5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Chamaesyce celastroides* var. *kaenana* (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, PIFWO
Marie Bruegmann, Plant Recovery Coordinator, PIFWO
Jess Newton, Recovery Program Leader, PIFWO
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 April 8, 2010. The review was based on a review of current, available information since the last 5-year review for *Chamaesyce celastroides* var. *kaenana* (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 celastroides* var. *kaenana* published on August 2, 2007 (available at http://www.fws.gov/pacific/ecoservices/endangered/recovery/Documents/ChamaesycecelastroideskaenanaPDF) 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 or 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. celastroides* var. *kaenana*.

This short-lived shrub is endangered and occurs on the island of Oahu (USFWS 1998). The current status and trends for *Chamaesyce celastroides* var. *kaenana* 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 celastroides* var. *kaenana*, for instance, was provided a name in *Euphorbia* by Sherff (1936), *E. celastroides* var. *kaenana*. 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 be referred to as *Euphorbia celastroides* var. *kaenana* for the remainder of this review.

New threats:

In July of 2009, a wildfire burned within 95 meters (311 feet) of the East of Alau population of *Euphorbia celastroides* var. *kaenana* in the Kaena population unit. This is the same area that burned in August of 2007 (U.S. Army Garrison 2009). A year later, on July 24, 2010 a fire at Makua Military Reservation burned through the North Kahanahaiki population unit, potentially impacting the population of *Euphorbia celastroides* var. *kaenana*(U.S. Army Garrison 2010). Surveys are needed to determine the status of this population.

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 exclosures – The Makua population unit is fenced from feral goats (*Capra hircus*).
- Ecosystem-altering invasive plant species control – Weed control is ongoing at the Makua, Puaakanoa, and Kaena population units around individuals of *Euphorbia celastroides* var. *kaenana* (U.S. Army Garrison 2009).
- Captive propagation for genetic storage and reintroduction:
    - In 2008, the U.S. Army had 36,686 seeds in storage and a single propagule in their nursery (U.S. Army Garrison 2008b). The U.S. Army has completed genetic storage for 110 individuals from six different populations of *Euphorbia celastroides* var. *kaenana*.
    - In 2009, the Center for Conservation Research and Training Seed Storage Laboratory (2009) had 30,554 seeds in storage.
    - In 2010, the Waimea Valley Arboretum had six individuals in their nursery (Waimea Valley Arboretum 2010).
- Fire protection:
    - In 2010, staff of Oahu Army Natural Resources Program pursued an agreement with the Department of Land and Natural Resources to create a fire break east of the Alau population of *Euphorbia celastroides* var. *kaenana* by removing a large stand of *Prosopis pallida* (kiawe) trees; the status of this agreement is unknown (U.S. Army Garrison 2010).
    - Fuel-load reduction for fire prevention is ongoing within the Makua and Puaakanoa population units (U.S. Army Garrison 2009).
- Surveys / inventories – In November of 2009 a new group of approximately 30 individuals of *Euphorbia celastroides* var. *kaenana* were found at Kaena population unit (U.S. Army Garrison 2010).
- Excluder fence – In November of 2010, construction of a predator proof fence around a portion of Kaena Point Natural Area Reserve began (Hawaii Department of Land and Natural Resources 2010). The fence was completed in March 2011(Hawaii Department of Land and Natural Resources 2011) and will protect a subset of the population of *Euphorbia celastroides* var. *kaenana* at Kaena Point (U.S. Army Garrison 2010). The fence is 640 meters long (2,100 feet) and 2.0 meters (6.5 feet) tall that encompasses a total of 23.9 hectares (59.0 acres) (Hawaii Department of Land and Natural Resources 2011). It will keep out predators such as cats, dogs, mongooses, rats, and mice as young as two days old (Hawaii Department of Land and Natural Resources 2011).

- Threats monitoring and control:
    - At the Kaena East of Alua population unit and at the wild site containing *Euphorbia celastroides* var. *kaenana* in the Kaena population unit, staff of Oahu Army Natural Resources Program monitored the effects (if any) of nonnative ants on populations of *E. celastroides* var. *kaenana* (U.S. Army Garrison 2010).
    - Within the lower Ohikilolo management unit, staff of Oahu Army Natural Resources Program monitored the potential impacts of rodents and nonnative ants on a single population of *Euphorbia celastroides* var. *kaenana* (U.S. Army Garrison 2010).
    - Staff of Oahu Army Natural Resources Program monitored individuals at North Kahanahaiki population unit after a wildfire burned through the area on July 24, 2010 (U.S. Army Garrison 2010).
- Population viability monitoring – All the population units at U.S. Army Garrison except for the Waianae Kai population unit were monitored in 2010 and there were no changes in the number of individuals (U.S. Army Garrison 2010).
- Population biology research – A graduate student at the University of Hawaii at Manoa Botany Department began a pollination study on the breeding system and pollination biology of *Euphorbia celastroides* var. *kaenana* within the population units located at U.S. Army Garrison (U.S. Army Garrison 2010).

Synthesis:

In 2010, the following population units had a total of 792 wild mature individuals, 51 wild immature individuals, and 2 seedlings of *Euphorbia celastroides* var. *kaenana*: Makua had 125 wild mature and 2 wild immature; Kaena had 300 wild mature; Kaena, East of Alau had 26 wild mature and a single wild immature; Puaakanoa had 132 wild mature and 16 wild immature; East Kahanahaiki had 2 wild mature individuals; Kaluakauila had 11 wild mature and 2 immature; North Kahanahaiki had 110 wild mature and 28 wild immature; Keawaula had 53 wild mature, 2 immature, and 2 seedlings; and Waianae Kai had 33 wild mature (U.S. Army Garrison 2010).

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 celastroides* var. *kaenana* 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 been met, as there are three population containing 50 or more mature individuals at Makua, Kaena, and Puaakanoa

population units and threats are only being partially managed throughout all of the populations (Table 2).

For downlisting, a total of five to seven populations of *Euphorbia celastroides* var. *kaenana* should be documented on the island of Oahu where it now occurs or occurred historically. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with a minimum of 300 mature individuals per population. Each population should persist at this level for a minimum of five consecutive years before downlisting is considered.

The downlisting goals for this species have not been me, as there is only a single population containing more than 300 mature individuals at Kaena population unit (Table 1), and all threats are only being partially managed throughout all of the populations (Table 2). Therefore, *Euphorbia celastroides* var. *kaenana* 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 – Search for individuals of *Euphorbia celastroides* var. *kaenana* in the southeastern Koolau Mountains.
- Fire protection:
  - Continue to implement the wildland fire management plan developed by the U.S. Army.
  - Continue to establish and maintain fire breaks by reducing the fuel load created by invasive plant species.

- Population viability monitoring – Study *Euphorbia celastroides* var. *kaenana* 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.
- Existing population management and restoration – Develop and implement management actions for other populations of *Euphorbia celastroides* var. *kaenana* that are not being managed by staff of the U.S. Army Garrison.
- Alliance and partnership development – Work with the U.S. Army, Hawaii Division of Forestry and Wildlife, and other 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 celastroides* var. *kaenana* from listing through current 5-year review.

Date	No. wild indivs	No. outplanted	Downlisting Criteria identified in Recovery Plan	Downlisting Criteria Completed?
1991 (listing)	<200	0	All threats managed in all 5-7 populations	No
			Complete genetic storage	No
			5-7 populations with 300 mature individuals each	No
			Naturally reproducing, stable, and increasing in number	Unknown
			Stable for five consecutive years	Unknown
1998(recovery plan)	545	1	All threats managed in all 5-7 populations	Partially
			Complete genetic storage	Partially
			5-7 populations with 300 mature individuals each	No
			Naturally reproducing, stable, and increasing in number	Unknown

Date	No. wild indivs	No. outplanted	Downlisting Criteria identified in Recovery Plan	Downlisting Criteria Completed?
			Stable for five consecutive years	Unknown
2003 (critical habitat)	569	0	All threats managed in all 5-7 populations	Partially
			Complete genetic storage	Partially
			5-7 populations with 300 mature individuals each	No
			Naturally reproducing, stable, and increasing in number	No
			Stable for five consecutive years	Unknown
2007 (5-yr review)	>900	0	All threats managed in all 5-7 populations	Partially
			Complete genetic storage	Partially
			5-7 populations with 300 mature individuals each	No
			Naturally reproducing, stable, and increasing in number	Partially
			Stable for five consecutive years	Partially
2012 (5-yr review)	792	0	All threats managed in all 5-7 populations	Partially (see Table 2)
			Complete genetic storage	Partially
			5-7 populations with 300 mature individuals each	No
			Naturally reproducing, stable, and increasing in number	Partially
			Stable for five consecutive years	Partially: Fire is still a huge threat

Table 2. Threats to *Euphorbia celastroides* var. *kaenana* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulates – Degradation of habitat and herbivory	A, C, D	Ongoing	Partially: Makua population unit is fenced
Established ecosystem-altering invasive plant species	A	Ongoing	Partially: Weeds controlled at Kaena but not within the entire Makua population
Fire	E	Ongoing	Partially: Firebreaks at Makua, and few at Waianae Kai; wildland fire management plan for U.S. Army lands
Established invasive plant species competition	E	Ongoing	Partially: Weeds controlled at Kaena but not within the entire Makua population
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 celastroides* var. *kaenana* (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:_____

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

Field Supervisor, Pacific Islands Fish and Wildlife Office

for

Jess Newton

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