5-YEAR REVIEW
Short Form Summary
Species Reviewed: *Canavalia molokaiensis* (awikiwki)
Current Classification: Endangered

Federal Register Notice 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.

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

Name of Reviewer(s):
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Assistant Field Supervisor for Endangered Species, 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 16, 2009. The review was based on final critical habitat designations for *Canavalia molokaiensis* and other species from the island of Molokai (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 Samuel Aruch, 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.

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 *Canavalia molokaiensis* published in the Federal Register on March 18, 2003 (USFWS 2003) 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 *C. molokaiensis*.

At the time of listing in 1992 there were 7 known populations with an estimated total of 50 individuals of *Canavalia molokaiensis* (USFWS 1992). Currently, *C. molokaiensis* is found in 10 populations totaling approximately 175 individuals.

Historically, *Canavalia molokaiensis* was known from East Molokai, at Kalaupapa, Pelekunu, and farther south in Kahuaawi Gulch and the region of Manawai (USFWS 1992). It was more restricted in range in 1996, from Kalaupapa to Waialeia, Kaunakakai, and Kamakou (USFWS 1996). In 1979, *C. molokaiensis* was observed in Kaunakakai Gulch's north fork at 719 meters (2,360 feet) elevation during bird survey work (Hawaii Biodiversity and Mapping Program 2009). In 1982, it was observed in the west fork of Kawela Gulch on the east side at 933 meters (3,060 feet) elevation in a patch six by 12 meters (20 by 40 feet) across (Hawaii Biodiversity and Mapping Program 2009). Observations in 1989 from Kalaupapa National Historical Park record *C. molokaiensis* at the east side of the mouth of Waialeia Stream at 9.1 to 14 meters (30 to 45 feet) elevation, and from Keanakua between the mouth of Waialeia and Waikolu Valley at 3 to 61 meters (10 to 200 feet) elevation. It has not been observed there since that time (Hawaii Biodiversity and Mapping Program 2009). Plants observed in 1953 on the Kalaupapa Trail and on Kalaupapa Beach were not observed since (Hawaii Biodiversity and Mapping Program 2009). Another plant observed from 1989 at Kamiloloa Gulch between Puu Makaliilii and Kaulahuki at 914 to 945 meters (3,000-3,100 feet) elevation has apparently not been observed since (Hawaii Biodiversity and Mapping Program 2009).

In 1992, a single individual of *Canavalia molokaiensis* was observed in the Kawailena Drainage of the Nature Conservancy's Pelekunu Preserve on Molokai at 579 meters (1,900 feet) elevation (Hawaii Biodiversity and Mapping Program 2009).

About 100 individuals of *Canavalia molokaiensis* were seen growing in the canopy trees on the west side of Kua Gulch drainage below and east of Kamakou, Molokai at 777 to 823 meters (2,550 to 2,700 feet) elevation in 1997 (Wood 2009). About 10 individual vines were seen in 2002 at 781 meters (2,562 feet) elevation on the west slope of Kua, in the back of the gulch, and more east of Kua on the top of a ridge at 821 meters (2,694 feet) elevation (Perlman 2009).

Steve Perlman of the National Tropical Botanical Garden observed up to 30 individuals of *Canavalia molokaiensis* in Kupaia Gulch, off Makakupaia Road, near where Kupaia Gulch has a junction with Kaunakakai Gulch, between 792 and 908 meters (2,600 and 2,980 feet) elevation from 1990 to 1999 (Hawaii Biodiversity and Mapping Program 2009; Perlman 2009). Ten to 20 individuals were observed in 2001 at 896 meters (2,940 feet) elevation (Perlman 2009). This cluster of vines, consisting of 1 to 3 individuals, was revisited in 2009 (Tangalin 2009).

Between 5 and 10 vines were seen in 2001 on Molokai's north coast, at Waiehu, west of Wailau; in coastal forest above Waiehu shelf on the back slope at 104 meters (340 feet) elevation (Hawaii Biodiversity and Mapping Program 2009; Perlman 2009). Ten

individuals were also seen in 2001 at Wailua above the cliffs towards Olokui at 625 meters (2,050 feet) elevation (Hawaii Biodiversity and Mapping Program 2009).

About 4 individuals were observed in 2008 at Puu O Kaeha, in West Kawela Gulch (Perlman 2009). About 15 wild individuals are known from Kukaiwaa where they have been collected since 2002 (W. Garnett, Wiliwili Rare Plant Nursery, pers. comm. 2009). Natalia Tangalin of the National Tropical Botanical Garden collected propagules in 2009 from 6 individuals in Mokomoko Gulch, 1 to 4 individuals in one patch in Upper Kupaia Gulch, and approximately 10 individuals at the Waialeia Stream mouth (Tangalin 2009; N. Tangalin, National Tropical Botanical Garden, pers. comm. 2010).

At Kua Gulch, Kamakou, the habitat is *Metrosideros waialealae* var. *fauriei* (ohia) – *Dicranopteris linearis* (uluhe) – *Nestegis sandwicensis* (olopua) lowland mesic to wet forest characterized by steep drainage walls with *Alyxia stellata* (maile), *Bobea elatior* (akahea lau nui), *Cyanea angustifolia* (haha), *Dodonaea viscosa* (aalii), *Doodia* sp. (okupukupu), *Labordia triflora* (kamakahala), *Leptecophylla tameiameiae* (pukiawe), *Mariscus fauriei* (no common name [NCN]), *Melicope peduncularis* (alani), *Myrsine lanaiensis* (kolea), *M. lessertiana* (kolea lau nui), *Nephrolepis multiflora* (NCN), *Neraudia sericea* (maaloa), *Panicum tenuifolium* (mountain pili), *Pipturus* sp. (mamake), *Pisonia* sp. (papala kepau), *Pleomele auwahiensis* (hala pepe), *Psychotria mariniana* (kopiko), *Sadleria cyatheoides* (amau), *Stenogyne bifida* (NCN), *Urera glabra* (opuhe), *Wikstroemia oahuensis* (akia), and *Xylosma hawaiiense* (maua) (National Tropical Botanical Garden 2009a; Perlman 2009; Wood 2009, Wood and Perlman 2002).

At Kupaia, the habitat is *Metrosideros polymorpha* (ohia) – *Diospyros* sp. (lama) – *Leptecophylla tameiameiae* mesic forest and shrubland with *Alyxia stellata*, *Chamaesyce celastroides* (akoko), *Coprosma* sp. (pilo), *Dodonaea viscosa*, *Dubautia linearis* (naenae), *Kadua affinis* (manono), *Leptecophylla tameiameiae*, *Melicope hawaiiensis* (mokihana kukae moa), *Myrsine lanaiensis*, *Osteomeles anthyllidifolia* (ulei), *Pittosporum confertiflorum* (hoawa), *Pleomele auwahiensis*, *Psychotria* sp., *Psydrax odorata* (alahee), *Pteridium aquilinum* var. *decompositum* (kilau), *Scaevola chamissoniana* (naupaka kuahiwi), *S. gaudichaudii* (naupaka kuahiwi), *Vaccinium* sp. (ohelo), and *Wikstroemia oahuensis* (National Tropical Botanical Garden 2009b; Perlman 2009).

At Puu O Kaeha, in West Kawela Gulch, the habitat is *Metrosideros polymorpha* – *Dicranopteris linearis* mesic forest with *Cibotium* sp. (hapuu) and *Broussaisia arguta* (kanawao) (Perlman 2009). In Waiehu, the habitat is *Diospyros sandwicensis* – *Metrosideros polymorpha* coastal mesic forest with associated native species that include *Alyxia stellata*, *Bidens molokaiensis* (kookoolau), *Chamaesyce celastroides* var. *amplectens*, *Dodonaea viscosa*, *Kadua acuminata* (au), *Kadua affinis*, *Eragrostis variabilis* (kawelu), *Pittosporum glabrum* (hoawa), *Pleomele auwahiensis*, *Psychotria albidus*, *Rauvolfia sandwicensis* (hao), *Reynoldsia sandwicensis* (ohe makai), and *Xylosma hawaiiense* (National Tropical Botanical Garden 2009b).

At Wailau, the habitat is *Metrosideros polymorpha – Dicranopteris linearis* lowland wet forest with *Alyxia stellata*, *Antidesma platyphylla* (hame), *Broussaisia arguta*, *Cheirodendron trigynum*, *Cibotium glaucum*, *Cyanea solenocalyx*, *Cyrtandra grayi* (keokeo haiwale), *C. grayana* (keokeo haiwale), *C. lydgatei* (keokeo haiwale), *Deparia prolifera* (NCN), *Freycinetia arborea* (ie ie), *Ilex anomala* (kawau), *Labordia hedyosmifolia* (kamakahala), *Mecodium recurvum* (ohia ku), *Psychotria mariniana*, *Nothocestrum longifolium* (aeia), *Tetraplasandra oahuensis* (ohe mauka), *Pneumatopteris sandwicensis* (hoio kula), *Touchardia latifolia* (olona), and *Vandenboschia davallioides* (palai hihi) (Hawaii Biodiversity and Mapping Program 2009).

At Mokomoko Gulch, the habitat is *Metrosideros polymorpha* mixed mesic forest with *Alyxia stellata*, *Antidesma platyphyllum*, *Bobea elatior*, *Dicranopteris linearis*, *Dodonaea viscosa*, *Ochrosia compta* (holei), *Cyanea mannii* (haha), *Scaevola chamissoniana*, *Leptecophylla tameiameiae*, *Psychotria mariniana*, *Coprosma* sp., *Carex* spp. (NCN), *Pleomele auwahiensis*, *Pittosporum glabrum*, and *Viola chamissoniana* subsp. *robusta* (pamakani) (Tangalin 2009).

At Mokomoko, Kua, and Waiehu, deer (*Axis axis*), goats (*Capra hircus*), and pigs (*Sus scrofa*) are very abundant (Listing Factors A and D), which contributes to habitat degradation and landslides (Listing Factor E). Invasive introduced plant species that compete with natives and degrade *C. molokaiensis* habitat include *Ageratina adenophora* (sticky snake root), *Buddleia asiatica* (dog tail), *Clidemia hirta* (Koster's curse), *Cordyline fruticosa* (ti), *Bryophyllum pinnatum* (airplant), *Lantana camara* (lantana), *Melinis minutiflora* (molasses grass), *Psidium cattleianum* (strawberry guava), *Rubus rosifolius* (thimbleberry), and *Schinus terebinthifolius* (Christmasberry) (Listing Factors A and E) (Hawaii Biodiversity and Mapping Program 2009; Perlman 2009; Tangalin 2009; Wood 2009). At Mokomoko, *Erigeron karvinskianus* (daisy fleabane), which blankets and outcompetes seedlings, is especially dense (Tangalin 2009). At Kupaia, the threats are introduced invasive plants including *Pinus* sp. (pine), *Melinis minutiflora*, *Casuarina* sp. (ironwood), and *Psidium cattleianum* (Listing Factor E). Kupaia also has the threats of pigs, deer, and goats (Listing Factors A and D) and has had several forest fires (Listing Factor E) (Perlman 2009; Tangalin 2009).

Goats and rats (*Rattus* spp.) may consume this species (Listing Factor C) (Perlman 2009; Tangalin 2009; USFWS 1996). Climate change may also pose a threat to this species (Listing Factors A and E). 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.

Reintroductions and outplantings have been made at the top of the Kalaupapa Trail (28 individuals), on the fences around the Kalaupapa Nursery, at Waihanau (4 individuals), in the Kalaupapa settlement (11 individuals), and at Kauaiwaa and Papapaiki near Huelo Rock (33 individuals), which is fenced (W. Garnett, pers. comm. 2010). The National

Tropical Botanical Garden has 323 seeds in storage from 5 populations (National Tropical Botanical Garden 2010). The Lyon Arboretum has 19 seeds in storage (Harold L. Lyon Arboretum Micropropagation Laboratory 2009).

In 2009, $1 million in funds from the federal Department of Interior's Cooperative Endangered Species Conservation Fund is being used on Molokai to help acquire a perpetual conservation easement over 248 hectares (614 acres) of strategic watershed on the eastern end of the island. This property has several federally listed threatened or endangered species as well as critical habitat in and around the proposed easement area. Among federally listed species benefiting from this protection are *Bidens wiebkei* (kookoolau), *Canavalia molokaiensis* (awikiwiki), *Canavalia molokaiensis* (kokio keokeo), *Brighamia rockii* (puaala), *Cyanea dunbariae* (haha), *Gardenia brighamii* (nanu), *Pritchardia munroi* (loulu), and *Phyllostegia hispida* (USFWS 2009; C. Rowland, USFWS, pers. comm. 2010).

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for the Molokai pant cluster (USFWS 1996), based on whether the species is an annual, a short-lived perennial (fewer than ten years), or a long-lived perennial. *Canavalia molokaiensis* 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. 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 as no population has more than 50 mature wild individuals (Table 1), and not all threats have been managed (Table 2). Therefore, *Canavalia molokaiensis* meets the definition of endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

- Continue protection from feral ungulates.
- Continue removal of invasive introduced plant species.
- Collect propagules for propagation and genetic storage.
- Propagate for reintroduction to augment existing populations.
- Establish additional populations within protected habitat.
- 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.

- Assess the modeled effects of climate change on this species, and use to determine future landscape needed for the recovery of the species.

References:

Harold L. Lyon Arboretum Micropropagation Laboratory. 2009. Micropropagation database. University of Hawaii at Manoa. Unpublished.

Hawaii Biodiversity and Mapping Program. 2009. Program database. University of Hawaii, Center for Conservation, Research and Training. Accessed on 10 October 2009.

National Tropical Botanical Garden. 2009a. Herbarium database. National Tropical Botanical Garden, Kalaheo, Hawaii. Accessed on 10 October 2009.

National Tropical Botanical Garden. 2009b. Living collections database. National Tropical Botanical Garden, Kalaheo, Hawaii. Accessed on 10 October 2009.

National Tropical Botanical Garden. 2010. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. National Tropical Botanical Garden, Kalaheo, Hawaii. 45 pages. Unpublished.

Perlman, S. 2009. *Canavalia molokaiensis*. National Tropical Botanical Garden, Kalaheo, Hawaii. 3 pages. Unpublished.

Tangalin, Natalia. 2009. *Canavalia molokaiensis*. National Tropical Botanical Garden, Kalaheo, Hawaii. 3 pages. Unpublished.

Wood, K. R. 2009. Notes on *Canavalia molokaiensis*. National Tropical Botanical Garden, Kalaheo, Hawaii. 1 page. Unpublished.

Wood, K. R., and S. Perlman. 2002 Personal observations of the Kumueli-Wawaia region Molokai, Hawaii including a checklist of vascular plants. Special report prepared for The Nature Conservancy of Hawaii. National Tropical Botanical Garden, Kalaheo, Hawaii. 17 pages.

[USFWS] U.S. Fish and Wildlife Service. 1992. Endangered and threatened wildlife and plants; determination of threatened or endangered status for 16 plants from the island of Molokai, Hawaii; final rule. Federal Register 57(196):46325-46340.

[USFWS] U.S. Fish and Wildlife Service. 1996. Recovery plan for the Molokai plant cluster. U.S. Fish and Wildlife Service, Portland, Oregon. 143 pages.

[USFWS] U.S. Fish and Wildlife Service. 2003. 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. 2009. Press Release: Fish and Wildlife Service provides $1 million in land acquisition funds to Hawaii. Honolulu, Hawaii. April 17, 2009.

Personal communications:

Garnett, William. 2009. Williwilli Rare Plant Nursery. Interview with Margret Clark, National Tropical Botanical Garden, dated November 22, 2009.

Garnett, William. 2010. Williwilli Rare Plant Nursery. E-mail to Marie Bruegmann, USFWS, dated February 4, 2010. Subject: Outplanting data.

Rowland, Craig. 2010. U.S. Fish and Wildlife Service. E-mail to Marie Bruegmann, USFWS, dated April 16, 2010. Subject: Additional information on status of Molokai easement.

Table 1. Status of *Canavalia molokaiensis* from listing through 5-year review.

Date	No. wild indivs	No. outplanted	Stability Criteria identified in Recovery Plan	Stability Criteria Completed?
1992 (listing)	~ 50	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
1996 (recovery plan)	< 1000	Unknown	All threats managed in all 3 populations	No
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2003 (critical habitat)	>50	Unknown	All threats managed in all 3 populations	No
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2010 (5-year review)	~ 175	76	All threats managed in all 3 populations	No (Table 2)
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No: there are no populations with 50 mature individuals

Table 2. Threats to *Canavalia molokaiensis*.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulates – habitat modification and herbivory	A, D	Ongoing	No
Rats – herbivory	C	Ongoing	No
Invasive introduced plants	A, E	Ongoing	No
Climate change	A, E	Increasing	No

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SIGNATURE PAGE for 5-YEAR REVIEW of *Canavalia molokaiensis* (awikiwiki)

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

Field Supervisor, Pacific Islands Fish and Wildlife Office

Date 6/3/11