

*Euphorbia haeleleana*  
(akoko)

**5-Year Review  
Summary and Evaluation**

**U.S. Fish and Wildlife Service  
Pacific Islands Fish and Wildlife Office  
Honolulu, Hawaii**

# 5-YEAR REVIEW

Species reviewed: *Euphorbia haeleeleana* (akoko)

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**5-YEAR REVIEW**  
***Euphorbia haeleleana* (akoko)**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery, Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor, (808)  
792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

N/A

**1.2 Methodology used to complete the 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 the final critical habitat designation for *Euphorbia haeleleana* and other species from the islands of Oahu, Kauai, and Niihau (USFWS 2003a, b), 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.

**1.3 Background:**

**1.3.1 Federal Register (FR) Notice citation announcing initiation of this review:**

USFWS. 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.

### 1.3.2 Listing history

Original Listing

**FR notice:** USFWS. 1996. Endangered and threatened wildlife and plants; determination of endangered or threatened status for 14 plants from the Hawaiian Islands; final rule. Federal Register 61(198):53109-53124.

**Date listed:** October 10, 1996

**Entity listed:** Species

**Classification:** Endangered

Revised Listing, if applicable

**FR notice:** N/A

**Date listed:** N/A

**Entity listed:** N/A

**Classification:** N/A

### 1.3.3 Associated rule makings :

USFWS. 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. 2003b. 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.

Critical habitat was designated for *Euphorbia haelealeana* in two units totaling 370 hectares (919 acres) on the island of Kauai. These designations includes habitat on State lands (USFWS 2003a). Critical habitat was designated for *E. haelealeana* in three units totaling 659 hectares (1,630 acres) on the island of Oahu. These designations includes habitat on State and private lands (USFWS 2003b).

### 1.3.4 Review History:

Species status review [FY 2009 Recovery Data Call (August 2009)]:

Declining

### Recovery achieved:

1 (0-25%) (FY 2007 Recovery Data Call – this is the last year this was reported)

### 1.3.5 Species' Recovery Priority Number at start of this 5-year review:

5

### 1.3.6 Current Recovery Plan or Outline

**Name of plan or outline:** USFWS. 1999. Recovery plan for multi-island plants. U.S. Fish and Wildlife Service, Portland, Oregon. 206 pages + appendices.

Date issued: July 10, 1999.

Dates of previous revisions, if applicable: N/A

## 2.0 REVIEW ANALYSIS

### 2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate?

*Yes*

*No*

2.1.2 Is the species under review listed as a DPS?

*Yes*

*No*

2.1.3 Was the DPS listed prior to 1996?

*Yes*

*No*

2.1.3.1 Prior to this 5-year review, was the DPS classification reviewed to ensure it meets the 1996 policy standards?

*Yes*

*No*

2.1.3.2 Does the DPS listing meet the discreteness and significance elements of the 1996 DPS policy?

*Yes*

*No*

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy?

*Yes*

*No*

### 2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

*Yes*

*No*

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

*Yes*  
 *No*

**2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria?**

*Yes*  
 *No*

**2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:**

A synthesis of the threats (Factors A, C, D, and E) affecting this species is presented in section 2.4. Factor B (overutilization for commercial, recreational, scientific, or educational purposes) is not known to be a threat to this species.

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for 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. *Euphorbia haelealeana* 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, weeding, etc.) 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 Kauai and Oahu 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.

On Kauai there are greater than three populations with 50 or more mature individuals; however, on Oahu there are only two populations and neither has 50 or more mature individuals. Therefore this recovery objective has not been met.

For downlisting, a total of five to seven populations of *Euphorbia haelealeana* should be documented on islands where they now occur 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.

This recovery objective has not been met.

For delisting, a total of eight to ten populations of *Euphorbia haelealeana* should be documented on islands where they now occur or occurred historically. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with 300 mature individuals per population for short-

lived perennials. Each population should persist at this level for a minimum of five consecutive years before delisting is considered.

This recovery objective has not been met.

### 2.3 Updated Information and Current Species Status

In addition to the status summary table below, information on the species' status and threats was included in the final critical habitat rule referenced above in section 1.3.3 ("Associated Rulemakings") and in section 2.4 ("Synthesis") below, which also includes any new information about the status and threats of the species.

**Table 1. Status of *Euphorbia haeleleana* from listing through 5-year review.**

<b>Date</b>	<b>No. wild individuals</b>	<b>No. outplanted</b>	<b>Stabilization Criteria identified in Recovery Plan</b>	<b>Stabilization Criteria Completed?</b>
1996 (listing)	450-625	0	All threats managed in all populations	No
			Complete genetic storage	Unknown
			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)	450-625	0	All threats managed in all populations	Partially
			Complete genetic storage	Partially
			5-7 populations with 300 mature individuals each	No
			Naturally reproducing, stable, and increasing in number	Unknown
			Stable for five consecutive years	Unknown
2003 (critical habitat)	354-454	0	All threats managed in all populations	Partially

			Complete genetic storage	Partially
			5-7 populations with 300 mature individuals each	Partially
			Naturally reproducing, stable, and increasing in number	Unknown
			Stable for five consecutive years	Unknown
2008 (5-year review)	445	0	All threats managed in all populations	Partially
			Complete genetic storage	Partially
			5-7 populations with 300 mature individuals each	Partially
			Naturally reproducing, stable, and increasing in number	Unknown
			Stable for five consecutive years	Unknown

### **2.3.1 Biology and Habitat**

**2.3.1.1 New information on the species' biology and life history:**

**2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:**

**2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):**

**2.3.1.4 Taxonomic classification or changes in nomenclature:**

**2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):**

**2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):**



### **2.3.1.7 Other:**

## **2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)**

### **2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:**

### **2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:**

### **2.3.2.3 Disease or predation:**

### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

## **2.4 Synthesis**

Wagner *et al.* (1999) identified only one population of *Euphorbia haeleeleana* on Oahu in the Waianae Mountain range and four on Kauai. Currently, there are more populations of *E. haeleeleana* on Oahu and at least 11 populations on Kauai known to botanists at the National Tropical Botanical Garden. These are in Kuia Valley, Waimea Canyon, Mahanaloa Valley, Haeleele Valley, Kalalau Valley, Pohakuao Valley, Hipalau Valley off Koaie Canyon, Makaha Valley, Hanakapiai Valley, Kawaiula Valley, and Poopooiki Valley (Perlman 2008).

On Oahu in 1987, about 100 individuals with male and female flowers were seen at Kaluakauila Gulch at 366 meters (1,200 feet). There were about 50 individuals seen in 1999, at 335 meters (1,100 feet) elevation. Another population of 12 individuals was also seen in 1999 at 421 meters (1,380 feet) elevation (National Tropical Botanical Garden 2008a; Perlman 2008). Joel Lau of the Hawaii Biodiversity and Mapping Program observed two mature individuals at Kaimuhole Gulch in 2003. Earlier observations include 4 individuals seen 1994 at Kaumokunui Ridge; 4 individuals seen in Kahanahaiki Valley in 1993; and 43 individuals seen in three locations in Alaiheihē Gulch (Hawaii Biodiversity and Mapping Program 2008).

On Kauai in Mahanaloa Valley, up to 100 individuals were seen between 2005 and 2008 at 518 to 610 meters (1,700 to 2,000 feet) elevation (Perlman 2008; Tangalin 2008). Below Kuia and above the Poopooiki confluence seven individuals were seen in 1996 at elevations of 549 to 610 meters (1,800 to 2,000 feet). Thirty individuals were observed in that area at 561 meters (1,841 feet) in 2002 (National Tropical Botanical Garden 2008a)

A single individual 7.6 meters (25 feet) tall and 35.5 centimeters (14 inches) in diameter at breast height was observed in 1990 on the Haeleele Ridge in Puu Ka Pele Forest Reserve (National Tropical Botanical Garden 2008b). In Kalalau Valley, 9 to 20 individuals were observed in 1994 (Hawaii Biodiversity and Mapping Program 2008; Perlman 2008), but only a single individual was seen in 1999 (National Tropical Botanical Garden 2008b). In Pohakuao Valley, a single individual was last seen in 1999 at 396 meters (1,300 feet) elevation (Perlman 2008). In Hipalau Valley off Koaie Canyon, about 20 individuals were observed in 1992 (National Tropical Botanical Garden 2008b), 15 to 20 individuals in 1996 (National Tropical Botanical Garden 2008a), and 5 individuals in 2000 at 549 meters (1,800 feet) elevation (Perlman 2008).

In Kauai's Makaha Valley, 50 individuals were observed in 1996 at 607 meters (1,991 feet) (National Tropical Botanical Garden 2008a). In 2002, 75 to 100 individuals were seen on the north facing slopes below Makaha Road, above the radar station, on ridges above the valley floor (National Tropical Botanical Garden 2008b). In 2004, 15 individuals were noted at 853 meters (2,800 feet), on a steep northern exposure (National Tropical Botanical Garden 2008b). In 2001, in Hanakapiai Valley below Pohakea, 16 individuals were counted at two elevations, one at 256 to 274 meters (840 to 899 feet) and the other at 411 meters (1,348 feet) (National Tropical Botanical Garden 2008a). Five small individuals 4 to 5 meters (13 to 16 feet) tall were observed at this ridge site on a west facing steep valley slope in 2003. In 2004, three individuals were noted at 271 meters (890 feet) elevation (Perlman 2008).

In Kawaiula Valley, a total of 60 individuals were noted in 2000, at 671 to 878 meters (2,200 to 2,880 feet) elevation (Hawaii Biodiversity and Mapping Program 2008; National Tropical Botanical Garden 2008b; Perlman 2008). Also in 2000, 3 individuals were seen in Poopooiki's upper east end at 890 meters (2,920 feet) elevation, and 34 individuals at 671 to 732 meters (2,200 to 2,400 feet) elevation. This appears to be a decrease from the 60 to 80 individuals seen before in 1988 (Hawaii Biodiversity and Mapping Program 2008; National Tropical Botanical Garden 2008b). In Kuia Valley in 2000, Ken Wood of the National Tropical Botanical Garden counted 121 individuals, 85 percent of them were mature, 10 percent were immature, and 5 percent were seedlings (Hawaii Biodiversity and Mapping Program 2008; National Tropical Botanical Garden 2008a). From observations made since 2000, it appears that there are at least 400 trees remaining on Kauai in as many as 14 populations, and as many as 45 individuals on Oahu in 2 populations.

*Euphorbia haeleeleana* is dioecious (male and female flowers on separate trees), and some populations appear to have mostly male flowers and do not produce much seed. The capsules are explosively dehiscent so seed tends to be collected in the immature stage for genetic storage and propagation, as ripe seeds have already been dispersed. Seeds on the ground are often empty and non-viable. It is unclear if rats (*Rattus* spp.) eat viable seeds or if most seeds produced are not viable. Seedlings were only observed at the Mahanaloa population on Kauai (Tangalin 2008).

On Oahu, the habitat at Kaluakauila is dry to mesic *Sapindus oahuensis* (lonomea) - *Erythrina sandwicensis* (wili wili) - *Reynoldsia sandwicensis* (ohe ohe) - *Diospyros* sp. (lama) forest with native plant associates including *Bidens torta* (kookoolau), *Bobea sandwicensis* (ahakea), *Bonamia menziesii* (no common name [NCN]), *Charpentiera tomentosa* (papala), *Dodonaea viscosa* (aalii), *Eugenia reinwardtiana* (nioi), *Myoporum sandwicensis* (naio), *Nestegis sandwicensis* (olopua), *Nototrichium humile* (kulei), *Peperomia tetraphylla* (ala ala wai nui), *Pittosporum glabrum* (hoawa), *Pouteria sandwicensis* (alaa), *Psydrax odorata* (alaahee), *Rauvolfia sandwicensis* (hao), *Reynoldsia sandwicensis* (ohe makai), *Sapindus oahuensis* (lonomea), and *Schiedea hookeri* (NCN) (Hawaii Biodiversity and Mapping Program 2008; National Tropical Botanical Garden 2008b; Perlman 2008).

The diverse mesic forests of Mahanaloa, Poopooiki, Kawaiula, Haeleele, and Makaha have native plant associates including combinations of *Acacia koa* (koa), *Alphitonia ponderosa* (kauila), *Alyxia stellata* (maile), *Antidesma platyphyllum* (hame), *Bidens cervicata* (kookoolau), *Bobea brevipes* (ahakea lau lii), *Bonamia menziesii*, *Broussaisia arguta* (kanawao), *Carex meyenii* (NCN), *C. wahuensis* (NCN), *Chamaesyce atrococca* (akoko), *C. halemanui* (akoko), *Charpentiera elliptica* (papala), *Cheirodendron trigynum* (olapa), *Claoxylon sandwicense* (laukea), *Cyrtandra kauaiensis* (ulunahale), *Delissea kauaiensis* (NCN), *Dicranopteris linearis* (uluhe), *Diellia pallida* (NCN), *Diospyros hillebrandii*, *D. sandwicensis* (lama), *Diplazium sandwichianum* (hoio), *Dodonaea viscosa*, *Doodia kunthiana* (okupukupu), *Elaeocarpus bifidus* (kalia), *Flueggea neowawraea* (mehamehame), *Freycinetia arborea* (ie ie), *Gahnia beecheyi* (NCN), *Hibiscus waimeae* subsp. *waimeae* (kokio keokeo), *Ilex anomala* (kawau), *Isodendron laurifolia* (aupaka), *Kadua affinis* (manono), *Kokia kauaiensis* (kokio), *Leptecophylla tameiameia* (pukiawe), *Lepisorus thunbergianus* (pakahakaha), *Lipochaeta fauriei* (nehe), *Lysimachia kalalauensis* (NCN), *Melicope anisata* (moki-hana), *M. barbiger* (alani), *Metrosideros polymorpha* (ohia), *Morinda trimera* (noni kuahiwi), *Myrsine* sp. (kolea), *Neraudia kauaiensis* (NCN), *Nestegis sandwicensis*, *Nototrichium* sp., *Panicum nephelophilum* (konakona), *Peperomia kokeana* (ala ala wai nui), *Peucedanum sandwicense* (makou), *Pipturus kauaiensis* (mamake), *Pisonia wagneriana* (papala kepau), *Pittosporum kauaiensis* (hoawa), *Polypodium pellucidum* (ae lau nui), *Pouteria sandwicensis*, *Pritchardia minor* (loulou), *Psychotria hobdyi* (kopiko), *Psydrax odorata*, *Pteralyxia kauaiensis* (kaulu), *Santalum freycinetianum* var. *pyrularium* (iliahi), *Scaevola procera* (naupaka kuahiwi), *Smilax melastomifolia* (pi oi), *Streblus pendulinus* (ai-ai), *Tetraplasandra kavaiensis* (ohe ohe), *Vaccinium dentatum* (ohelo), *Wikstroemia furcata* (akia), *Wilkesia gymnophixium* (iliau), and *Zanthoxylum dipetalum* var. *dipetalum* (kawau) (Hawaii Biodiversity and Mapping Program 2008; National Tropical Botanical Garden 2008b; Perlman 2008; Tangalin 2008).

In Kalalau Valley, the habitat for *Euphorbia haeleeleana* is diverse mesic forest and *Diospyros* sp. mixed with *Antidesma platyphyllum*, *Doodia kunthiana*, *Pouteria sandwicensis*, *Psychotria mariniana* (kopiko), *Pteralyxia kauaiensis*, *Rauvolfia sandwicensis*, and *Tetraplasandra kavaiensis* (National Tropical Botanical Garden 2008b). *Euphorbia haeleeleana* was almost a dominant species in 1994, with 100 or more individuals in the area (Hawaii Biodiversity and Mapping Program 2009).

In Kuia Valley, *Euphorbia haelealeana* grows in *Diospyros* spp. mixed mesic forest, with a closed canopy of *Acacia koa*, *Metrosideros polymorpha* var. *glaberrima*, *Aleurites moluccana* (kukui), *Alphitonia ponderosa*, *Cheirodendron* sp., *Claoxylon sandwicensis*, *Kokia kauaiensis*, *Pouteria sandwicensis*, *Tetraplasandra kavaiensis*, and *T. waimeae* (ohe kikoola). The understory species include *Antidesma platyphylla* var. *hillebrandii* (hame), *Coprosma foliosa* (pilo), *C. waimeae* (olena), *Chamaesyce celastroides* var. *hanapepensis* (akoko), *Dianella sandwicensis* (uki uki), *Dodonaea viscosa*, *Elaeocarpus bifidus*, *Kadua affinis*, *K. knudsenii*, *Leptecophylla tameiameia*, *Melicope anisata*, *M. ovata*, *M. barbiger*, *Myrsine lanaiensis* (kolea), *Nesoluma polyneisicum* (keahi), *Nestegis sandwicensis*, *Pipturus albidus* (mamake), *P. kauaiensis*, *Pittosporum kauaiensis*, *Pleomele aurea* (hala pepe), *Psychotria greenwelliae*, and *Wikstroemia furcata*. Ground cover species include *Asplenium aethiopicum* (iwa iwa a), *Bidens sandwicensis*, *Carex meyenii*, *Diellia pallida*, *Dryopteris unidentata* (akole), *Cyperus hypochlorus* (ahu awa), *Melanthera fauriei* (nehe), *Microlepis strigosa* (palapalai), and *Peucedanum sandwicensis* (Hawaii Biodiversity and Mapping Program 2008; National Tropical Botanical Garden 2008b).

The dry forests of Hipalau have *Artemisia* sp. (hinahina), *Bidens* sp. (kookoolau), *Bobea timonioides* (ahakea), *Chamaesyce celastroides*, *Diospyros* spp., *Erythrina sandwicensis*, *Flueggea neowawraea*, *Gahnia asper* var. *globosa* (round sawsedge), *Hibiscadelphus distans* (hau kuahiwi), *Hibiscus waimeae*, *Lobelia niuhauensis* (NCN), *Myrsine* sp., *Nototrichium sandwicense* (kului), *Peucedanum sandwicense*, *Psydrax odorata*, and *Wilkesia gymnoxiphium* (iliau) (National Tropical Botanical Garden 2008b; Perlman 2008).

In Hanakapiai Valley below Pohakea on the western side of the valley, on steep west-facing slopes *Euphorbia haelealeana* grows in *Metrosideros polymorpha* - *Diospyros* sp. mesic forest with *Alphitonia ponderosa*, *Alyxia stellata*, *Bidens* sp., *Bobea elatior*, *Hibiscus kokio* ssp. *saintjohnianus* (kokio ula ula), *Ochrosia kauaiensis* (holei), *Pisonia wagneriana*, *Pleomele aurea*, *Pouteria sandwicensis*, *Pritchardia limahuliensis* (loulu), *Psychotria* sp., *Pteralyxia kauaiensis*, *Rauvolfia* sp., *Santalum freycinetianum*, and *Wikstroemia furcata* (National Tropical Botanical Garden 2008b).

In Poopooiki, the habitat is *Acacia koa* - *Metrosideros polymorpha* mesic forest with *Antidesma platyphylla*, *Alyxia stellata*, *Claoxylon sandwicense*, *Dicranopteris linearis*, *Diplazium sandwichianum*, *Dodonaea viscosa*, *Freycinetia arborea*, *Isodendron laurifolia*, *Kadua affinis*, *Melicope anisata*, *Melicope barbiger* (uahiapele), *Nestegis sandwicensis*, *Santalum* sp., and *Scaevola procera* (National Tropical Botanical Garden 2008b).

Threats to this species on Kauai and Oahu include habitat disturbance and predation by pigs (*Sus scrofa*) and goats (*Capra hircus*), and on Kauai, mule deer (*Odocoileus hemionus*) (Factors A, C, and D). Invasive introduced plant species alter the mesic habitats for *Euphorbia haelealeana* and compete with it for resources. Some of these invasive species on Kauai include *Lantana camara* (lantana), *Adiantum hispidulum*

(rough maidenhair fern), *Ageratum conyzoides* (billy goat weed), *Aleurites moluccana* (candlenut), *Andropogon glomeratus* (beardgrass), *Axonopus fissifolius* (narrow-leaved carpetgrass), *Bryophyllum pinnatum* (airplant), *Grevillea robusta* (silk oak), *Hedychium gardnerianum* (kahili ginger), *Passiflora ligularis* (sweet granadilla), *Pinus elliottii* (slash pine), *Psidium cattleianum* (strawberry guava), *Rubus argutus* (blackberry), *R. rosifolius* (thimbleberry), and *Setaria parviflora* (yellow foxtail) (Hawaii Biodiversity and Mapping Program 2008; National Tropical Botanical Garden 2008b; Perlman 2008; Tangalin 2008). In drier Hialau population, the primary invasive introduced plant threats are *Melia azedarach* (pride-of-India), *Grevillea robusta*, and *Lantana camara* (Factor E) (National Tropical Botanical Garden 2008b; Perlman 2008).

Invasive introduced plants are also a threat to *Euphorbia haeleleana* on Oahu. Some of the invasive species there include *Caesalpinia decapetala* (wait-a-bit), *Coffea arabica* (Arabian coffee), *Digitaria insularis* (sourgrass), *Grevillea robusta*, *Hyptis pectinata* (comb hyptis), *Lantana camara*, *Leucaena leucocephala* (haole koa), *Psidium cattleianum*, *Panicum maximum* (guinea grass), *Passiflora suberosa* (corky passionflower, huehue haole), *Rivina humilis* (coral berry), *Schinus terebinthifolius* (Christmas berry), and *Toona ciliata* (Australian red cedar) (Factor E) (Hawaii Biodiversity and Mapping Program 2008; Institute of Pacific Islands Forestry 2008; Perlman 2008).

Fire is a concern on both islands, but on Oahu the concern is increased by a history of fires in designated critical habitat areas managed by the Army (Factor E). Threats to *Euphorbia haeleleana* critical habitat in the military training action areas include fires ignited by the public and military training, and invasion by introduced plant species, some of which, like *Panicum maximum*, are particularly flammable. Up to half of critical habitat in Kaluakauila was burned in 1970, 1984, 1995, and 2003 fires. More than half of the critical habitat in Puulu to Alaiheihe is on private land currently used to raise cattle (*Bos taurus*) and goats. Browsing by ungulates has been observed (Factor C) (USFWS 2008).

Unknown species of leaf hoppers were noted as a threat to individuals on Oahu and Kauai (Factor C) (National Tropical Botanical Garden 2008a). The individuals in Hanakapiai were observed to have signs of goat damage to the bark (Factor C). This area recently burned in a forest fire at the end of October 2008 (Factor E) (Tangalin 2008). Pigs uproot seedlings (Factor C) (Tangalin 2008). Rats eat the seeds of this tree (Factor C) (Hawaii Biodiversity and Mapping Program 2008; Perlman 2008). Climate change may also pose a threat to *Euphorbia haeleleana* (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.

Despite ongoing consultation with the Army and fire prevention measures, fire has continued to impact critical habitat for this species on Oahu (Factors D and E) (USFWS 2008).

The Army will minimize the fire risk to this critical habitat unit by implementing weapons restrictions, installing fuel breaks, and staffing resources to suppress fires

ignited by training and the public. Approximately 53 percent of critical habitat in Puulu to Alaiheihe is within the perimeter of the 2007 Waialua fire. However, the proposed Puulu to Alaiheihe fuel break establishment and Army ungulate exclusion efforts will minimize fire risk to the 35 percent of critical habitat within the Army's Puulu to Alaiheihe management unit. Prescribed intensive grazing management will temporarily reduce the establishment of shrubs and trees within one percent of critical habitat, but this harm is outweighed by the ongoing degradation of habitat for *Euphorbia haelealeana* that would occur without Army management. Other than interagency efforts to protect this area from fire, no ongoing conservation actions benefit *E. haelealeana* critical habitat in the Puulu to Alaiheihe fuel break portion of the action area (USFWS 2008).

Conservation measures implemented by the Army on Oahu include fencing, control of invasive introduced plants, and control of rats (USFWS 2008). Forty-four individuals of *Euphorbia haelealeana* were reintroduced into the Kahanahaiki management unit of the Army's Makua Military Reservation (US Army 2008a).

The Waimea Arboretum has seven propagules in their nursery (Waimea Arboretum 2009). The Honolulu Botanical Garden has 14 individuals in their nursery (Honolulu Botanical Garden 2009). There are an unknown number of seeds in storage at the National Tropical Botanical Garden and 258 plants in their nursery (National Tropical Botanical Garden 2009). The Army has 14 individuals in their nursery (US Army 2008b).

The downlisting goals for this species have not been met (see Table 1), as none of the populations have greater than 300 mature individuals and all threats are not being managed. Also, regeneration is impeded by a number of threats. Therefore, *Euphorbia haelealeana* meets the definition of endangered as it remains in danger of extinction throughout its range.

### 3.0 RESULTS

#### 3.3 Recommended Classification:

Downlist to Threatened

Uplist to Endangered

Delist

Extinction

Recovery

Original data for classification in error

No change is needed

#### 3.2 New Recovery Priority Number:

**Brief Rationale:**

#### 3.3 Listing and Reclassification Priority Number:

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number: \_\_\_\_**  
**Delisting (regardless of current classification) Priority Number: \_\_\_\_**

**Brief Rationale:**

**4.0 RECOMMENDATIONS FOR FUTURE ACTIONS**

- Fence to exclude feral ungulates.
- Develop and implement fire management plans for fire-prone populations.
- Control introduced invasive plants.
- Develop and implement rodent control to reduce seed predation.
- Propagate both common and endangered native species for restoration of habitat in the Army managed areas of *Euphorbia haeleeleana* on Oahu.
- Research reproductive biology of *Euphorbia haeleeleana* to enhance seed production and possible propagation and augmentation of wild populations.
- Continue to work with U.S. Army, Hawaii Division of Forestry and Wildlife, and other landowners to initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this species.

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**Signature Page**  
**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW of *Euphorbia haeleeleana* (akoko)**

**Current Classification:** \_\_\_\_\_ T \_\_\_\_\_

**Recommendation resulting from the 5-Year Review:**

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

**Appropriate Listing/Reclassification Priority Number, if applicable:** \_\_\_\_\_

**Review Conducted By:**

Marie Bruegmann, Plant Recovery Coordinator  
Marilet A. Zablan, Assistant Field Supervisor for Endangered Species  
Jeff Newman, Acting Deputy Field Supervisor

Approved  \_\_\_\_\_ Date **AUG 27 2010**  
for **Field Supervisor, Pacific Islands Fish and Wildlife Office**