

5-YEAR REVIEW

Short Form Summary

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

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2013. Endangered and threatened wildlife and plants; Initiation of 5-year status reviews of 44 species in Oregon, Hawaii, Guam, and the Northern Mariana Islands. Federal Register 78(24):8185-8187.

Lead Region/Field Office:

Region 1/Pacific Islands Fish and Wildlife Office (PIFWO), Honolulu, Hawaii

Name of Reviewer(s):

Chelsie Javar-Salas, Plant Biologist, PIFWO

Marie Bruegmann, Plant Recovery Coordinator, PIFWO

Kristi Young, Programmatic Deputy Field Supervisor, PIFWO

Methodology used to complete this 5-year 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 4, 2013. The review was based on a review of current, available information since the last 5-year review for *Kadua coriacea* (= *Hedyotis coriacea*) (USFWS 2008). The evaluation by Chelsie Javar-Salas, Plant Biologist, was reviewed by the Plant Recovery Coordinator. It was subsequently reviewed and approved by the Programmatic Deputy Field Supervisor.

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 at: http://ecos.fws.gov/tess_public.

Review Analysis:

Please refer to the previous 5-year review for *Kadua coriacea* (= *Hedyotis coriacea*) published on January 18, 2008 (available at: https://ecos.fws.gov/docs/five_year_review/doc1818.pdf) for a complete review of the species’ status, threats, and management efforts. No significant new information regarding the species’ biological status has come to light since listing to warrant a change in the Federal listing status of *K. coriacea*.

This short-lived perennial shrub is a member of the coffee family (Rubiaceae) and is an endangered taxon (USFWS 1997). Historically, *Kadua coriacea* was found on Oahu, Maui, and Hawaii Island (Wagner *et al.* 1999). At the time of the previous 5-year review, *K. coriacea* was known to occur at the U.S. Army’s Pohakuloa Training Area (PTA) on Hawaii Island and in the Lihau Natural Area Reserve (NAR) on Maui (USFWS 2008). However, the individual at Lihau was burned during a wildfire and died (PEPP 2008). The status and trends for *K. coriacea* are provided in the tables below. There are

currently no known occurrences of *K. coriacea* on Oahu (USFWS 2012a; Hawaii Biodiversity and Mapping Program 2008).

New taxonomic information:

- In 2012, USFWS revised the taxonomic status for this species when it revised critical habitat on Oahu, with no change in range or distribution (USFWS 2012a). This species is now listed as *Kadua coriacea* (formerly *Hedyotis coriacea*) and addressed as such for the remainder of this review.

New status information:

- At the time of the previous 5-year review, the wild population at PTA contained nine populations with 149 mature and 6 immature individuals (USFWS 2008). In 2009, there were 160 mature and 7 immature wild individuals at PTA (U.S. Army Garrison Pohakuloa [U.S. Army] 2010). In 2010, the population remained stable with 167 wild individuals of *Kadua coriacea* at PTA (162 mature and 5 immature), with two immature individuals advancing to the mature life stage (U.S. Army 2010). The 167 wild individuals are located within seven Areas of Species Recovery (ASR) managed by the U.S. Army (U.S. Army 2014).
- There are four reintroduction sites outside of PTA containing approximately 448 individuals of *Kadua coriacea* (U.S. Army 2015).
- Overall, the numbers of individuals have increased from the 156 wild individuals reported in the previous 5-year review to approximately 167 wild individuals in 2015. There are four reintroduction populations containing approximately 448 individuals.

New threats:

- Climate change destruction or degradation of habitat – Fortini *et al.* (2013) conducted a landscape-based assessment of climate change vulnerability for native plants of Hawaii 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 *K. coriacea* is moderately vulnerable to the impacts of climate change. Therefore, additional management actions are needed to conserve this taxon into the future.
- Stochastic events – Drought mortality or reduced viability – Drought may exacerbate the effects of ungulates and has direct adverse impacts on *K. coriacea* (U.S. Army 2014).

New management actions:

- Surveys / inventories
 - In 2010, no formal surveys were conducted for *K. coriacea*. However, a new plant was found near ASR 13 while conducting routine management activities (U.S. Army 2010).
 - From October 2011 to September 2013, approximately 84 locations of *K. coriacea* were found using the new installation-wide survey method that was developed to refresh plant location data over a 5-year cycle (U.S. Army 2014). In

- addition, an immature individual of *K. coriacea* was found during routine weed control activities (U.S. Army 2014).
- In 2014, surveys conducted in previously un-surveyed areas and previously surveyed areas discovered approximately eight locations of *K. coriacea* (U.S. Army 2015).
 - Ungulate monitoring and control
 - In 2010, the emergency fences were repaired in ASRs 18 (Kipuka Kalawamauna East Fence Unit), 21 (Naohuleelua Fence Unit), 29 (*Kadua coriacea* Fence Unit), and 30 (*Kadua coriacea* and Kipuka Alala Fence Units) at PTA (U.S. Army 2010). The emergency fences were constructed to protect individuals of *K. coriacea* inside large-scale fence units while ungulates were being removed from the units. These emergency fences will continue to be maintained and repaired until ungulates are removed (U.S. Army 2010). The *K. coriacea* fence unit (including ASR 29) was completed and ungulates removed during 2010. The perimeter of the western fence that includes the Naohuleelua fence unit was completed in 2010. Therefore, all known *K. coriacea* individuals are within large-scale fence units.
 - As of 2013, the Kipuka Kalawamauna East, Kipuka Alala, and *Kadua coriacea* Fence Units were ungulate-free meaning that less than three individual ungulates were observed since 2011 (U.S. Army 2014). The Naohuleelua Fence Unit of 1,626 hectares is pending ungulate removal (U.S. Army 2014).
 - Invasive plant monitoring and control
 - Annual weed control is conducted at PTA (U.S. Army 2010, 2014). In 2010, weed control buffers established in ASRs 11, 18, 21, and 22 were revisited but did not require maintenance spraying because of drought conditions and lack of weed regeneration (U.S. Army 2010). In addition, hand clearing is conducted in the proximity of each individual of *K. coriacea* (U.S. Army 2010).
 - In 2012 to 2013, within ASR 11 more than 28 acres of weeds were controlled to benefit *K. coriacea* (U.S. Army 2014). In addition, more than 20 acres were managed in ASR 18, three acres in ASRs 21 and 22, 17.5 acres in ASR 29, and 17.8 acres in ASR 30 (U.S. Army 2014).
 - Manual and chemical weed control occurred at State-owned reintroduction sites and the County-owned site (U.S. Army 2015).
 - Captive propagation for genetic storage and reintroduction
 - In 2010, approximately 1,200 seedlings were propagated and will be ready for reintroduction in 2011 and 2012 (U.S. Army 2010).
 - In 2013, the Pohakuloa Training Area (2013) had 116 seeds representing 4 individuals in storage and propagated 117 individuals for reintroductions at Puu Waawaa.
 - As of September 2014, there are a total of 290 accessions in storage at PTA including all 6 groups of *K. coriacea* and more than 36,000 seeds (U.S. Army 2014). These include the 131 accessions collected in 2009 and the 89 accessions collected in 2011 (U.S. Army 2014).
 - In 2015, there were more than 26,000 seeds in storage from 69 founders of *K. coriacea* at PTA (U.S. Army 2015).

- Captive propagation protocol development – Approximately half of the seeds of *K. coriacea* germinated readily (U.S. Army 2014). Seed longevity for *K. coriacea* is estimated at approximately nine years based on propagation trials at PTA (U.S. Army 2015).
- Reintroduction / translocation
 - Near Saddle Road on State of Hawaii property, 75 individuals were reintroduced in 2002 to 2012; none of these reintroductions were monitored in 2014 (US Army 2015).
 - On State-owned lands in North Kona, there were 85 individuals reintroduced during 2004 to 2009 with two individuals monitored in 2014 (U.S. Army 2015).
 - On State-owned land at Puu Waawaa, 231 individuals of *K. coriacea* were reintroduced during 2005 to 2012 (U.S. Army 2015). In 2014, 75 individuals was reintroduced to Puu Waawaa and 142 individuals were monitored (U.S. Army 2015).
 - On County lands in North Kona, nine individuals were reintroduced during 2008 and 2012 (US Army 2015). In 2014, 10 individuals of *K. coriacea* were reintroduced and 16 individuals were monitored (U.S. Army 2015).
- Population viability monitoring and analysis
 - In 2010, annual monitoring of the wild populations at PTA was conducted with supplemental monitoring conducted during May, June, and July 2010 (U.S. Army 2010). An assessment of vigor during the supplemental monitoring indicated that approximately a quarter of the plants were suffering from drought conditions that have persisted since the last substantial rain event that occurred in March 2009.
 - In 2014, a single individual naturally recruited from outplanted individuals at Puu Waawaa (U.S. Army 2015).
- Fire monitoring and control
 - In July 2012, a wildland fire occurred within the Kipuka Kalawamauna East Fence Unit and covered approximately 445 square meters (4,790 square feet) (U.S. Army 2014). The area was surveyed in August and no individuals of *K. coriacea* were affected, however; they were located approximately 255 meters (740 feet) from the burned area.
 - In November 2012, a wildland fire was ignited as a result of detonating an unexploded ordnance within the Kipuka Kalawamauna East Fence Unit and burned approximately 188 hectares (U.S. Army 2014). A post-fire survey was conducted from December 2012 to March 2013 to assess the impacts of the fire on federal-listed plant species. *Kadua coriacea* was located within and surrounding the burned area and may have been impacted by the fire but there was little to no impact on the distribution of the species (U.S. Army 2014). The specific impacts to the distribution of *K. coriacea* were not described in the report.
- Population biology research – Research on the genetics, pollinator(s), pollination, and reproductive biology of *K. coriacea* began in 2008 at PTA by a student from the University of Hawaii at Manoa (U.S. Army 2010). The U.S. Army did not provide results of the study in preceding reports.
- Listing and critical habitat designation

- Seven units of critical habitat were designated for *K. coriacea* on Oahu in the lowland mesic ecosystem (USFWS 2012a).
- Two units of critical habitat were proposed on Maui in the lowland dry ecosystem for *K. coriacea* (USFWS 2012b). The final rule for critical habitat designations has not been published at the time of this review.

Synthesis:

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for Maui plant cluster (USFWS 1997), based on whether the species is an annual, a short-lived perennial (fewer than 10 years), or a long-lived perennial. *Kadua coriacea* is a short-lived perennial, and to be considered stable, the taxon must be managed to control threats (e.g., fenced) and be represented in an *ex situ* (at other than the plant’s natural location, such as a nursery or arboretum) collection. In addition, a minimum of three populations should be documented on Maui and, if possible, at least one other island 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.

The interim stabilization goals for this species have not been met. Two of the seven ASRs (11 and 30) at PTA contain more than 50 mature individuals falls short of the required three populations (Table 1) (U.S. Army 2010). The outplanted populations on State-owned land may contribute to the interim stabilization goals for this species, however; improved monitoring data is needed to confirm the population status at these sites. In addition, all of the threats are not being sufficiently managed throughout all of the populations (Table 2). Therefore, *Kadua coriacea* meets the definition of endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

- Surveys / inventories – Survey geographical and historical range for a current assessment of the species’ status.
- Captive propagation for genetic storage and reintroduction
 - Continue collection of genetic resources for storage, propagation, and reintroduction into protected suitable habitat within historical range. Expand locations of genetic resources for storage.
 - Evaluate genetic resources currently in storage to determine the need to place additional genetic resources in long-term storage due to this species’ vulnerability to climate change.
- Ungulate monitoring and control – Maintain existing fences and continue removing ungulates from remaining fenced units to protect them from the impacts of feral ungulates.
- Invasive plant monitoring and control – Eradicate invasive introduced plants within ungulate exclosures and maintain exclosures free of invasive plants.
- Population viability monitoring and analysis – Continue monitoring wild and reintroduced individuals.
- Alliance and partnership development – Initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this taxon.

- Climate change adaptation strategy – Research the suitability of habitat for reintroducing this species in the future due to the impacts of climate change.

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

Date	No. wild indivs	No. outplanted	Stability Criteria identified in Recovery Plan	Stability 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
1998 (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)	150	160	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2008 (5-yr review)	156	85	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Partially
2015 (5-yr review)	167	~448	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No

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

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulates – degradation of habitat and herbivory	A, C, D, E	Ongoing	Partially, PTA is fenced but some areas are not ungulate-free
Invasive introduced plants	A, E	Ongoing	None
Military activities	A	Ongoing	Partially, ESA consultations at PTA
Invertebrate predation or herbivory – scale insects	C	Ongoing	None
Fire	E	Ongoing	None
Drought	E	Ongoing	None
Climate change	A, E	Increasing	None

References:

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

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. 141 pages.

Hawaii Biodiversity and Mapping Program. 2008. Hawaii species database. GIS shapefiles and database. Unpublished.

[PEPP] Plant Extinction Prevention Program. 2008. Plant Extinction Prevention Program annual report, fiscal year 2008 (July 1, 2007-June 30, 2008). Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii.

[U.S. Army] U.S. Army Garrison Pohakuloa. 2010. Natural Resources Program, annual report, Pohakuloa Training Area, Island of Hawaii. 01 October 2009 to 30 September 2010. U.S. Army Garrison Pohakuloa LTC Rolland C. Niles, Commanding December 2010. Prepared in cooperation with the Center for Environmental Management of Military Lands, Colorado State University. 147 pages.

[US Army] U.S. Army Garrison Pohakuloa. 2014. Natural Resources Office, biennial report, Pohakuloa Training Area, Island of Hawaii. 01 October 2011 to 30 September 2013. Prepared in cooperation with the Center for Environmental Management of Military Lands, Colorado State University. 166 pages.

- [U.S. Army] U.S. Army Garrison. 2015. FY 2014 annual report for the natural resources office, Pohakuloa Training Area, Island of Hawaii. 84 pages. 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. 1997. Recovery plan for Maui plant cluster. U.S. Fish and Wildlife Service, Portland, Oregon. 130 pages + appendices.
- [USFWS] U.S. Fish and Wildlife Service. 2008. *Hedyotis coriacea* (kio‘ele) 5-year review summary and evaluation. Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii. 13 pages.
- [USFWS] U.S. Fish and Wildlife Service. 2012a. Endangered and threatened wildlife and plants; endangered status for 23 species on Oahu and designation of critical habitat for 124 species; final rule. Federal Register 77(181):57648-57862.
- [USFWS] U.S. Fish and Wildlife Service. 2012b. Endangered and threatened wildlife and plants; listing 38 species on Molokai, Lanai, and Maui as endangered and designating critical habitat on Molokai, Lanai, Maui, and Kahoolawe for 135 species; proposed rule. Federal Register 77(112):34464-34775.
- Wagner, W.L., D. Herbst, and S.H. Sohmer. 1999. Manual of the flowering plants of Hawaii, revised edition. University of Hawaii Press, Bishop Museum Press, Special Publication 97. 1,918 pages.

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
- No Change in listing status

Appropriate Listing/Reclassification Priority Number, if applicable: _____

for
Programmatic Deputy Field Supervisor, Pacific Islands Fish and Wildlife Office

Mai M Buegmann

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