

5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Kadua parvula* (no common name)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2017. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 138 species in Hawaii, Oregon, Washington, and California. Federal Register 82(75): 18665–18668, April 20, 2017.

Lead Region/Field Office:

Region 1/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 2018. The review was based on a review of current, available information since the last 5-year review for *Kadua parvula* (as *Hedyotis parvula*) (USFWS 2013). The evaluation completed 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 reviews for *Kadua parvula* (as *Hedyotis parvula*) published in the Federal Register on January 18, 2008 and August 12, 2013 (available at https://ecos.fws.gov/docs/five_year_review/doc1817.pdf and https://ecos.fws.gov/docs/five_year_review/doc4220.pdf) for a complete review of the species' status, threats, and management efforts. 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 *K. parvula*.

This short-lived perennial branched, erect to sprawling shrub in the Rubiaceae (coffee) family is endangered and endemic to O'ahu. The current status and trends for *Kadua parvula* are provided in the tables below.

New Status Information:

- Currently there are 71 mature, 149 immature, and 20 seedlings of *Kadua parvula* in two populations in the Wai‘anae mountains of O‘ahu (ANRP 2018).
- As discussed in the previous 5-year review, Terrell *et al.* (2005) determined that the Hawaiian species of *Hedyotis* were distinct from other Asian and Pacific species, and resurrected the name *Kadua*. In our 2012 designation of critical habitat (77 FR 57648, September 18, 2012) we recognized and published this taxonomic change to *Kadua parvula*.
- In 2012, 11 critical habitat units in two ecosystems (lowland mesic and dry cliff) were designated for *Kadua parvula* in the Wai‘anae mountains of O‘ahu (7,312 ac, 2,960 ha) (77 FR 57648, September 18, 2012).

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 *Kadua parvula* is extremely vulnerable to the impacts of climate change, with a vulnerability score of 0.96 (on a scale of 0 being not vulnerable to 1 being extremely vulnerable to climate change). In addition, this species has no overlap between current and future climate envelopes, and is unlikely to tolerate expected changes in climate at its current location. This means that this species must persist within suitable microrefugia, or move to newly available climate-compatible areas to avoid extinction. Therefore, additional management actions may be needed to conserve this taxon into the future, such as identifying suitable microsites where climate change is anticipated to occur more slowly and considering suitable habitat in areas outside of its known range.

New Management Actions:

- Ungulate monitoring and control—The Army Natural Resources Program-O‘ahu (ANRP) has removed ungulates from one wild population and one reintroduced population unit, ‘Ōhikilolo and ‘Ēkahanui (ANRP 2018).
- Invasive plant monitoring and control—The ANRP controls nonnative plants in one wild and one reintroduced population unit, with close to 100 percent removal at ‘Ōhikilolo and ‘Ēkahanui (ANRP 2018).
- Captive propagation for genetic storage and reintroduction—
 - In 2018, the ANRP reported that two populations have met genetic storage goals, ‘Ōhikilolo and Halona (ANRP 2018). There are 122 plants, representing two populations (‘Ōhikilolo and Halona) with more than 50 viable seeds each in storage, and an additional 20 plants represented with fewer than 50 seeds in storage.
 - The National Tropical Botanical Garden (NTBG) reports two individuals as living collections at the McBryde garden (NTBG 2018).

- Lyon Arboretum’s Seed Conservation Laboratory reports collection of over 13,000 seeds, 900 of which were used in testing, leaving over 12,000 in storage representing one individual of *K. parvula* at the Pahole greenhouse (Lyon Arboretum 2018).
- Reintroduction—The ANRP reports 50 mature and four immature reintroduced *Kadua parvula* at ‘Ōhikilolo and 58 mature and 29 immature reintroduced *K. parvula* at ‘Ēkahanui (ANRP 2018).

Synthesis:

Currently there are 71 mature, 149 immature, and 20 seedlings of *Kadua parvula* in two populations. 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 *K. parvula* is extremely vulnerable to the effects of climate change. Ungulates and nonnative plants are controlled in two large management areas. Over 140 plants have been reintroduced into managed areas and thousands of seeds representing 144 individuals are in storage.

Stabilizing (interim), downlisting, and delisting objectives were provided in the Recovery Plan for the O‘ahu Plants (USFWS 1998), 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.

Kadua parvula is a short-lived perennial erect to sprawling shrub. To prevent extinction, which is the first step 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 O‘ahu where they now occur or occurred historically and each of these populations must be naturally reproducing (*i.e.*, viable seeds, seedlings, saplings) and increasing in number, with a minimum of 50 mature, reproducing individuals per population.

The preventing extinction goals for this species have not been met. Although there are two reintroduced populations that total at least 50 mature individuals (‘Ōhikilolo and ‘Ēkahanui) it is unknown if these mature individuals are successfully reproducing and all plants at these sites have been planted (Table 1). Genetic representation is complete for two populations; however, not all threats are managed (Table 1, Table 2). Therefore, *Kadua parvula* meets the definition of Endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

Other than the new data on the extreme vulnerability of this taxon to climate change, we are not aware of any new threats or significant new information regarding the species’ biological status since the last 5-year review in 2013. Thus, the following recommendations for future actions are reiterated for the 5-year review for 2019.

- Ungulate monitoring and control—Maintain existing exclosures and monitor for potential incursions.
- Invasive plant monitoring and control—Continue to control established ecosystem-altering nonnative invasive plant species, and those that compete with *Kadua parvula*.
- Fire monitoring and control—Implement fire management plans and coordinate fire response efforts.
- 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.
- Population biology research—Study *Kadua parvula* populations with regard to population size and structure, geographical distribution, flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, limiting factors, and threats.
- Captive propagation for genetic storage and reintroduction—Continue collection and propagation efforts for maintenance of genetic stock and for reintroduction.
- Reintroduction and translocation—Continue to augment or establish new populations within suitable habitat to increase numbers of individuals and populations.
- Alliance and partnership development—Work with the U.S. Army and other land managers to initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this species.

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

Date	No. wild individuals	No. outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization Criteria Completed?
1991 (listing)	0	0	All threats managed in all three populations	No
			Complete genetic storage	No
			Three populations with 50 mature individuals each	No

1998 (recovery plan)	220–235	0	All threats managed in all three populations	No
			Complete genetic storage	Partially
			Three populations with 50 mature individuals each	Partially
2003 (critical habitat)	116–131	0	All threats managed in all three populations	No
			Complete genetic storage	Partially
			Three populations with 50 mature individuals each	Partially
2008 (5-year review)	263	0	All threats managed in all three populations	Partially
			Complete genetic storage	Partially
			Three populations with 50 mature individuals each	Partially, two populations >50 individuals
2012 (critical habitat)	240	0	All threats managed in all three populations	Partially
			Complete genetic storage	Partially
			Three populations with 50 mature individuals each	Partially
2013 (5-year review)	197 mature, 216 immature, 5 seedlings = 413 total	0	All threats managed in all three populations	Partially
			Complete genetic storage	Yes
			Three populations with 50 mature individuals each	Partially, two populations >50 individuals

Date	No. wild individuals	No. outplanted	*Preventing Extinction Criteria identified by HPPRCC	*Preventing Extinction Criteria Completed?
2019 (5-year review)	71 mature, 149 immature = 220 total	>140	All threats managed in all three populations	Partially for two populations
			Complete genetic storage	Yes
			Reproduction (<i>i.e.</i> viable seeds, seedlings) at all three populations	No
			Three populations with 50 mature individuals each	Partially, two populations > 50 individuals

* 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 after Preventing Extinction).

Table 2. Threats to *Kadua parvula* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulate degradation and destruction of habitat	A	Ongoing	Partial, fencing and ungulate removal at two managed areas
Established ecosystem altering invasive plant species degradation of habitat	A	Ongoing	Partial, nonnative plant control at two managed areas
Fire destruction and degradation of habitat	A	Ongoing	Partial, management plan and coordinated fire response efforts
Climate change degradation or loss of habitat	A	Ongoing	None
Competition with established invasive plant species	E	Ongoing	Partial, nonnative plant control at two managed areas
Stochastic events and small populations	E	Ongoing	Partial, seed collection, propagation, and reintroduction ongoing

References:

See previous 5-year reviews for a full list of references (USFWS 2008, 2013). Only references for new information are provided below.

[ANRP] Army Natural Resource Program-O‘ahu. 2018. 2018 status report for the Makua and Oahu implementation plans. 217 pp.

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.

Lyon Arboretum. 2018. Report on controlled propagation of listed and candidate 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, Hawaii.

[NTBG] National Tropical Botanical Garden. 2018. Report on controlled propagation of listed and candidate 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, Hawaii.

[USFWS] U.S. Fish and Wildlife Service. 2012. Endangered and threatened wildlife and plants; Endangered status for 23 species on Oahu and designation of critical habitat for 124 species; final rule. Department of the Interior, Federal Register 77 (181): 57648–57862, September 18, 2012.

[USFWS] 2013. *Hedyotis parvula* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI.
https://ecos.fws.gov/docs/five_year_review/doc4220.pdf.

[USFWS] 2017. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 138 species in Hawaii, Oregon, Washington, and California. Federal Register 82(75): 18665–18668, April 20, 2017.

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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

For Field Supervisor, Pacific Islands Fish and Wildlife Office

_____ Date _____