5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Kadua coriacea* (kio‘ele)

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 *Kadua coriacea* (USFWS 2015). 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 reviews for *Kadua coriacea* published in the Federal Register on January 18, 2008 and August 3, 2015 (available at *https://ecos.fws.gov/docs/five_year_review/doc1818.pdf* and *https://ecos.fws.gov/docs/five_year_review/doc4555.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 *K. coriacea*.

This short-lived perennial shrub in the Rubiaceae (coffee) family is endangered. The status and trends for *Kadua coriacea* are provided in the tables below.

New Status Information:

- In 2013, there were 67 reported locations (monitoring plots) of *Kadua coriacea* on the Pōhakuloa Training Area (PTA) on the island of Hawai‘i (U.S. Army Garrison 2013, pp. 9–10). In 2019, there were 119 locations for this species (U.S. Army Garrison 2020, p. 6). Currently, there are six populations within PTA, totaling 145 mature and three immature individuals. Very little natural recruitment was observed (U.S. Army Garrison 2020, pp. 13, 17–18, 31, 54).
- In 2016, two critical habitat units in the lowland dry ecosystem were designated on the island of Maui for *K. coriacea* (1,577 ha; 3,898 ac) (81 FR 17790, March 30, 2016).

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 *Kadua coriacea* is highly vulnerable to the impacts of climate change, with a vulnerability score of 0.611 (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 this taxon into the future, such as locating key microsites that overlap with current and future climate envelopes for outplanting efforts.

New Management Actions:

- Surveys and inventories—The U.S. Army Garrison monitors *Kadua coriacea* quarterly at Pōhakuloa Training Area (PTA) (U.S. Army Garrison 2010, 213 pp.). PTA reported conducting surveys over eight census periods from 2016 to 2019 to assess the status of *K. coriacea* and recorded its presence at 119 locations (U.S. Army Garrison 2020, pp. 6, 11, 17–18).
- Captive propagation for genetic storage and reintroduction—
    - In 2019, PTA reported collection of almost 20,000 seeds for genetic storage representing at least 51 founders from Nā‘ōhule‘elua-Charlie Circle, Nā‘ōhule‘elua-Northwest New Bobcat Trail, Kīpuka ‘Alalā North, and Kīpuka Kālawamauna East, and 280 seeds collected from plants in the Rare Plant Propagation Facility (RPPF) (PTA 2019; U.S. Army Garrison 2020, p. 35, 61).
    - In 2019, 349 individuals of *K. coriacea* were propagated in the RPPF (U.S. Army Garrison 2020, p. 42).
    - PTA conducted 18 germination trials of 810 seeds from *K. coriacea*, and reported that seeds germinated readily, with 71 percent germination (U.S. Army Garrison 2020, p. 40). Longevity of seeds is estimated to be nine years (U.S. Army Garrison 2013, p. 16).
- Reintroduction—
    - PTA reported reintroduction on PTA of 107 individuals representing three founders of *K. coriacea* at four locations, of which 64 survive (61

percent). Of those reintroduced at Pu‘uwa‘awa‘a between 2004 and 2015, 13 mature and three immature individuals survive (U.S Army Garrison 2020, pp. 43, 48, 122–125, 132–138).

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

Date	No. wild individuals	No. outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization Criteria Completed?
1992 (listing)	3	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
1997 (recovery plan)	<20	0	All threats managed in all 3 populations	No
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2003 (critical habitat)	1 (Maui) 0 (O‘ahu) 150 (Hawai‘i)	160	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2008 (5-year review)	156 (Hawai‘i)	85	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially

			3 populations with 50 mature individuals each	Partially
2012 (critical habitat)	0 (O‘ahu)		All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2015 (5-year review)	162 mature, 5 immature (Hawai‘i)	448	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2016 (critical habitat)	0 (Maui)	0 on Maui	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Partially, no recruitment
Date	**No. wild individuals**	**No. outplanted**	***Preventing Extinction Criteria identified by HPPRCC**	***Preventing Extinction Criteria Completed?**
2020 (5-year review)	145 mature, 3 immature (Hawai‘i)	ca 80 survive (>107 planted)	All threats managed in all 3 populations	Partially, all populations fenced with nonnative plant control
			Complete genetic storage	Partially, at least 51 founders represented

			Reproduction (i.e. viable seeds, seedlings, saplings) at all 3 populations	No
			3 populations with 50 mature individuals each	No

* 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 *Kadua coriacea* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulate destruction and degradation of habitat	A, E	Ongoing	Partial, all populations at PTA within exclosures
Established ecosystem altering invasive plant species degradation of habitat and competition	A, E	Ongoing	Partial, nonnative plant control efforts within exclosures
Fire destruction and degradation of habitat	A	Ongoing	Partial, PTA fire management plan
Drought destruction and degradation of habitat	A	Ongoing	None
Climate change degradation or loss of habitat	A	Ongoing	None
Predation and herbivory by ungulates	C	Ongoing	Yes, all populations at PTA within exclosures
Predation and herbivory by invertebrates–scale	C	Ongoing	None
Lack of adequate hunting regulations	D	Ongoing	Partial, all populations at PTA within exclosures
Reduced viability due to low numbers	E	Ongoing	Partial, collection, storage, and reintroduction
Military activities	E	Ongoing	Partial, military activities monitored for effects to species

Synthesis:
Currently, there are six populations of *Kadua coriacea* totaling 147 individuals on the island of Hawai‘i. 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. coriacea* is highly vulnerable to the effects of climate change. All known wild and reintroduced individuals are provided protection from feral ungulates by fencing. Some nonnative plant control is ongoing within exclosures. Seed collection, propagation, and reintroduction are ongoing; however, there is very little natural recruitment.

Stabilizing (interim), downlisting, and delisting objectives were provided in the Recovery Plan for the Maui Plant Cluster (USFWS 1997), 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 coriacea is a short-lived perennial shrub. 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 islands of Hawai‘i and at least one other island (Maui, O‘ahu) where they now occur or occurred historically and each of these populations must be naturally reproducing (i.e., viable seeds, seedlings), with a minimum of 50 mature, reproducing individuals per population.

The preventing extinction goals for this species have not been met. There are no populations totaling 50 mature individuals and very little natural recruitment is observed (Table 1). Genetic representation is partially complete with at least 51 founders represented (Table 1). However, not all threats are being managed (Table 1, Table 2). Therefore, *Kadua coriacea* meets the definition of Endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:
There are no new threats or other significant new information regarding the species' biological status since the last 5-year review in 2015. Thus, the following recommendations for future actions are reiterated for the 5-year review for 2020.

- Surveys and inventories—Continue to survey geographical and historical range of *Kadua coriacea* for a current assessment of the species' status.

- Ungulate monitoring and control—Continue to construct, maintain, and monitor exclosures and remove any remaining ungulates from within to protect individuals from their negative impacts.
- Ecosystem-altering invasive plant monitoring and control—Continue to control nonnative invasive plant species and those that degrade and destroy habitat and that compete with *K. coriacea* within exclosures.
- Fire protection—Continue to improve and implement the fire management plan developed for PTA.
- Drought protection—Continue to monitor and control feral ungulates and nonnative plants to protect and increase vigor of *K. coriacea* during times of drought.
- Climate change adaptation strategy—Assess the modeled effects of climate change on this species and use to determine future landscape needed for its recovery.
- Predation and herbivory by invertebrates—Determine effects of invertebrates and develop and implement effective control methods within the vicinity of all known *K. coriacea* populations if necessary.
- Captive propagation for genetic storage and reintroduction—
    - Continue collection and propagation efforts for maintenance of genetic stock and for reintroduction into protected suitable habitat within historical range.
    - Expand locations of storage of genetic resources.
    - Assess the need for placing additional genetic resources into long-term storage due to this species' low natural recruitment and vulnerability to climate change.
- Reintroduction and translocation—Continue to establish new populations in historical (Maui, Oʻahu) and other suitable habitat, and augment wild populations on the island of Hawaiʻi.
- Population biology research—Carry out studies to determine possible causes for lack of natural recruitment.
- Alliance and partnership development—Continue to work with the U.S. Army Garrison at PTA and other partners and land managers in planning and implementation of ecosystem-level restoration and management to benefit this species.

References:

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[PTA] Pōhakuloa Training Area. 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.

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U.S. Army Garrison. 2013. Memorandum: FY 2012 annual report for the Natural Resources Office, Pōhakuloa Training Area, Island of Hawaii, Department of the Army, Headquarters, U.S. Army Garrison, Pōhakuloa, Hilo, HI 26 pp.

U.S. Army Garrison. 2020. 2019 annual report for Pōhakuloa Training Area, Hawai‘i Island, Hawai‘i. Recovery Permit TE-40123A-2. Prepared by Colorado State University, Center for Environmental Management and Military Lands. 190 pp.

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[USFWS] 2008. *Kadua coriacea* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. *https://ecos.fws.gov/docs/five_year_review/doc1818.pdf.*

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[USFWS] 2016. Endangered and threatened wildlife and plants; designation and nondesignation of critical habitat on Molokai, Lanai, Maui, and Kahoolawe for 135 species; final rule. 81 FR 17790, March 30, 2016.

[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.

U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of *Kadua coriacea*
(kio‘ele)

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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