

5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Alectryon macrococcus* (mahoe)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2008. Endangered and threatened wildlife and plants; initiation of 5-year status reviews of 70 species in Idaho, Montana, Oregon, Washington, and the Pacific Islands. Federal Register 73(83):23264-23266.

Lead Region/Field Office:

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

Name of Reviewer(s):

Marie Bruegmann, Pacific Islands Fish and Wildlife Office, Plant Recovery Coordinator
Marilet A. Zablan, Pacific Islands Fish and Wildlife Office, Assistant Field Supervisor for Endangered Species

Jeff Newman, Pacific Islands Fish and Wildlife Office, Acting Deputy Field Supervisor

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 April 29, 2008. The review was based on final critical habitat designations for *Alectryon macrococcus* and other species from the islands of Kauai and Niihau, Molokai, Maui, Kahoolawe, and Oahu (USFWS 2003a, b, c, d) 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 Samuel Aruch, biological consultant, was reviewed by the Plant Recovery Coordinator. The document was then reviewed by the Assistant Field Supervisor for Endangered Species and Acting Deputy Field Supervisor before submission to the Field Supervisor for approval.

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).

Application of the 1996 Distinct Population Segment (DPS) Policy:

This Policy does not apply to plants.

Review Analysis:

Please refer to the final critical habitat designations for *Alectryon macrococcus* published in the Federal Register on February 27, March 18, May 14, and June 17 of 2003 (USFWS 2003a, b, c, d) for a complete review of the species' status (including biology and habitat), threats, and management efforts. No new threats and no significant new

information regarding the species biological status have come to light since listing to warrant a change in the Federal listing status of *A. macrococcus*.

Alectryon is endemic to the Hawaiian Islands, with two recognized varieties, var. *macrococcus* and var. *auwahiensis*. *Alectryon macrococcus* var. *macrococcus* is known from a number of sites on Kauai, Oahu, Molokai, and West Maui, while *A. macrococcus* var. *auwahiensis* is only known from East Maui and now has only one population remaining.

Observers on Oahu report that while a substantial percentage of the trees of this species flower, many never bear fruit. Fruit-bearing is substantially better in some populations than others, but the reasons for this are unclear. Several trees in cultivation which have been observed more closely did not flower until they were 15 years old and 20 feet high. Other demographic and life cycle information is still unknown (USFWS 2007).

At the time of listing in 1992 there were 9 individuals in one population of *Alectryon macrococcus* var. *auwahiensis* and 500 individuals of *Alectryon macrococcus* var. *macrococcus* between the islands of Maui, Molokai, Oahu, and Kauai (USFWS 1992).

Alectryon macrococcus var. *auwahiensis* has only one population remaining on private land in Auwahi, East Maui, on the southern slopes of Haleakala, with seven mature trees and no reproduction. One of these plants will be enclosed within the Kanaio Natural Area Reserve boundary fence when it is completed (H. Oppenheimer, Plant Extinction Prevention Program, pers. comm. 2008; Perlman 2008b.). K. R. Wood of the National Tropical Botanical Garden observed 12 trees in Auwahi in 1999 (Hawaii Biodiversity and Mapping Program 2007).

Alectryon macrococcus var. *macrococcus* now has approximately 330 individuals state-wide. Seventy-nine to 85 plants are thought to remain on Kauai on the western side of the island from Waimea Canyon to Kalalau Valley, primarily within the Kokee, Waimea Canyon, and Napali State Parks. These include approximately 30 individuals in Kawaiiki, 30 to 40 in Koaie Canyon, 3 in Haeleele, and at least 2 trees in Kalalau Valley (Perlman 2008a; Tangalin 2008; Wood 2008; USFWS 2007). Only 10 individuals are located on Molokai: 1 individual at Kahawai, 8 individuals from Kaunakakai to Kawela, and 1 individual in Makolelau (USFWS 2007).

West Maui has approximately 21 individuals. One individual each is left at Waikapu and Launiupoko Valley, 15 individuals at Haena Nui, and 2 individuals each at Iao Valley and Honokowai Ditch Trail (Wood 2008; USFWS 2007). On Oahu, *Alectryon macrococcus* var. *macrococcus* remains in its historical range in the Waianae Mountains, but is no longer present in the Koolau Mountains. In 1997, USFWS estimated up to 400 individuals existed throughout the Waianae mountain range at numerous sites (USFWS 1997). In 2007, the taxon totaled only about half that number: 46 individuals in Kahanahaiki to West Makaleha, 33 individuals in Makua, 6 individuals in South Mohiaka, 56 individuals in Central Kaluaa to Central Waieli, 68 individuals in Makaha, and 6 individuals in Waianae Kai, for a total of 213 trees, including some immature

individuals (US Army 2007). Over the last two years, numbers have declined even more: 36 individuals in Kahanahaiki to West Makaleha, 22 individuals in Makua, 4 individuals in South Mohiakea, 17 individuals in Central Kaluaa to Central Waieli, 70 individuals in Makaha, and no individuals in Waianae Kai, for a total of 168 individuals, including a few immature individuals (US Army 2009).

In Auwahi, East Maui, *Alectryon macrococcus* var. *auwahiensis* occurs in *Metrosideros polymorpha* (ohia lehua) - *Diospyros sandwicensis* (lama) montane mesic forest with *Alphitonia ponderosa* (kauila), *Chamaesyce* spp. (akoko), *Coprosma* spp. (pilo), *Melicope hawaiiensis* (alani), *Myrsine lessertiana* (kolea lau nui), *Ochrosia haleakalae* (holei), *Osteomeles anthyllidifolia* (ulei), *Pleomele auwahiensis* (halapepe), *Pouteria sandwicensis* (alaa), *Santalum* spp. (iliahi), *Streblus pendulinus* (ai ai), *Tetraplasandra oahuensis* (ohe mauka), and *Xylosma hawaiiense* (ae) (Perlman 1995).

Alectryon macrococcus var. *macrococcus* occurs on West Maui in upper Waikapu, along main stream, above the falls, in *Metrosideros polymorpha* mixed shrub lowland wet forest with *Boehmeria grandis* (akolea), *Cyanea* sp. (haha), *Freycinetia arborea* (ie ie), *Labordia tinifolia* (kamakahala), *Lysimachia hillebrandii* (kolokolo kuahiwi), *Peperomia* spp. (ala ala wai nui), *Pipturus albidus* (mamaki), *Pisonia* sp. (papala), *Psychotria mariniana* (kopiko), and *Wikstroemia* sp. (akia) (Wood 2008).

On Kauai in the Kalalau Valley below Kahuamaa Flat, *Alectryon macrococcus* var. *macrococcus* occurs at elevations of 518 to 610 meters (1,700 to 2,000 feet) in *Diospyros sandwicensis* mixed mesic forest on slopes below the cliffs. Associated species include *Antidesma platyphyllum* (hame), *Doodia kunthiana* (okupukupu), *Pouteria sandwicensis* (alaa), *Psychotria mariniana* (kopiko), *Pteralyxia kauaiensis* (kaulu), *Rauvolfia sandwicensis* (hao), and *Tetraplasandra kavaiensis* (ohe ohe) (Wood 2008).

Koaie has a *Metrosideros polymorpha* mixed mesic forest habitat with associated species including *Acacia koa* (koa), *Adiantum tenerum* (brittle maidenhair fern), *Aleurites moluccana* (kukui), *Bobea brevipes* (ahakea lau lili), *B. timonioides* (ahakea), *Cystopteris* sp. (no common name [NCN]), *Dodonaea viscosa* (aalii), *Diospyros sandwicensis* (lama), *Hibiscus waimeae* subsp. *waimeae* (kokio keokeo), *Ilex anomalum* (kawau), *Kokia kauaiensis* (kokio), *Sphenomeris chinensis* (palaa), *Streblus pendulinus* (ai ai), *Kadua affinis* (manono), *Melicope anisata* (mokihana), *M. haupeensis* (alani), *M. knudsenii* (alani), *Myrsine lanaiensis* (kolea), *Nesoluma polynesianum* (keahi), *Nestegis sandwicensis* (olopua), *Nototrichium sandwicense* (kului), *Perrottetia sandwicensis* (olomea), *Peucedanum sandwicense* (makou), *Pleomele* sp. (halapepe), *Pritchardia minor* (loulou), *Psychotria greenwelliae* (kopiko), *Pteralyxia kauaiensis* (kaulu), *Santalum* sp. (iliahi), *Sapindus* sp. (lonomea), *Senna gaudichaudii* (kolomona), *Tetraplasandra kavaiensis* (ohe ohe), *T. waimeae* (ohe kiko ola), and *Xylosma* spp. (NCN) (Tangalin 2008; Wood 2008).

On Oahu on the Makaha side of dividing ridge, west of Waianae Kai and north of Puu Kawiwi, separate from the site known as Pinnacles, *Alectryon macrococcus* var. *macrococcus* occurs on basalt mesic cliffs and forested slope at elevations of 732 to 792

meters (2,400 to 2,600 feet) with *Bidens torta* (kookoolau), *Carex meyenii* (NCN), *Carex wahuensis*, (NCN), *Diospyros* sp., *Dodonaea viscosa* (aalii), *Doodia kunthiana*, *Leptecophylla tameiameia* (pukiawe), *Polypodium pellucidum* (ae), and *Viola chamissoniana* (pamakani) (Wood 2008).

At Makaleha gulch below Mt. Kaala Road, *Alectryon macrococcus* var. *macrococcus* occurs in *Acacia koa* – *Metrosideros polymorpha* mesic forest with *Diospyros hillebrandii* (lama), *Melicope peduncularis* (alani), *Morinda trimera* (noni kuahiwi), *Psychotria hathewayi* (kopiko), and *Syzygium sandwicense* (ohia ha) (Wood 2008).

Threats to *Alectryon macrococcus* var. *auwahiensis* include fire (Factor E); habitat degradation by deer (*Axis axis*), pigs (*Sus scrofa*), goats (*Capra hircus*), and cattle (*Bos taurus*) (Factors A, C, and D); predation by rats (*Rattus* spp.) (Factor C); and competition from invasive introduced plant species such as *Pennisetum clandestinum* (kikuyu grass), *Lantana camara* (lantana), *Bocconia frutescens* (NCN), and *Schinus terebinthifolius* (Christmas berry) (Factor E) (H. Oppenheimer, pers. comm. 2008.)

Threats to *Alectryon macrococcus* var. *macrococcus* include habitat degradation and herbivory by goats and pigs (Factors A, C, and D); predation by black twig borer (*Xylosandrus compactus*) and rats (*Rattus* spp.) (Factor C); and competition from invasive introduced plant species *Bryophyllum pinnatum* (air plant), *Buddleia asiatica* (dog tail butterfly bush), *Erigeron karvinskianus* (daisy fleabane), *Grevillea robusta*, *Lantana camara* (lantana), *Melia azedarach* (pride-of-India), *Paspalum urvillei* (Vasey grass), *Rubus argutus* (prickly Florida blackberry), *Schinus terebinthifolius* (Christmas berry), *Setaria parviflora* (yellow foxtail), and *Triumfetta semitriloba* (Sacramento burr) (Factor E) (Perlman 2008a; Tangalin 2008; Wood 2008; Plant Extinction Prevention Program 2007). The groundcover in Koaie consists of 50 percent *Bryophyllum pinnatum* and *Lantana camara* (Tangalin 2008) (Factor E). Goats are a major threat to this population (Factor A, C, and D) (Wood 2008). In Kalalau, threats include landslides, fire (Factor E), goats (Factors A, C, and D), rats (Factor C), and invasive introduced plant species such as *Lantana camara*, *Erigeron karvinskianus*, *Bryophyllum pinnatum*, and *Psidium guajava* (guava) (Factor E) (Wood 2008). Climate change may also pose a threat to this species (Factors A and E). However, current climate change models do not allow us to predict specifically what those effects, and their extent, would be for this species.

Other threats in some localities on Oahu are rock slides and fire (Factor E) (US Army 2007; Wood 2008).

Goats, cattle, and deer may browse this species, and rats are known to eat the seeds. Rat control is conducted around some of the Auwahi trees, as well as by Army Environmental personnel at some of the Oahu sites. Bagging of fruit may help protect seed from rats. Black twig borer (*Xylosandrus compactus*) is very damaging to both varieties of this species, and research is being conducted to find better control methods. In addition to twig borer, larvae of another unknown seed predator have been observed to destroy seeds (US Army 2006).

Army Environmental staff on Oahu have increased the number of plants that are fenced and protected from rats, and have continued work on twig borer biocontrol. More propagation by air-layering has been attempted (US Army 2009).

Conservation measures have been considerable, but with limited success. *Alectryon macrococcus* var. *macrococcus* seedlings have almost never been observed in the wild or at reintroduction sites. Collection for storage and propagation is a challenge, needing intermediate *inter-situ* or *ex situ* plantings to facilitate seed collection. Seeds are believed to be intermediate between recalcitrant and orthodox, and do not seem to store well. Micropropagation has been successful, but is not a good means of long-term storage (US Army 2006).

Seeds were collected recently by the Plant Extinction Prevention Program from one individual of *Alectryon macrococcus* var. *auwahiensis* for propagation at the Hawaii Olinda Rare Plant Facility (H. Oppenheimer, pers. comm. 2008.).

The National Tropical Botanical Garden has 92 seeds in storage (National Tropical Botanical Garden 2009). The Harold L. Lyon Arboretum Micropropagation Laboratory has one plant in storage from Lower Makua, Oahu (Harold L. Lyon Arboretum Micropropagation Laboratory 2009). The Center for Conservation Research and Training has 33 seeds in storage (Center for Conservation Research and Training 2008). The Waimea Arboretum has one plant in their nursery (Waimea Arboretum 2008). The US Army has five individuals represented in their nursery and reintroduced seven individuals (US Army 2009).

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for the Maui plant cluster (USFWS 1997), based on whether the species is an annual, a short-lived perennial (fewer than ten years), or a long-lived perennial. *Alectryon macrococcus* is a long-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* (at other than its original site, *e.g.*, a nursery) 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 25 mature individuals per population.

The interim stabilization goals for this species have not been met as only two populations on Oahu have more than 25 mature wild individuals. In addition, not all threats have been managed and the species does not appear to be naturally reproducing (see Table 1). Therefore, *Alectryon macrococcus* meets the definition of endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

- Continue collection of seeds and propagation for reintroduction, using hand pollination of flowers to increase seed set, where possible.
- Continue research on methods to control the black twig borer.
- Continue research to find the best seed storage methods and to identify and control other seed predator insects.
- Continue fencing, removal of invasive introduced plant species, and control of rats at wild populations.
- Work with U.S. Army, 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.

References:

- Center for Conservation Research and Training Seed Storage Laboratory. 2008. Database. Unpublished.
- Harold L. Lyon Arboretum Micropropagation Laboratory. 2009. Micropropagation database. University of Hawaii at Manoa, Honolulu, Hawaii. Unpublished.
- Hawaii Biodiversity and Mapping Program. 2007. Program database. University of Hawaii, Center for Conservation, Research and Training. Unpublished.
- National Tropical Botanical Garden. 2009. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. Unpublished.
- Plant Extinction Prevention Program. 2007. Maui Nui program database. University of Hawaii at Manoa, Honolulu, Hawaii. Unpublished.
- Perlman, S. 1995. *Alectryon macrococcus* var. *auwahiensis*, NTBG # 950101. In living collections database. National Tropical Botanical Garden, Kalaheo, Hawaii. Unpublished.
- Perlman, S. 2008a. Field notes summary for *Alectryon macrococcus* var. *macrococcus*. National Tropical Botanical Garden, Kalaheo, Hawaii. 4 pages. Unpublished.
- Perlman, S. 2008b. Summary of field notes and maps, *Alectryon macrococcus* var. *auwahiensis*. National Tropical Botanical Garden, Kalaheo, Hawaii. 2 pages. Unpublished.

- Tangalin, N. 2008. Field notes on *Alectryon macrococcus* var. *macrococcus*. National Tropical Botanical Garden, Kalaheo, Hawaii. 1 page. Unpublished.
- [US Army] U.S. Army Garrison. 2006. 2006 Status reports for the Makua implementation plan and the draft Oahu implementation plan. U.S. Army Garrison, Directorate of Public Works Environmental Division, Schofield Barracks, Hawaii.
- [US Army] U.S. Army Garrison. 2007. 2007 Status reports for the Makua implementation plan and the draft Oahu implementation plan. U.S. Army Garrison, Directorate of Public Works, Environmental Division, Schofield Barracks, Hawaii.
- [US Army] U.S. Army Garrison. 2009. 2009 Status reports for the Makua and Oahu implementation plans. U.S. Army Garrison, Directorate of Public Works, Environmental Division, Schofield Barracks, Hawaii.
- [USFWS] U.S. Fish and Wildlife Service. 1992. Endangered and threatened wildlife and plants; determination of endangered or threatened status for 15 plants from the island of Maui; final rule. Federal Register 57(95):20772-20788.
- [USFWS] U.S. Fish and Wildlife Service. 1997. Recovery plan for the Maui plant cluster. U.S. Fish and Wildlife Service, Portland, Oregon. 198 pages + appendices.
- [USFWS] U.S. Fish and Wildlife Service. 2003a. Endangered and threatened wildlife and plants; final designation or nondesignation of critical habitat for 95 plant species from the islands of Kauai and Niihau, Hawaii; final rule. Federal Register 68(39):9116-9479.
- [USFWS] U.S. Fish and Wildlife Service. 2003b. Endangered and threatened wildlife and plants; final designations and nondesignations of critical habitat for 42 plant species from the island of Molokai, Hawaii; final rule. Federal Register 68(52):12982-13141.
- [USFWS] U.S. Fish and Wildlife Service. 2003c. Endangered and threatened wildlife and plants; designation of critical habitat for 60 plant species from the islands of Maui and Kahoolawe, Hawaii; final rule. Federal Register 68(93):25934-26165.
- [USFWS] U.S. Fish and Wildlife Service. 2003d. Endangered and threatened wildlife and plants; final designation or nondesignation of critical habitat for 101 plant species from the island of Oahu, Hawaii; final rule. Federal Register 68(116):35949-35998.

[USFWS] U.S. Fish and Wildlife Service. 2007. Reinitiation of the 1999 biological opinion of the U.S. Fish and Wildlife Service for U.S. Army military training at Makua Military Reservation, island of Oahu.

Waimea Arboretum. 2008. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. Unpublished

Wood, K.R. 2008. Phytogeographical notes - *Alectryon macrococcus* var. *macrococcus* (Sapindaceae). National Tropical Botanical Garden, Kalaheo, Hawaii. 5 pages. Unpublished.

Personal communications:

Oppenheimer, Hank. 2008. Maui Nui Plant Extinction Prevention Program Manager. E-mail to Margaret Clark, National Tropical Botanical Garden, dated July 29, 2008. Subject: *Alectryon macrococcus* var. *auwahiensis*.

Table 1. Status of *Alectryon macrococcus* from listing through 5-year review.

Date	No. wild indivs.	No. outplanted	Stability Criteria identified in Recovery Plan	Stability Criteria Completed?
1992 (listing)	500	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 25 mature individuals each	No
1997 (recovery plan)	500	0	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 25 mature individuals each	No
2003 (critical habitat)	500-515	0	All threats managed in all 3 populations	No
			Complete genetic storage	Partially
			3 populations with 25 mature individuals each	Partially
2009 (5-year review)	337	2	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Partially

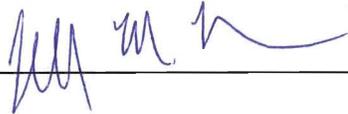
U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of *Alectryon macrococcus* (mahoe)

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

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



Date AUG 27 2010