5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Chamaesyce herbstii* (Akoko)

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 69 species in Idaho, Washington, Hawaii, Guam, and the Commonwealth of the Northern Mariana Islands. Federal Register 75(67):17947-17950.

Lead Region/Field Office:

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

Name of Reviewer(s):

Chelsie Javar, Fish and Wildlife Biologist
Marie Bruegmann, Plant Recovery Coordinator
Jess Newton, Recovery Program Leader
Assistant Field Supervisor for Endangered Species

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 8, 2010. The review was based on a review of current, available information since the last 5-year review for *Chamaesyce herbstii* (USFWS 2007). Bernice Pauahi Bishop Museum 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 Chelsie Javar, Fish and Wildlife Biologist, was reviewed by the Plant Recovery Coordinator. The document was then reviewed by the Recovery Program Leader 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).

Review Analysis:

Please refer to the previous 5-year review for *Chamaesyce herbstii* published on August 2, 2007 (available at http://ecos.fws.gov/docs/five_year_review/doc1125.pdf) and the recovery plan for the Oahu plants (USFWS 1998), for a complete review of the species' status, 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. herbstii*.

This short-lived shrub is endangered and occurs on the island of Oahu (USFWS 1998). The current status and trends for *Chamaesyce herbstii* are provided in the tables below.

New taxonomic information:

Chamaesyce, a cosmopolitan genus of about 250 species, has historically often been treated as a subgroup of the genus *Euphorbia*, but is sometimes recognized as a segregate genus (Koutnik 1987). In Hawaii, Sherff (1937) published a full treatment of this group in the genus *Euphorbia*, and at about the same time, Degener and Croizat (1936a, 1936b, 1937) argued for the recognition of *Chamaesyce* as a separate genus and published new combinations for all Hawaiian endemic members known at the time. St. John (1973) continued to recognize all taxa under *Euphorbia* rather than *Chamaesyce*. Koutnik (1987) chose to treat the group under *Chamaesyce*, and his taxonomy was accepted in the *Manual of the Flowering Plants of Hawaii* (Wagner *et al*. 1999). With subsequent improvement of molecular techniques and analysis, however, it has become clear that *Chamaesyce* was one of several polyphyletic genera nested among species of *Euphorbia* (Steinmann and Porter 2002; Bruyns 2006). Steinmann and Porter (2002) argued for a broader concept of *Euphorbia*, in opposition to the trend at the time of splitting the genus into segregate genera, such as *Chamaesyce*. Bruyns (2006) formally proposed a reclassification of the subtribe Euphorbiinae (family Euphorbiaceae), up to that point including several genera (such as *Euphorbia*, *Chamaesyce*, *Monadenium*, *Pedilanthus*, and *Synadenium*), synonymizing all genera into a single large genus, *Euphorbia*. Within the genus, four subgenera were proposed; Hawaiian material previously in *Chamaesyce* would fit into *Euphorbia* subg. *Chamaesyce* (Bruyns 2006). Warren Wagner (Botanist, Smithsonian Institution, pers. comm. 2009) confirmed that the evidence for lumping segregate genera into a large *Euphorbia* was compelling, and that *Chamaesyce* in Hawaii would be synonymized. Names for all taxa recognized as *Chamaesyce* in Wagner *et al*. (1999) all have valid alternatives in *Euphorbia*. *Chamaesyce herbstii*, for instance, was provided a name in *Euphorbia* by Oudejans (1989), *E. herbstii* (W.L. Wagner) Oudejans. This change in taxonomy does not result in any change in the range of the taxon as it was listed. Recently published taxonomic papers accepting the enlarged *Euphorbia* include Pahlevani (2011). Therefore, this taxon will now be referred to as *Euphorbia herbstii* for the remainder of this review.

New threats:

Climate change may also 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) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

New management actions:

- Ungulate exclosure – Fence construction has begun around the remaining unprotected portions of the Kapuna to Pahole population unit (U.S. Army Garrison 2010). The Makaha population unit fence was finished in 2007 and staff from the Oahu Army

Natural Resource Program began reintroducing this taxon in the fenced area in 2007 (U.S. Army Garrison 2007).

- Ungulate control:
  - The fence at the Makua population unit was declared ungulate-free in the summer of 2009 (U.S. Army Garrison 2009).
  - Staff of the Oahu Army Natural Resources Program is continuing to assist staff of the Hawaii Natural Area Reserve System to control ungulates from the Kapuna fenced exclosure (U.S. Army Garrison 2009).
- Ecosystem-altering invasive plant species control – Weeds are controlled around individuals of *Euphorbia herbstii* within the Makua and Makaha population units (U.S. Army Garrison 2010).
- Population viability monitoring:
  - In 2009, detailed population monitoring of the Makaha population unit began by staff of the Oahu Army Natural Resources Program, which showed a decline in the number of *in situ* mature individuals of *Euphorbia herbstii* in the Kapuna to Pahole population unit (U.S. Army Garrison 2010).
  - The draft plan for continued stage class modeling of the Makaha population unit, which contains 19 individuals of *Euphorbia herbstii*, was submitted to Dr. Tiffany Knight, an Associate Professor at Washington University in St. Louis, for review (U.S. Army Garrison 2010). U.S. Army Garrison is working with Dr. Knight to develop a population matrix model that will be used to aid in future reintroductions at the Makaha population unit.
  - In 2009, three species of *Hylaeus* (bees) were observed visiting flowers of *Euphorbia herbstii* in the Makaha population unit (U.S. Army Garrision 2010). Two of these species of *Hylaeus* are possibly new, undescribed species while the third species is a candidate for Federal listing.
- Genetic research – Collections of leaf material of *Euphorbia herbstii* for genetic research by Dr. Cliff Morden at the University of Hawaii Botany Department were completed in 2010 and the results of this study are expected in December 2010 (U.S. Army Garrison 2010).
- Captive propagation for genetic storage and reintroduction:
  - In 2009, there were 20 seeds in genetic storage and 14 individuals of *Euphorbia herbstii* growing at the U.S. Army Garrison nursery (U.S. Army Garrison 2009).
  - In 2010, 20 seeds for propagation for reintroduction purposes were collected from the Pahole to Kapuna population unit (U.S. Army Garrison 2010). There are 13 individuals growing in the U.S. Army Garrison nursery (U.S. Army Garrison 2010).
  - In 2009, the Center for Conservation Research and Training Seed Storage Laboratory (2009) had 1,009 seeds of *Euphorbia herbstii* in storage.

- In 2010, the Pahole Rare Plant Facility had five individuals growing at their nursery (Pahole Rare Plant Nursery 2010).

- Captive propagation protocol development – Extensive seed from *Euphorbia herbstii* were collected at the Pahole reintroduction site for use in a seed storage study to determine the most appropriate seed storage conditions for this taxon. Germination results from seeds stored for propagation have indicated that seeds stored dry and frozen for four years have remained viable (U.S. Army Garrison 2008). However, the seed storage protocol for *E .herbstii* is still in the development stage. Recommendations should be available by 2012 (U.S. Army Garrison 2009).
- Reintroduction / translocation implementation – Eighteen immature individuals of *Euphorbia herbstii* were reintroduced at the Makaha population unit (U.S. Army Garrison 2009). Additional individuals were reintroduced at the Makaha population unit; however the number of individuals was not provided (U.S. Army Garrison 2010).
- Reintroduction / translocation site identification – The West Makaleha population unit will be used as a future reintroduction site for this species once this population unit is fenced (U.S. Army Garrison 2009).
- Reintroduction / translocation population management and monitoring – Natural recruitment of reintroduced individuals of *Euphorbia herbstii* was noted at the Makaha population unit (U.S. Army Garrison 2010).

Synthesis:

In 2010, the Kapuna to Pahole population unit contained 26 mature and 35 immature wild individuals of *Euphorbia herbstii*, and a single wild seedling, while the augmented population consisted of 38 mature and 56 immature individuals. The Makaha population unit (a reintroduction site), contained 19 mature and 124 immature individuals, and 26 seedlings. The West Makaleha population unit (a reintroduction site) contained no reintroduced individuals of *E. herbstii* as this site is not protected from ungulates (U.S. Army Garrison 2010). As of 2010, there were a total of 83 mature individuals, 215 immature individuals, and 27 seedlings of *E. herbstii*.

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for plants from the island of Oahu (USFWS 1998), based on whether the species is an annual, a short-lived perennial (fewer than 10 years), or a long-lived perennial. *Euphorbia herbstii* 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 the island of Oahu. 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 only been partially met, as there is only a single population containing 50 or more mature individuals at the Kapuna to Pahole population unit (Table 1) and threats are only being partially managed throughout

all of the populations (Table 2). Therefore, *Euphorbia herbstii* 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 to collect seeds from tagged individuals, keeping close track of the maternal source for use in *ex situ* propagation.
  - Continue to collect seeds from all existing populations and send to at least two or three different venues for propagation.
- Reintroduction / translocation implementation – Continue to reintroduce the species back into its known historical range.
- Ungulate exclosures:
  - Continue to construct fenced exclosures around existing and reintroduced populations to provide protection from feral ungulates.
  - Monitor fenced exclosures for evidence of breaching by feral ungulates.
- Ungulate control – Continue to protect all populations against disturbances from feral ungulates.
- Ecosystem-altering invasive plant species control – Continue to control invasive introduced plant species around all populations.
- Surveys / inventories – Resurvey the historical range of the species to search for additional populations or individuals and to determine the current status of the species.
- Fire protection – Develop and implement a fire management plan for all populations.
- Population viability monitoring – Study *Euphorbia herbstii* populations with regard to population size and structure, geographical distribution, flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, limiting factors, and threats.
- Alliance and partnership development – Work with the U.S. Army, Hawaii Division of Forestry and Wildlife, and other land managers to continue planning and contribute to implementation of ecosystem-level restoration and management to benefit this species.
- Federal Register update – Update the listed entity on 50 CFR 17 to match the currently recognized taxonomy.
- Threats research – Assess the modeled effects of climate change on this species, and use to determine future landscape needed for the recovery of the species.

Table 1. Trends of *Euphorbia herbstii* from listing through current 5-year review.

Date	No. wild indivs	No. outplanted	Stability Criteria identified in Recovery Plan	Stability Criteria Completed?
1996 (listing)	< 200	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
1998(recovery plan)	<200	0	All threats managed in all 3 populations	Partially
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2003 (critical habitat)	~ 164	0	All threats managed in all 3 populations	Partially
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2007 (5-yr review)	58	2	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2012 (5-yr review)	83	180	All threats managed in all 3 populations	Partially: (see Table 2)
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Partially

Table 2. Threats to *Euphorbia herbstii* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulates – Degradation of habitat and herbivory	A, C	Ongoing	Partially: Makaha population unit is fenced; fence construction began in the unprotected areas of Kapuna to Pahole population unit; Makaha population unit is ungulate-free
Established ecosystem-altering invasive plant species	A	Ongoing	Partially: Weed control at Kapuna to Pahole and Makaha population unit
Fire	E	Ongoing	No
Established invasive plant species competition	E	Ongoing	Partially: Weed control at Kapuna to Pahole and Makaha population unit; no weed control at West Makaleha
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.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Chamaesyce herbstii* (Akoko)

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

Appropriate Listing/Reclassification Priority Number, if applicable:_____

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