

*Delissea undulata*  
(No common name)

**5-Year Review  
Summary and Evaluation**

**U.S. Fish and Wildlife Service  
Pacific Islands Fish and Wildlife Office  
Honolulu, Hawaii**

## 5-YEAR REVIEW

Species reviewed: *Delissea undulata* (No common name)

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**5-YEAR REVIEW**  
*Delissea undulata* (No common name)

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

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**Lead Field Office:**

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**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

N/A

**1.2 Methodology used to complete the 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 April 8, 2010. The review was based on the designation of critical habitat for *Delissea undulata* and the Big Island plant cluster recovery plan (USFWS 2003, 1996b), as well as a review of current, available information. The Bernice Pauahi Bishop Museum 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 Samuel Aruch, biological consultant, was reviewed by a recovery biologist and the Plant Recovery Coordinator. The document was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 Federal Register (FR) Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2010. Endangered and threatened wildlife and plants; 5-year review status of 69 species in Idaho, Washington, Hawaii, Guam, and the Commonwealth of the Northern Mariana Islands. Federal Register 75(67):17947-17950.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** USFWS. 1996a. Endangered and threatened wildlife and plants; endangered status for the plant *Delissea undulata* (no common name); final rule. Federal Register 61(198):53124-53129.

**Date listed:** October 10, 1996

**Entity listed:** Species

**Classification:** Endangered

#### Revised Listing, if applicable

**FR notice:** N/A

**Date listed:** N/A

**Entity listed:** N/A

**Classification:** N/A

### 1.3.3 Associated rulemakings:

USFWS. 2003. Endangered and threatened wildlife and plants; final designation and nondesignation of critical habitat for 46 plant species from the island of Hawaii, Hawaii; final rule. Federal Register 68(127):39624-39761.

Critical habitat was designated for *Delissea undulata* in two units totaling 472 hectares (1,752 acres) on Hawaii Island. These designations include habitat on State lands (USFWS 2003).

### 1.3.4 Review History:

Species status review [FY 2011 Recovery Data Call (August 2011)]:  
Declining

#### **Recovery achieved:**

1 (0-25%) (FY 2007 Recovery Data Call)

### 1.3.5 Species' Recovery Priority Number at start of this 5-year review:

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan or outline:** USFWS. 1996b. Big Island plant cluster recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon. 202+ pages. Available online at <<http://www.fws.gov/pacificislands/recoveryplans.html>>.

**Date issued:** September 26, 1996

**Dates of previous revisions, if applicable:** N/A

**2.0 REVIEW ANALYSIS**

**2.1 Application of the 1996 Distinct Population Segment (DPS) policy**

**2.1.1 Is the species under review a vertebrate?**

*Yes*  
 *No*

**2.1.2 Is the species under review listed as a DPS?**

*Yes*  
 *No*

**2.1.3 Was the DPS listed prior to 1996?**

*Yes*  
 *No*

**2.1.3.1 Prior to this 5-year review, was the DPS classification reviewed to ensure it meets the 1996 policy standards?**

*Yes*  
 *No*

**2.1.3.2 Does the DPS listing meet the discreteness and significance elements of the 1996 DPS policy?**

*Yes*  
 *No*

**2.1.4 Is there relevant new information for this species regarding the application of the DPS policy?**

*Yes*  
 *No*

**2.2 Recovery Criteria**

**2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?**

*Yes*  
 *No*

**2.2.2 Adequacy of recovery criteria.**

**2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?**

*Yes*  
 *No*

**2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria?**

*Yes*  
 *No*

**2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:**

A synthesis of the threats (Listing Factors A, B, C, D, and E) affecting this species is presented in Section 2.3.2 and Table 2.

Stabilizing, downlisting, and delisting objectives are provided in the Big Island plant cluster recovery plan (USFWS 1996b), based on whether the species is an annual, a short-lived perennial (fewer than ten years), or a long-lived perennial. *Delissea undulata* is a short-lived perennial, and to be considered for stabilization, which is the first step in recovering the species, the taxon must be managed to control threats (*e.g.*, fenced) and be represented in an *ex situ* (off-site) collection. In addition, a minimum of three populations should be documented on islands where they now occur or occurred historically. For the species to be considered stable, each of these populations must be naturally reproducing and increasing in number, with a minimum of 50 mature individuals per population.

This recovery objective has not been met.

For downlisting, a total of five to seven populations of *Delissea undulata* should be documented on the island of Hawaii. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with a minimum of 300 mature individuals per population. Each population should persist at this level for a minimum of five consecutive years before downlisting is considered.

This recovery objective has not been met.

For delisting, a total of eight to ten populations of *Delissea undulata* should be documented on the island of Hawaii. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with 300 mature individuals per population for short-lived perennials. Each population should persist at this level for a minimum of five consecutive years before delisting is considered.

This recovery objective has not been met.

## 2.3 Updated Information and Current Species Status

### 2.3.1 Biology and Habitat

#### 2.3.1.1 New information on the species' biology and life history:

*Delissea undulata* is a short-lived perennial, unbranched tree species in the bellflower family (Campanulaceae) (Lammers 2005; USFWS 2002).

Lammers (2005) indicates the time of flowering and fruiting material as being in June to mid-February, and fruiting from September to February. Carlquist (2009) studied xylem heterochrony in a number of species, including *Delissea undulata*. A study by Buss *et al.* (2001) examined seed coat morphology using scanning electron microscopy among some genera of Campanulaceae in Hawaii. These authors included a specimen of *D. undulata*, which has a wrinkled (“rugose”) outer seed coat. This pattern, one of several noted, was shared with another species in the genus (*D. subcordata*) and the two species sampled of *Brighamia*.

The seeds of *Delissea undulata* are said to have a “physiological dormancy” problem (Baskin *et al.* no date–a), wherein “there is a ‘physiological problem’ in the embryo that prevents it from generating enough push power or growth potential to overcome the mechanical constraint of the seed coat and other covering tissues (if present)” (Baskin *et al.* no date–b).

A species of picture-wing drosophila, *Drosophila heteroneura*, is known to breed in the bark of stems of a few trees, including *Delissea undulata* (Giffin 2009).

#### 2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Giffin (2009) rediscovered a single individual *Delissea undulata* in 1992 in dry montane forest near Poohohoo Crater, growing on the side of a collapsed lava tube, and a fence was constructed to protect this individual.

At the time critical habitat was recommended (USFWS 2002), *Delissea undulata* evidently was known from only a single extant individual on the island of Hawaii.

According to USFWS (2002) and Lammers (2005), a single individual of *Delissea undulata* existed in the wild on Puu Waawaa on State land.

Giffin (2009) indicated that the last remaining wild specimen of several species, including *D. undulata*, had been extirpated in the wild by 2006 (L. Perry, Hawaii Department of Land and Natural Resources, pers. comm. 2011).

#### **2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):**

Givnish *et al.* (2008) carried out a molecular study of Hawaiian lobeliads, which included two species in *Delissea*, but not *D. undulata*. The two members studied of *Delissea* were shown to be most closely related to members of the genus *Brighamia*. It is unknown whether any molecular studies have focused primarily on the genus *Delissea*.

#### **2.3.1.4 Taxonomic classification or changes in nomenclature:**

The species was originally described by Gaudichaud in 1829, based on one of his own collections made in 1819 (Lammers 2005). The concept of the species, as recognized by Wagner *et al.* (1999), was broad and included several taxonomic synonyms. The taxonomic history of the species listed as *Delissea undulata* is complex (Lammers 1999, 2005; USFWS 1996a, 1996b, 2002). In a series of revisionary treatments of *Delissea*, Lammers (1988, 1999, 2005) modified his taxonomic concept of *D. undulata* through time. Lammers (1988) at first narrowed the taxonomic concept of *D. undulata* as being a species restricted to the island of Hawaii, and recognized additional subspecies under *D. niihauensis* (summarized in Lammers [1999]). Lammers (2005) later elevated or re-elevated some of the subspecific taxa to the specific level as *D. undulata*, *D. niihauensis*, *D. kauaiensis*, and *D. argutidentata*. Most importantly from a taxonomic and nomenclatural standpoint, Lammers (2005) now considers the taxon that corresponds to the type specimen of *D. undulate*, the name by which the species was first listed by USFWS (1996a), to be restricted to West Maui. Furthermore, he considers the correct name for the taxon listed for the island of Hawaii to be *Delissea argutidentata* (Lammers 2005). An accepted synonym for *D. argutidentata* is *D. konaensis* (Lammers 2005).

For purposes of this review, *Delissea argutidentata* will be used for what previously was called *D. undulata* (e.g., USFWS 2002, 2003). Because of the taxonomic changes made by Lammers (2005), some of the previous information is no longer accurate due to the historical and current distribution of the species described.

#### **2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or**

**historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):**

It is worth stressing again that the interpretations of what was reported nearly twenty years ago must be reconsidered in light of the taxonomic changes made by Lammers (2005), see section 2.3.1.4 above. Previously (USFWS 2002), the species was stated as having been known from West Maui, but that region harbors the “true” *D. undulata* as it is recognized by Lammers (2005), and not *D. argutidentata* the species in review. Hank Oppenheimer of the Plant Extinction Prevention Program (pers. comm. 2011) reports that the “true” *D. undulata* from West Maui has not been seen in approximately 100 years. Because of the taxonomic changes made by Lammers (2005), some of the previous information is no longer accurate due to the historical and current distribution of the species described.

**2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):**

*Delissea argutidentata* occurs in mesic *Acacia koa* (koa) forest from 915 to 1,585 meters (3,002 to 5,200 feet) elevation. Its range is somewhat north and southeast of Hualalai on the western side of the island of Hawaii. The soils recorded for the species include ustollic eutrandsrepts, typic dystandsrepts, and typic tropofolists (Hawaii Biodiversity and Mapping Program 2010). Native plant species growing in association with *D. argutidentata* include *Sophora chrysophylla* (mamane), *Metrosideros polymorpha* (ohia), *Diospyros sandwicensis* (lama), *Dodonaea viscosa* (aalii), *Psychotria* spp. (kopiko), *Santalum paniculatum* (iliahi), and *Nothocestrum breviflorum* (aiea) (USFWS 2002).

**2.3.1.7 Other:**

No new information.

**2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)**

**2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:**

**Threats:**

- Ungulate degradation of habitat (USFWS 2002, 2003, 2010; Hawaii Department of Land and Natural Resources 2005)
  - Cattle (*Bos taurus*)
  - Feral sheep (*Ovis aries*)

- Goats (*Capra hircus*)
- Pigs (*Sus scrofa*)
- Established ecosystem-altering invasive plant species degradation of habitat (USFWS 2002, 2003, 2010; Hawaii Department of Land and Natural Resources 2005)
  - *Passiflora tarminiana* (banana poka)
  - *Pennisetum clandestinum* (kikuyu grass)

**Current conservation efforts:**

- Ungulate exclosure – Giffin (2009) constructed a fenced exclosure around a single individual of *Delissea argutidentata* that was rediscovered in 1992 near Poohohoo Crater in Puu Waawaa.

**2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:**

None reported.

**2.3.2.3 Disease or predation:**

**Threats:**

- Rodent predation or herbivory – Seed and fruit predation by rats (*Rattus* sp.) (USFWS 2002, 2003, 2010; Hawaii Department of Land and Natural Resources 2005)
- Nonnative bird predation – Seed and fruit predation by introduced game birds (USFWS 2002, 2003, 2010; Hawaii Department of Land and Natural Resources 2005)
- Slugs – Herbivory of foliage and fruits (USFWS 2002, 2003, 2010; Hawaii Department of Land and Natural Resources 2005)

**2.3.2.4 Inadequacy of existing regulatory mechanisms:**

**Threats:**

- Lack of adequate hunting regulation in areas with ungulates – The lack of adequate ungulate control and the existence of established hunting programs in areas where *Delissea argutidentata* occurs continue to threaten this species.

**2.3.2.5 Other natural or manmade factors affecting its continued existence:**

**Threats:**

- Low numbers – increased likelihood of stochastic extinction due to changes in demography, the environment, genetics, or other factors (USFWS 2002, 2003, 2010; Hawaii Department of Land and Natural Resources 2005)
- Established invasive plant species competition (USFWS 2002, 2003, 2010; Hawaii Department of Land and Natural Resources 2005)
  - *Delairea odorata* (Cape ivy)
- Fire (USFWS 2002, 2003, 2010; Hawaii Department of Land and Natural Resources 2005)
- Climate change may pose a threat to this species. 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.

**Current conservation efforts:**

- Captive propagation for genetic storage and reintroduction:
  - Giffin (2009) sent immature seeds from the single individual rediscovered in 1992 to Lyon Arboretum. Lyon Arboretum produced over one hundred individuals from this seed source (Giffin 2009).
  - The Hawaii Island Plant Extinction Prevention Program (2007a) reported receiving 86 accessions of this species. Also, the Plant Extinction Prevention Program (2007b) reported that 86 individuals were propagated for eventual reintroduction.
- Reintroduction / translocation implementation – The Plant Extinction Prevention Program (2007a) reported 120 individuals of *Delissea argutidentata* were reintroduced at Puu Waawaa. In the most recent report, USFWS (2010) indicated that 415 individuals were reintroduced at Puu Waawaa, although the time they were reintroduced is uncertain and the status of the reintroduction is unknown. Of the approximately 415 individual plants that were reintroduced at Puu Waawaa, some of these individuals were reintroduced at Makala-Ooma Forest Reserve near Kaloko (L. Perry, pers. comm. 2011), but it is uncertain how many of these survived. In contrast, the Plant Extinction Prevention Program (2007b) reported that 73 individuals were reintroduced at Puu Waawaa in 2007.

## 2.4 Synthesis

The interim stabilization goals for this species have not been met, as the last known wild individual of *Delissea argutidentata* located at Puu Waawaa died in 2006 (L. Perry pers. comm. 2011) (Table 1). In addition, all threats are not being managed (Table 2).

Therefore, *D. argutidentata* meets the definition of endangered as it remains in danger of extinction throughout its range.

**Table 1. Status of *Delissea argutidentata* from listing through 5-year review.**

<b>Date</b>	<b>No. wild individuals</b>	<b>No. outplanted</b>	<b>Stabilization Criteria identified in Recovery Plan</b>	<b>Stabilization Criteria Completed?</b>
1996 (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	Partially
			3 populations with 50 mature individuals each	No
2012 (5-year review)	0	415	All threats managed in all 3 populations	Partially (see table 2)
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No

**Table 2. Threats to *Delissea argutidentata* and ongoing conservation efforts.**

<b>Threat</b>	<b>Listing factor</b>	<b>Current Status</b>	<b>Conservation/ Management Efforts</b>
Ungulates – Degradation of habitat	A, D	Ongoing	Partially: Fenced enclosure near Poohohoo Crater
Established ecosystem-altering invasive plant species degradation of habitat	A	Ongoing	No
Slugs	C	Ongoing	No
Rodent predation or herbivory – Rats	C	Ongoing	No
Nonnative bird predation	C	Ongoing	No
Established invasive plant species competition	E	Ongoing	No
Fire	E	Ongoing	No
Low numbers	E	Ongoing	Partially: Captive propagation for genetic storage and reintroduction, reintroduction / translocation implementation, and monitoring
Climate change	A, E	Increasing	No

### 3.0 RESULTS

#### 3.1 Recommended Classification:

**Downlist to Threatened**

**Uplist to Endangered**

**Delist**

*Extinction*

*Recovery*

*Original data for classification in error*

**No change is needed**

#### 3.2 New Recovery Priority Number:

**Brief Rationale:**

#### 3.3 Listing and Reclassification Priority Number:

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number:** \_\_\_\_\_

**Delisting (regardless of current classification) Priority Number:** \_\_\_\_\_

**Brief Rationale:**

#### 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Captive propagation for genetic storage and reintroduction:
  - Continue to collect seed from all populations and distribute to at least two centers where it may be stored and/or propagated.
  - Maximize the number of individuals from which seed is collected to help maintain existing genetic variation within the species.
  - Increase the number of individuals growing *ex situ* for later reintroduction.
- Captive propagation protocol development – Investigate seeds of *D. argutidentata* for “physiological dormancy” problem (Baskin *et al.* no date–a) and determine effective ways to germinate seeds for reintroduction.
- Reintroduction / translocation site identification – Identify suitable habitat within the historical range of the species for reintroduction.
- Reintroduction / translocation implementation – Continue to reintroduce the species back into its known historical range.
- Ungulate exclosure – Continue to construct ungulate-proof fenced exclosures around each population and monitor the fences for any signs of breaching.
- Ungulate control – Protect all populations against disturbances from feral ungulates.
- Ecosystem-altering invasive plant species control – Control invasive introduced plant species around all populations.
- Surveys / inventories – Resurvey the known historical range of the species to search for additional populations.
- Population biology research – Carry out field studies to determine the pollination biology and seed dispersal mechanism of the species.
- Threat monitoring and control – Monitor each population for evidence of disease, insect damage, or mortality.
- Predator / herbivore control – Control rodents around existing populations.
- Threats research:
  - Determine the best ways to control damage from slugs.
  - Study *Delissea argutidentata* populations with regard to threats of nonnative bird predation.
  - Assess the modeled effects of climate change on this species, and use to determine future landscape needed for the recovery of the species.
- Fire protection – Develop and implement fire management plans for all wild and reintroduced populations.

- Alliance and partnership development – Work with the Hawaii Division of Forestry and Wildlife, and other land managers to continue implementation of ecosystem-level restoration and management to benefit this species.

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### **Personal Communications:**

Oppenheimer, Hank. 2011. Maui Nui Coordinator, Hawaii Plant Extinction Prevention Program, Lahaina, Hawaii. E-mail to Neil Snow, Bernice P. Bishop Museum, dated March 13, 2011. Subject: Status of *Delissea undulata* on Maui.

Perry, Lyman. 2011. Botanist, Department of Land and Natural Resources, Division of Forestry and Wildlife, Hilo, Hawaii. E-mail to Neil Snow, Bernice P. Bishop Museum, dated March 16, 2011. Subject: Status of *Delissea argutidentata* on Hawaii.

**Signature Page**  
**U.S. FISH AND WILDLIFE SERVICE**  
**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  
 No Change in listing status

**Appropriate Listing/Reclassification Priority Number, if applicable:** \_\_\_\_\_

**Review Conducted By:**

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

*for*

Jess Newton

Date 8/28/2012