

5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Bonamia menziesii* (no common name)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2010. Endangered and threatened wildlife and plants; initiation of 5-year status reviews of 58 species in Washington, Oregon, California, and Hawaii. Federal Register 75(226):71726-71729.

Lead Region/Field Office:

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

Name of Reviewer(s):

Vickie Caraway, Plant Biologist, PIFWO

Daniel Clark, Oahu, Kauai, Northwest Hawaiian and American Samoa Islands Team
Manager, PIFWO

Marie Brueggemann, Plant Recovery Coordinator, PIFWO
Recovery Program Lead, 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 January 31, 2012. The review was based on a review of current, available information since the last five-year review for *Bonamia menziesii* (USFWS 2010). The National Tropical Botanical Garden provided an initial draft of portions of the five-year review and recommendations for conservation actions needed prior to the next five-year review. The document was reviewed by the Plant Biologist, Islands Team Manager, and Plant Recovery Coordinator, followed by the Recovery Program Lead. 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 (http://ecos.fws.gov/tess_public).

Review Analysis:

Please refer to the previous 5-year review for *Bonamia menziesii* published on August 2, 2007 (available at http://ecos.fws.gov/docs/five_year_review/doc3324.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 *B. menziesii*.

This short-lived perennial vine is endangered and occurs or occurred historically on the islands of Hawaii, Oahu, Lanai, Kauai, and Maui. The current status and trends for *Bonamia menziesii* are provided in the tables below.

New status information:

In addition to those populations cited in the last five year review, new observations include the following:

- Monitoring on Lanai in the last year by the Plant Extinction Prevention Program (PEPP) found the four previously known plants have since died; however, it is believed that a seed bank still exists at Ahakea (H. Oppenheimer, PEPP, pers. comm. 2011).
- On West Maui, several individuals were found in the Honokowai Gulch in The Nature Conservancy's (TNC) Kapunakea Preserve where only two individuals were last seen in 2008 (Perlman 2011).
- An additional plant was observed in Kapunakea area on Maui (H. Oppenheimer, Maui Plant Extinction Prevention Program [PEPP], pers. comm. 2011); an individual seen at this location years ago has not been relocated, probably displaced by *Schinus terebinthifolius* (Christmasberry) (Pat Bily, TNC, pers. comm. 2011).
- A few individuals are growing in the Kahikinui Forest Reserve on Maui, above Lualailua, in a location previously not reported (B. Stevens, Department of Land and Natural Resources – Division of Forestry and Wildlife, pers. comm. 2011; J. Higashino, USFWS, pers. comm. 2012; K. Bustamente, Maui PEPP, pers. comm. 2012).
- On East Maui, Puu o Kali lava flows, the population has increased from two to several large individuals (A. Medeiros, U.S. Geological Survey, pers. comm., 2011).
- On Kauai, one individual not reported in the 2010 five-year review was observed in Mahanaloa in 2009, just above of one of the monitoring fences at 693 meters (2,275 feet elevation) in *Metrosideros polymorpha* – *Diospyros sandwicensis* (ohia – lama) mixed mesic forest. The associated native species were *Aleurites moluccana* (kukui), *Alyxia stellata* (maile), *Carex meyenii* (no common name [NCN]), *Diospyros* sp. (lama), *Euphorbia haelealeana* (NCN), *Isodendron laurifolium* (aupaka), *Melicope ovata* (alani), *Pisonia sandwicensis* (kaulu), *Pleomele* sp. (halapepe), *Schiedea kauaiensis* (NCN), *Xylosma hawaiiense* (ae), and *Zanthoxylum dipetalum* (kawau), with invasive introduced species including *Adiantum hispidulum* (rough maidenhair fern), *Blechnum appendiculatum* (no common name), *Bryophyllum pinnatum* (airplant), and *Lantana camara* (lantana) (N. Tangalin, National Tropical Botanical Garden [NTBG], pers. comm. 2011; M. DeMotta, NTBG, pers. comm. 2011).
- On Kauai, an individual was seen on Mount Kahili in August 2013 (NTBG 2013).

Overall, the numbers of individuals have changed little from 138-141 reported in the previous five-year review, to approximately 150 in 2013. The population on Lanai has disappeared but additional populations of one to two individuals have been discovered on

Kauai and Maui giving a population count of approximately 32 in 2013. Many populations have not been thoroughly surveyed recently.

New threats:

- Climate change – Climate change may pose a threat to this species. 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) funded climate modeling that will help resolve these spatial limitations. High spatial resolution climate outputs are expected in 2013.
- Ungulate degradation of habitat – For Maui, axis deer (*Axis axis*) populations have increased in the lowland dry habitat of *Bonamia menziesii* (P. Bily, pers. comm. 2011). Threats for the newly reported Mahanaloa population on Kauai include mule deer (*Odocoileus hemionus* subsp. *hemionus*) (N. Tangalin, pers. comm. 2011; M. DeMotta, pers. comm. 2011).
- Drought – Drought may exacerbate the effect of ungulates, and has direct adverse impacts on the *B. menziesii* individuals themselves (C. Chimera, Maui Invasive Species Committee, pers. comm. 2011).
- Landslides and flooding - Threats for the newly reported Mahanaloa population on Kauai erosion (N. Tangalin, pers. comm. 2011; M. DeMotta, pers. comm. 2011).
- Lack of reproduction – Finding mature seed of *Bonamia menziesii* has been difficult (P. Bily, pers. comm., 2011).

New management actions:

- Ungulate exclosures:
 - Maui's Kanaio Natural Area Reserve (NAR) boundary fence is expected to be completed by the end of 2013, which will enclose all of the wild plants within the reserve (B. Stevens, Hawaii Division of Forestry and Wildlife, pers. comm. 2011).
 - A portion of the Kahikinui Forest Reserve is proposed for inclusion in the State of Hawaii Natural Area Reserve System as the Nakula NAR, increasing the protection of *Bonamia menziesii* located there (B. Stevens, pers. comm. 2011; J. Higashino, USFWS, pers. comm. 2012).
- Captive propagation for genetic storage and reintroduction:
 - Twenty-five *Bonamia menziesii* individuals grown from garden stock are planted at Maui Nui Botanical Garden (MNBG); founders were cuttings from Puu o Kali in 2002 (S. Seidman, MNBG, pers. comm. 2012; MNBG 2011).
 - Best germination results (78 percent) for propagation were from tissue culture, with seeds from mature fruit (Sugii 2011).
 - Eleven plants are in the nursery at Waimea Valley from five Oahu founders (Waimea Valley 2011).
 - The Volcano Rare Plant Facility (VRPF) has three individuals from one founder in the greenhouses (VRPF 2011).

- The Harold L. Lyon Arboretum (2012) had 289 seeds in storage for *Bonamia menziesii* and is a single individual in micropropagation storage.
- Reintroduction / translocation - Six juveniles grown from seed are doing well with the protection of a small enclosure at Kanaio, Maui (B. Stevens, pers. comm. 2011).
- Life history research:
 - Seed physiologists studying members of the Convolvulaceae family showed that *B. menziesii* is atypical of its genus, and of its tribe, Cresseae. Isolated in Hawaii, the plant accumulated a number of traits not found in other species. *Bonamia menziesii* is unusual in that it lacks the impermeable seed coat which confers physical dormancy, and produces non-dormant seeds. Though having the same anatomy as related species with an impermeable seed coat, *B. menziesii* also has two openings filled with crushed cell material, allowing the seed to imbibe water slowly. This change may have developed as an adaptation to its dry and mesic forest habitats (Jayasuriya 2009).
 - Two articles address augmentation of the population in the dryland forest restoration at the Kaupulehu Preserve on the island of Hawaii, where outplanting of 250 individuals between 1999 and 2006 resulted in a 75% increase in the total of individuals of the species (Cordell 2008; Cabin 2011).
 - An article on the origins of Hawaiian species indicates that *B. menziesii*'s closest relatives are from the Neotropics, and South and Central America (Baldwin and Wagner 2010).

Synthesis:

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for the multi-island plants (USFWS 1999), based on whether the species is an annual, a short-lived perennial (fewer than 10 years), or a long-lived perennial. *Bonamia menziesii* 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 an 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 stabilization goals for this short-lived species have not been met (see Table 1), since no wild population contains 50 mature individuals. While the overall numbers of the species have increased slightly since the last five-year review, the threats continue and in some cases have increased, and not all threats are being sufficiently managed. Therefore, *Bonamia menziesii* meets the definition of endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

- Captive propagation for genetic storage and reintroduction

- Continue collecting material for genetic storage and propagation for reintroduction.
 - Investigate new propagation methods.
- Invertebrate control research - Investigate insect predation and appropriate control methods.
- Ungulate exclosures - Fence remaining populations to protect them from the impacts of feral ungulates.
- Ecosystem-altering invasive plant species control - Remove competing invasive introduced plant species within fenced areas and maintain those areas free of invasive introduced plants.
- Fire protection – Develop and implement fire prevention plans for vulnerable populations.
- Population biology research - Implement genetic studies to assess viability of remaining populations.
- Population biology research - Investigate causes of reproductive failure and techniques to improve natural recruitment.
- Surveys / inventories - Survey current and historical locations on all islands to determine current status of the rangewide.
- Alliance and partnership development - Initiate planning and contribute to implementation of ecosystem level restoration and management to benefit this taxon.

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

Date	No. wild individuals	No. outplanted	Stability Criteria identified in Recovery Plan	Stability Criteria Completed?
1994 (listing)	200	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
1999(recovery plan)	thousands	0	All threats managed in all 3 populations	Partially
			Complete genetic storage	No
			3 populations with 50 mature individuals each	Yes
2003 (critical habitat)	>166	0	All threats managed in all 3populations	Partially
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2009 (5-yr review)	138-141	6+	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2011 (5-yr review)	ca 150	250+	All threats managed in all 3 populations	Partially (Table 2)
			Complete genetic storage	Partial
			3 populations with 50 mature individuals each	No

Table 2. Threats to *Bonamia menziesii* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulates habitat modification and herbivory	A, C, D	Ongoing	Partially: fences are in place for some populations
Military activity on Oahu (Makua and Lualualei)	A,E	Ongoing	Partially
Fire –habitat modification and plant destruction	A, E	Ongoing	Partially
Insect predation – alien beetle (<i>Physomerus grossipes</i>)	C	Ongoing	No
Insect predation – unidentified ant species	C	Ongoing	No
Insect predation – unidentified scale insect	C	Ongoing	No
Invasive introduced plants on all islands	A, E	Ongoing	Partially
Drought	E	Ongoing	No
Climate change	A, E	Increasing	No

References:

See previous 5-year review for a full list of references (USFWS 2007). Only references for new information are provided below.

Baldwin, B.G. and W.L. Wagner. 2010. Hawaiian angiosperm radiations of North American origin. *Annals of Botany* 105:849-879.

Cabin, Robert J. 2011. *Intelligent tinkering: bridging the gap between science and practice*. Island Press, Washington, D.C. 218 pages.

Cordell, S., M. McClellan., Y.Y. Carter and L.J. Hadway. 2008. Towards restoration of Hawaiian tropical dry forests: the Kaupulehu outplanting programme. *Pacific Conservation Biology* 14:279–284. Available online at http://www.fs.fed.us/psw/publications/cordell/psw_2008_cordell001.pdf. Accessed December 21, 2011.

Harold L. Lyon Arboretum. 2012. Micropropagation database and seed storage databases. University of Hawaii at Manoa, Honolulu, Hawaii. Unpublished.

Jayasuriya, K.M.G., J.M. Baskin, R.L. Geneve and C.C. Baskin. 2009. Phylogeny of seed dormancy in Convolvulaceae subfamily Convolvuloideae (Solanales). *Annals of Botany* 103:45-63.

- [MNBG] Maui Nui Botanical Garden. 2011. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. 26 pages. Unpublished.
- [NTBG] National Tropical Botanical Garden. 2013. Provenance report: Convolvulaceae *Bonamia menziesii*. Kalaheo, Hawaii. 1 page. Unpublished.
- Perlman, Steve. 2011. *Bonamia menziesii* field notes. National Tropical Botanical Garden, Kalaheo, Hawaii. 1 page. Unpublished.
- Sugii, N.C. 2011. The establishment of axenic seed and embryo cultures of endangered Hawaiian plant species: special review of disinfestation protocols. *In Vitro Cellular and Developmental Biology – Plant* 47:157–169.
- U.S. Army Garrison. 2009. Status report for the Makua and Oahu implementation plans. U.S. Army Garrison, Hawaii and Pacific Cooperative Park Studies Unit. Schofield Barracks, Hawaii. 711 pages. Available online at <http://manoa.hawaii.edu/hpicesu/dpw_mit.htm>.
- U.S. Army Garrison. 2010. Status report for the Makua and Oahu implementation plans. U.S. Army Garrison, Hawaii and Pacific Cooperative Park Studies Unit. Schofield Barracks, Hawaii. 588 pages. Available online at <http://manoa.hawaii.edu/hpicesu/dpw_mit.htm>.
- [USFWS] U.S. Fish and Wildlife Service. 1999. Recovery plan for the multi-island plants. U.S. Fish and Wildlife Service, Portland. 206 pages + appendices.
- [USFWS] U.S. Fish and Wildlife Service. 2010. *Bonamia menziesii* (no common name) 5-year review summary and evaluation. U.S. Fish and Wildlife Service, Honolulu, Hawaii. 10 pages. Available online at <http://ecos.fws.gov/docs/five_year_review/doc1123.pdf>.
- [VRPF] Volcano Rare Plant Facility. 2011. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. 19 pages. Unpublished.
- Waimea Valley. 2011. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act, 15 pages. Unpublished.
- Personal communications:**
- Bily, Pat. 2011. Invasive Plant Specialist, The Nature Conservancy (TNC), Maui Program. E-mail to Margaret Clark, National Tropical Botanical Garden, dated December 6, 2011. Subject: *Bonamia menziesii* five year review.
- Bustamente, Keahi. 2012. Maui Plant Extinction Prevention Program. E-mail to Margaret Clark, National Tropical Botanical Garden, dated January 9, 2012. Subject: *Bonamia menziesii* Five Year Review.

- Chimera, Chuck. 2011. Maui Invasive Species Committee. E-mail to Margaret Clark, National Tropical Botanical Garden, dated December 5, 2011. Subject: *Bonamia menziesii* five year review.
- DeMotta, Michael. 2011. Living Collections and Horticulture Department, National Tropical Botanical Garden. E-mail to Margaret Clark, National Tropical Botanical Garden, dated November 21, 2011. Subject: *Bonamia menziesii* - 5 yr FWS review.
- Higashino, Jennifer. 2012. USFWS Conservation Partnerships Program, Maui. E-mail to Margaret Clark, National Tropical Botanical Garden, dated January 9, 2012. Subject: *Bonamia menziesii* - 5 yr FWS review.
- Medeiros, Arthur. 2010. U.S. Geological Survey, Makawao, Hawaii. E-mail to Margaret Clark, National Tropical Botanical Garden, dated December 6, 2010. Subject: *Bonamia menziesii* - 5 yr FWS review
- Oppenheimer, Hank. 2011. Maui Plant Extinction Prevention Program. E-mail to Margaret Clark, National Tropical Botanical Garden, dated November 28, 2011. Subject: *Bonamia menziesii* five year review.
- Seidman, Stephanie. 2012. Maui Nui Botanical Garden. E-mail to Margaret Clark, National Tropical Botanical Garden, dated January 3, 2012. Subject: *Bonamia menziesii* 5 yr review.
- Stevens, Bryon. 2011. Natural Area Reserve Specialist, Maui. Department of Land and Natural Resources; Division of Forestry and Wildlife. E-mail to Margaret Clark, National Tropical Botanical Garden, dated December 5, 2011. Subject: *Bonamia menziesii* Five Year Review.
- Tangalin, Natalia. 2011. Field Botanist, National Tropical Botanical Garden (NTBG), E-mail to Margaret Clark, National Tropical Botanical Garden, dated November 29, 2011. Subject: *Bonamia menziesii* - 5 yr FWS review.

U.S. FISH AND WILDLIFE SERVICE

SIGNATURE PAGE for 5-YEAR REVIEW of *Bonamia menziesii* (no common name)

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

acting deputy

Field Supervisor, Pacific Islands Fish and Wildlife Office

Maui M. Buegman

Date 2013-08-15