Ungulate control—The Department of Land and Natural Resources-Division of Forestry and Wildlife (DLNR-DOFAW) constructed a 0.3-hectare (0.75-ac) exclosure at Pu‘uwa‘awa‘a for *Delissea argutidentata* on the island of Hawai‘i at Pu‘uwa‘awa‘a (PEPP 2019).
- Captive propagation for genetic storage and reintroduction—
    - The Volcano Rare Plant Facility (VRPF) reported propagation of more than 400 plants between 2012 and 2019 for storage/inventory between 2012 and 2019. These plants represent at least one founder from Pu‘uwa‘awa‘a, but there are currently no plants in their inventory (VRPF 2019).
    - The plant nursery at Pu‘uwa‘awa‘a reports propagation and reintroduction of 22 plants in 2018 (Pu‘uwa‘awa‘a Plant Nursery 2018).
- Reintroduction—
    - VRPF reports reintroduction (between 2012 and 2019) of 489 plants at Pu‘uwa‘awa‘a and the Forest Bird Sanctuary cabin (VRPF 2019).
    - PEPP report reintroductions of *Delissea kauaiensis* at six sites on Kauai between 2009 and 2018. Of the approximately 804 reintroduced, 659 remain (PEPP 2020).

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

Date	No. wild individuals	No. outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization Criteria Completed?
1994 (listing)	1	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
1996 (recovery plan)	1	50	All threats managed in all 3 populations	No
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2003 (critical habitat)	8	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2012 (5-year review)	0	415	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
Date	**No. wild individuals**	**No. outplanted**	***Preventing Extinction Criteria identified by HPPRCC**	***Preventing Extinction Criteria Completed?**

2020 (5-year review)	16 (Kauaʻi)	511 (Hawaiʻi) 804, 659 remain (Kauaʻi)	All threats managed in all 3 populations	Partially, exclosures at Puʻuwaʻawaʻa (Hawaiʻi) and Mahanaloa, Paʻaiki, Nualolo, Kuia (Kauaʻi)
			Complete genetic storage	Partially
			Reproduction (i.e. viable seeds, seedlings) at all 3 populations	Partially (viable seeds)
			3 populations with 50 mature individuals each	Partially, 3 populations > 50, longevity and recruitment 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 *Delissea undulata* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulate degradation of habitat	A	Ongoing	Partial, exclosures at Puʻuwaʻawaʻa (Hawaiʻi) and Mahanaloa, Paʻaiki, Nualolo, Kuia (Kauaʻi)
Established ecosystem altering invasive plant species degradation of habitat and competition	A, E	Ongoing	None
Degradation and destruction by fire	A	Ongoing	None
Climate change degradation or loss of habitat	A	Ongoing	None
Predation and herbivory by rodents	C	Ongoing	None
Herbivory by slugs	C	Ongoing	None

Predation of seed by nonnative birds	C	Ongoing	None
Inadequacy of regulatory mechanisms–hunting	D	Ongoing	Partial, exclosures at Puʻuwaʻawaʻa (Hawaiʻi) and Mahanaloa, Paʻaiki, Nualolo, Kuia (Kauaʻi)
Loss of vigor due to low numbers	E	Ongoing	Partial, collection, propagation, and reintroduction

Synthesis:
Currently, there are four populations of *Delissea kauaiensis* on the island of Kauai totaling 16 wild individuals. At Mākaha there is one individual; at Mahanaloa there are four mature, one immature, and one seedling; at Poʻopoʻoiki there is one individual; and at Paʻaiki there are four mature and two immature individuals. There are no wild individuals remaining of *Delissea argutidentata*, *D. kauaiensis*, or *D. niihauensis* on the islands of Hawaiʻi, Maui, and Niʻihau, respectively. A landscape-based assessment of climate change vulnerability for native plants of Hawaiʻi using high resolution climate change projections was made by Fortini *et al.* (2013) and their analysis showed that *D. undulata* is highly vulnerable to the effects of climate change. Currently, more than 500 plants have been propagated and reintroduced at Puʻuwaʻawaʻa, but survivorship and recruitment are unknown. There are six reintroduced populations (initially more than 800 individuals) on Kauai at Mahanaloa middle (nine outplanted, one remains), Mahanaloa upper (153 outplanted); Paʻaiki (381 outplanted, 313 remain); and the upper and lower Kuia exclosures (256 outplanted, 191 remain), now totaling approximately 659 outplants. Fencing is maintained to protect the reintroductions.

Stabilizing (interim), downlisting, and delisting objectives were provided in the Recovery Plan for Big Island Plant Cluster (USFWS 1996), and have been updated according to the draft revised recovery objective guidelines developed by the Hawaiʻi 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.

Delissea argutidentata is a short-lived perennial shrub or palm-like 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 Hawaiʻi 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 50 mature, reproducing individuals per population.

The preventing extinction goals for this species have not been met. There are 16 wild individuals of *Delissea kauaiensis* on Kaua‘i; however, there are no wild individuals of *Delissea argutidentata*, *D. undulata*, or *D. niihauensis* (previously known as subspecies of *Delissea undulata*) on the islands of Hawai‘i, Maui, or Ni‘ihau. The only material in storage or propagation represents *D. argutidentata* and *D. kauaiensis*. More than 500 plants sourced from the last remaining wild individual on the island of Hawai‘i have been reintroduced since the last 5-year review; however, it is unknown if these individuals have survived, matured, or yielded the recruitment of new individuals (Table 1, Table 2). More than 800 individuals of *D. kauaiensis* have been reintroduced on Kaua‘i but only 659 currently survive and only one seedling has been observed. In addition, not all threats are being managed (Table 1, Table 2). Therefore, *Delissea argutidentata* (including *D. kauaiensis*) meets the definition of Endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:
No new threats and no other significant new information is reported regarding the species' biological status since the last 5-year review in 2012. Thus, the following recommendations for future actions are added or reiterated for the 5-year review for 2020.

- Surveys and inventories—Survey the known historical range of the species to determine the current status and to search for additional populations.
- Ungulate exclosures—Continue to construct exclosures at known populations and monitor and maintain fencing to protect *D. argutidentata* and *D. kauaiensis* from feral ungulates.
- Ecosystem-altering invasive plant species control—Control invasive nonnative plants at any wild and all reintroduced populations of *D. argutidentata* and *D. kauaiensis*.
- Fire prevention and control—Develop and implement fire management plans for any wild and all reintroduced populations.
- Climate change adaptation strategy—Assess the modeled effects of climate change on this species and use to determine future landscape needed for the species' recovery.
- Predation and herbivory monitoring and control—
    - Monitor each population for evidence of disease, insect damage, and mortality.
    - Implement effective control methods for rodents.
    - Determine effective control methods for slugs and implement at reintroductions if necessary.
    - Determine the effects of seed predation by nonnative birds and implement control methods if necessary.
- Captive propagation for genetic storage and reintroduction—

    - Continue collection of material for genetic storage and propagation for reintroduction.
    - Develop and implement an effective breeding program to maintain genetic diversity of reintroduced populations.
    - Continue to research effects of seed dormancy on successful recruitment.
    - Research and determine the pollination biology and seed dispersal mechanisms.
- Reintroduction and translocation—Continue reintroduction into suitable protected habitat.
- Alliance and partnership development—Continue to work with DOFAW, and other partners and land managers in planning and implementation of ecosystem-level restoration and management to benefit this species.
- Federal Register updates—Amend the list of Threatened and Endangered Species at 50 CFR 17 to reflect the revised taxonomy.

References:

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.

[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, Hawai‘i.

[PEPP] 2020. Pacific Islands Fish and Wildlife Office plant species database, unpublished.

Pu‘uwa‘awa‘a Plant Nursery. 2018 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.

[USFWS] U.S. Fish and Wildlife Service. 1996. Recovery plan for the Big Island Plant Species. Portland. 176 pp. + appendices.

[USFWS] 2012. *Delissea undulata* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. *https://ecos.fws.gov/docs/five_year_review/doc4083.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. 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.

U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of *Delissea undulata*
(no common name)

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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