

*Diellia unisora*  
(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: *Diellia unisora* / no common name

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**5-YEAR REVIEW**  
***Diellia unisora* (no common name)**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery, Jesse D'Elia, (503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor, (808) 792-9400

**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 March 16, 2009. The review was based on final critical habitat designations for *Diellia unisora* and other species from the island of Oahu (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.

**1.3 Background:**

**1.3.1 Federal Register (FR) Notice citation 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.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** USFWS. 1994. Endangered and threatened wildlife and plants; endangered status for three plants from the Waianae mountains, island of Oahu, Hawaii; final rule. Federal Register 59(122):32932 - 32938.

**Date listed:** June 27, 1994

**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 designations or nondesignations of critical habitat for 101 plant species from the island of Oahu, Hawaii; final rule. Federal Register 68(116):35949-36406.

Critical habitat was designated for *Diellia unisora* in a single unit totaling 362 hectares (894 acres) on Oahu. This designation includes habitat on State, Federal, and private lands (USFWS 2003).

### 1.3.4 Review History:

Species status review [FY 2010 Recovery Data Call (September 2010)]: Stable

#### **Recovery achieved:**

1 (0-25%) (FY 2007 Recovery Data Call – most recent year reported)

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

11

### 1.3.6 Current Recovery Plan or Outline

**Name of plan or outline:** U.S. Fish and Wildlife Service. 1998. Recovery plan for Oahu plants. U.S. Fish and Wildlife Service, Portland, Oregon. 207 pages, plus appendices.

**Date issued:** August 10, 1998.

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, C, D, and E) affecting this species is presented in section 2.3.2 and Table 2. Listing Factor B (overutilization for commercial, recreational, scientific, or educational purposes) is not known to be a threat to this species.

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for Oahu plants (USFWS 1998), based on whether the species is an annual, a short-lived perennial (fewer than 10 years), or a long-lived perennial. *Diellia unisora* is a short-lived perennial, and to be considered stabilized, which is the first step in recovering the species, the taxon must be managed to control threats (*e.g.*, fenced, weeding, etc.) 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. 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 *Diellia unisora* should be documented on islands where they now occur or occurred historically. 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 *Diellia unisora* should be documented on islands where they now occur or occurred historically.

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:**

Detailed observations of the life cycle and population dynamics of *Diellia unisora* have been made over the course of a decade of annual visits to the Hawaiian Islands by Estonian researcher Ruth Aguraiuja. Her work is outlined in a number of publications (Aguraiuja 2001; Aguraiuja 2005; Aguraiuja and Wood 2002; Aguraiuja *et al.* 2004). The development of ferns from one reproductive stage to the next is apparently quite variable, probably in response to the differences in climate from year to year.

#### **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:**

Six individuals of *Diellia unisora* were observed at Palikea on a ridge separating Lualualei from Nanakuli at 792 meters (2,600 feet) elevation in 1993 (Wood 2009). Below Palikea, on north facing forested slopes on the Lualualei side of the ridge along Nanakuli, 15 individuals were seen in 1996 at 792 meters (2,600 feet) elevation (Wood 2009). Aguraiuja counted 76 individuals of *Diellia unisora* at Ekahanui in 2002 (Aguraiuja 2005). Most recently, Joel Lau of the Hawaii Biodiversity and Mapping Program observed one individual of *Diellia unisora* at South Ekahanui Gulch at 750 meters (2,460 feet) elevation in 2004 (Hawaii Biodiversity and Mapping Program 2009).

At Honouliuli, in the Pualii drainage south of Pohakea Pass, about 100 individuals were seen in 1999 at 732 meters (2,400 feet) elevation (Wood 2009). On the same day, at another area to the east, 40 individuals were seen, also at 732 meters (2,400 feet) elevation (Wood 2009). Lau reported 600 individuals at north Pualii Gulch in Honouliuli Reserve at 701 to 762 meters (2,300 to 2,500 feet) elevation in 2000 (Hawaii Biodiversity and Mapping Program 2009). In 1999, 30 scattered individuals of *Diellia unisora* were observed at 780 meters (2,560 feet) elevation at Pualii Gulch (Perlman 2009), and in 2000 another population was seen at Pualii Gulch summit at an elevation of 671 meters (2,200 feet) (Wood 2009). Most recently, from 2004 to 2005, Agurauja identified four subpopulations at Pualii totaling 1,070 individuals (Agurauja 2005).

In South Palawai, southeast of Palikea at 671 to 732 meters (2,200 to 2,400 feet) elevation, a *Diellia* population of 44 mature and 68 immature individuals was seen in 1999. *Diellia unisora* was associated with a natural hybrid of *D. falcata* × *D. unisora*, also known as *D. lauii* (Hawaii Biodiversity and Mapping Program 2009; Wood 2009).

At the north branch of Halona Stream, Lualualei, two mature individuals were seen in 2004 at 713 to 750 meters (2,340 to 2,460 feet) elevation (Hawaii Biodiversity and Mapping Program 2009).

In total, before 2003 there were at least 244 to 827 individuals of *Diellia unisora* observed in four populations. Since 2003, 1,148 individuals have been observed in two populations.

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

*Diellia* is a genus endemic to Hawaii and includes six species, all of which may have originated from a single common ancestor (Palmer 2003). It is believed that *Diellia* ferns may have been some of the earliest colonists of the Hawaiian Islands, some 23 to 24 million years ago (Agurauja 2005). Three of the six species of *Diellia* are endemic to Oahu (Palmer 2003; USFWS 2007). *Diellia unisora* hybridizes with *D. falcata* to form an endemic hybrid *Diellia lauii*, which was described as locally common when found by J. Lau in 1991 (Palmer 2003;

USFWS 2007). The area where most of these hybrids occur is in South Palawai (Agurauja 2001).

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

In their molecular analyses of *Diellia* Schneider *et al.* (2005) resolved the genus as being monophyletic (evolved from a single ancestor), nested within *Asplenium*. They conclude that continued recognition of *Diellia* as an independent genus would render *Asplenium* as paraphyletic (evolved from multiple introductions), and suggest following Viane and Reichstein (1991) who transferred all species of *Diellia* to *Asplenium*. The species is now considered *Asplenium unisora* (Schneider *et al.* 2005). Therefore, *Diellia unisora* will be referred to as *Asplenium unisora* throughout the remainder of this review.

#### **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.):**

See above section 2.3.1.2.

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

In Palikea and the slopes below, the habitat of *Asplenium unisora* is *Metrosideros polymorpha* (ohia) mixed mesic and wet forest cliffs with associated native species including *Bidens torta* (kookoolau), *Eragrostis grandis* (lovegrass), *Kadua parvula* (no common name [NCN]), *K. cordata* subsp. *cordata* (kopa), *K. degeneri* var. *degeneri* (NCN), *Plantago princeps* var. *princeps* (laukahi kuahiwi), and *Silene perlmanii* (NCN) (Wood 2009).

At Honouliuli, the habitat where *Asplenium unisora* occurs is *Metrosideros polymorpha*-*Acacia koa* (koa) lowland mesic relic forest, with *Asplenium macraei* (iwa iwa lau lii), *Diospyros hillebrandii* (lama), *Doryopteris decipiens* (kumuniu), *Melicope peduncularis* (alani), *Neraudia melastomifolia* (maaloa), and *Pouteria sandwicensis* (alaa) (Wood 2009).

In South Palawai, south-east of Palikea, the habitat is relictual mesic forest with secondary succession of non-native *Schinus terebinthifolius* (Christmasberry), *Psidium cattleianum* (strawberry guava), and *Passiflora suberosa* (corksystem passionflower) (Wood 2009).

At Pualii Gulch, *Asplenium unisora* was observed growing in *Metrosideros polymorpha* — *Dicranopteris linearis* (uluhe) — *Schinus terabinthifolius* forest with associated native species such as *Alyxia stellata* (maile), *Antidesma* sp. (hame), *Bidens torta*, *Broussaisia arguta* (kanawao), *Carex meyenii* (NCN), *Coprosma longifolia* (pilo), *Dubautia plantaginea* (naenae), *Freycinetia arborea* (ie ie), *Kadua affinis* (manono), *Leptecophylla tameiameia* (pukiawe), *Lobelia yuccoides* (panaunau), *Melicope peduncularis*, *Perrottetia sandwicensis* (olomea), *Pipturus albidus* (mamake), *Pouteria sandwicensis*, *Psychotria hathewayi* (kopiko), *P. mariniana* (kopiko), *Scaevola gaudichaudiana* (naupaka kuahiwi), *Sida fallax* (ilima), *Vaccinium* sp. (ohelo), and *Zanthoxylum kauense* (heae) (Perlman 2009; Wood 2009).

**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:**

In the Waianae Mountains where *Asplenium unisora* is found, feral pigs (*Sus scrofa*) and goats (*Capra hircus*) disturb the ground and significantly contribute to erosion, and together represent the single greatest threat to this species. Invasive introduced plants also degrade the habitat and invade openings created by disturbance, thus crowding out areas which might otherwise recruit and support new sporelings (Aguraiuja 2005). These invasive introduced plants include *Ageratina adenophora* (sticky snakeroot), *Ageratina riparia* (spreading mist flower), *Buddleia asiatica* (dog tail), *Casuarina equisetifolia* (ironwood), *Clidemia hirta* (Koster's curse), *Grevillea robusta* (silk oak), *Lantana camara* (lantana), *Melinis minutiflora* (molasses grass), *Passiflora suberosa*, *Psidium cattleianum*, and *Schinus*

*terebinthifolius* (Agurauja 2005; Perlman 2009; Wood 2009).

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

Not a threat.

**2.3.2.3 Disease or predation:**

Rats (*Rattus rattus*) and goats are believed to eat *Asplenium unisora* (Perlman 2009).

**2.3.2.4 Inadequacy of existing regulatory mechanisms:**

Not a threat.

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

The invasive introduced plant species previously described in Section 2.3.2.1, in addition to degrading habitat, directly compete with *Asplenium unisora* for light, nutrients, and water.

Climate change may also 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.

Other species in the genus *Diellia* (now *Asplenium*) have been successfully propagated using tissue culture (micropropagation) techniques on Oahu (Harold L. Lyon Arboretum Micropropagation Laboratory 2009). However, no specific conservation measures, such as propagation, spore storage, or threat mitigation, have been undertaken for *Asplenium unisora*.

**2.4 Synthesis**

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for Oahu plants (USFWS 1998), based on whether the species is an annual, a short-lived perennial (fewer than ten years), or a long-lived perennial. *Asplenium unisora* is a short-lived perennial, and to be considered stabilized,

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.

The interim stabilization goals for this species have not been met. There are only two recently observed populations containing greater than 50 individuals each (Table 1) and none of the threats are being managed (see Table 2). In addition, there is no off-site representation of the species. Therefore, *Asplenium unisora* meets the definition of endangered as it remains in danger of extinction throughout its range.

**Table 1. Status of *Asplenium unisora* from listing through 5-year review.**

<b>Date</b>	<b>No. wild indivs</b>	<b>No. outplanted</b>	<b>Stability Criteria identified in Recovery Plan</b>	<b>Stability Criteria Completed?</b>
1994 (listing)	705-755	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	Unknown
1998 (recovery plan)	700	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2003 (critical habitat)	<800	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	Unknown
2010 (5-year review)	1,148	0	All threats managed in all 3 populations	No (Table 2)
			Complete genetic storage	No
			3 populations with 50 mature individuals each	Partially: only two populations with 50 mature individuals

**Table 2. Threats to *Asplenium unisora*.**

<b>Threat</b>	<b>Listing factor</b>	<b>Current Status</b>	<b>Conservation/ Management Efforts</b>
Ungulates – habitat modification and herbivory	A, C, D	Ongoing	No
Rats – herbivory	C	Ongoing	No
Invasive introduced plants	A, E	Ongoing	No
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**

- Collect material for genetic storage and propagation for reintroduction.

- Fence all populations to provide protection against the negative impacts of feral ungulates.
- Mitigate current erosion conditions in the vicinity of known populations.
- Control invasive introduced plant species around all populations.
- Control rats in the vicinity of these populations.
- 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.
- Update the listed entity on 50 CFR 17 to match the currently recognized taxonomy.
- Assess the modeled effects of climate change on this species, and use to determine future landscape needed for the recovery of the species.

## 5.0 REFERENCES

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**Signature Page**  
**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW of *Diellia unisora* (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:**

Chelsie Javar, Fish and Wildlife Biologist  
Marie Brueggemann, Plant Recovery Coordinator  
Jess Newton, Recovery Program Lead  
Assistant Field Supervisor for Endangered Species

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

  
\_\_\_\_\_

Date 8/2/11