

Euphorbia remyi var. *kauaiensis*
(‘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 remyi* var. *kauaiensis* ('Akoko)

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5-YEAR REVIEW
***Euphorbia remyi* var. *kauaiensis* ('Akoko)**

1.0 GENERAL INFORMATION

1.1 Reviewers:

Lead Regional Office:

Region 1, Endangered Species Program, Division of Recovery, Sarah Hall, (503) 231-6868

Lead Field Office:

Pacific Islands Fish and Wildlife Office, Mary M. Abrams, 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 in June 2016. The review was based on the final rule listing this species; the final critical habitat designation; the recovery outline; peer reviewed scientific publications; unpublished field observations by the USFWS, State of Hawaii, and other experienced biologists; unpublished survey reports; notes and communications from other qualified biologists; as well as a review of current, available information. The evaluation of Cheryl Phillipson, Biologist, was reviewed by Lauren Weisenberger, Plant Recovery Coordinator, and Gregory Koob, Conservation and Restoration Team Manager.

1.3 Background:

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

[USFWS] U.S. Fish and Wildlife Service. 2015a. Endangered and threatened wildlife and plants; 5-year status reviews of 133 species in Hawaii, Oregon, Idaho, and Washington. Federal Register 80(30): 8100-8103.

1.3.2 Listing history:

Original Listing

FR notice: USFWS. 2010a. Endangered and threatened wildlife and plants; determination of endangered status for 48 species on Kauai and designation of critical habitat, final rule. Federal Register 75(70): 18960–19165.

Date listed: April 13, 2010

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 rulemakings:

N/A

1.3.4 Review History:

This is the first 5-year review for this species. *Euphorbia remyi* var. *kauaiensis* is a shrub that was listed as endangered, with designation of critical habitat, on April 13, 2010 (USFWS 2010a). The recovery outline for *E. remyi* var. *kauaiensis* is included in the recovery outline for the Kauai Ecosystem, published in 2010 (USFWS 2010b). A draft recovery plan is in preparation.

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

At the start of the 5-year review, the Recovery Priority Number proposed for *Euphorbia remyi* var. *kauaiensis* is 3 (using the USFWS scale of 1 to 18), based on the high degree of threat, a high potential for recovery with threats that are well understood and easily alleviated, and its status as a variety (USFWS 2010b).

1.3.6 Current Recovery Plan or Outline:

Name of plan or outline: USFWS. 2010b. Recovery outline for the Kauai ecosystem. U.S. Fish and Wildlife Service, Portland, Oregon. 43 pages.

Date issued: June 17, 2010

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

 X 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, B, C, D, and E) affecting this species is presented in section 2.3.2.

The recovery plan is currently being drafted. However, the Hawaii and Pacific Plants Recovery Coordinating Committee (HPPRCC) has outlined the actions and goals for stages leading towards recovery (2011). These stages are described below.

Current information is lacking for many Hawaiian plant species on the status of the species and their habitats, breeding systems, genetics, and propagule storage options. The following downlisting and delisting criteria for plants have therefore been adopted from the revised recovery objective guidelines developed by the HPPRCC (2011). Many of the Hawaiian plant species are at very low numbers, so USFWS also developed criteria for avoiding imminent extinction and an interim stage before downlisting, based on the recommendations of the HPPRCC, to assist in tracking progress toward the ultimate goal of recovery. These criteria are assessed on a species-by-species basis, especially as additional information becomes available.

In general, long-lived perennials are those taxa either known or believed to have life spans greater than 10 years; short-lived perennials are those known or believed to have life spans greater than one year but less than 10 years; and annuals are those known or believed to have life spans less than or equal to one year. When it is unknown whether a species is long- or short-lived, USFWS has erred on the side of caution and considered the species short-lived. This will be revised as more is learned about the life histories of these species. A species with a narrow extant range is one currently known from one or two adjacent gulches or ridges within the same mountain range. Some species have historically been known from only one population. For these species, given the limited information known of their habitat requirements, the number of mature individuals needed to prevent extinction was doubled within the known population rather than expanding the known range of the species for preventing extinction and the interim stage. Obligate outcrossers are those species that either have male and female flowers on separate plants or otherwise require cross-pollination to fertilize seeds, and therefore require equal numbers of individuals contributing to reproduction as males and females, doubling the number of mature individuals. Species that reproduce vegetatively may reproduce sexually only on occasion, resulting in the majority of the genetic variation being between populations, therefore requiring additional populations. Species that have a tendency to fluctuate in number from year to year require a larger number of mature individuals on average to allow for decline in years of extreme habitat conditions and recuperation in numbers in years of more normal conditions.

Preventing Extinction

To prevent extinction of *Euphorbia remyi* var. *kauaiensis* (a short-lived shrub with no specific characteristics known) the species needs a minimum of three

populations consisting of 50 mature individuals per population. In addition to achieving the numbers of reproducing individuals, all major threats must be controlled in the immediate vicinity of the populations, each population must show evidence of some stage of natural reproduction (*i.e.*, viable seeds or seedlings), and 50 mature individuals from each of three populations, or less if fewer than 50 remain, must be represented in an *ex situ* collection that is secure and well managed.

Very little information is available for this taxon. As only one population has been monitored within the last fifteen years, to the best of our understanding, we are not confident of population estimates from the 1990's and the year 2000. Therefore, this recovery objective has not been met (see Table 1).

Interim Stage

To meet the interim stage of recovery of *Euphorbia remyi* var. *kauaiensis*, 300 mature individuals are needed in each of three populations and all major threats must be controlled around the populations designated for recovery at this stage. There should also be demonstrated regeneration of seedlings and growth to at least sapling stage for woody species and documented replacement regeneration within each of the target populations. The populations must be adequately represented in an *ex situ* collection as defined in the Center for Plant Conservation's guidelines (Guerrant *et al.* 2004). Adequate monitoring must be in place and conducted to assess individual plant survival, population trends, trends of major limiting factors, and response of major limiting factors to management.

This recovery objective has not been met (see Table 1).

Downlisting Criteria

In addition to achieving 5 to 10 populations with 500 mature individuals per population and all of the goals of the interim stage, all target populations must be stable, secure, and naturally reproducing for a minimum of 10 years. Species-specific management actions are not ruled out. Downlisting should not be considered until an adequate population viability analysis (PVA) has been conducted to assess needed numbers more accurately based on current management and monitoring data collected at regular intervals determined by demographic parameters of the species, although they should only be one of the factors used in making a decision to downlist. Information necessary for the PVA that should be available through monitoring (ideally annually) includes: major limiting factors, breeding system, population structure and density, and proven management methods for major threats.

This recovery objective has not been met (see Table 1).

Delisting Criteria

In addition to achieving 5 to 10 populations with 500 mature individuals per populations and all of the goals of the interim and downlisting stages, all target populations must be stable, secure, naturally reproducing, and within secure and viable habitats for a minimum of 20 years. Species-specific management actions must no longer be necessary, but ecosystem-wide management actions are not ruled out if there are long-term agreements in place to continue management. These numbers are initial targets, but may be revised upward as additional information is available, including adequate PVAs for individual species based on current management and monitoring data collected at regular intervals determined by demographic parameters of the species, although they should only be one of the factors used in making a decision to delist. Genetic analyses should be conducted to ensure that adequate genetic representation is present within and among populations compared to the initial variation assessed in the interim stage. Numbers need to be considered on a species-by-species basis.

This recovery objective has not been met (see Table 1).

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

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

A recent study has confirmed that the Hawaiian species of *Euphorbia* are a diverse and unique lineage, with a North American origin. DNA analysis suggests that extensive hybridization was involved in the evolution of Hawaiian *Euphorbia*. C_4 photosynthesis is a physiological and anatomical system commonly associated with plants adapted to warm, dry climates. In the Hawaiian Islands there are many *Euphorbia* that use the C_4 system including *Euphorbia remyi* var. *kauaiensis* that grow in mesic (wetter) habitats or have evolved into woody plants and trees, which is highly unusual for plants using this type of photosynthetic process (Yang and Berry 2011). Little else is known about the life history of *E. remyi* var. *kauaiensis*. This species has been observed flowering in February and October (NTBG 1992a, 2009, 2015). Its pollination vectors, seed dispersal agents, longevity, specific environmental requirements, and limiting factors are unknown (USFWS 2010a).

Euphorbia remyi var. *kauaiensis*, a member of the spurge family (Euphorbiaceae), is a shrub with stems erect to scandent (climbing), 0.3 to 2 meters (1 to 6.6 feet) long, and flowering branches 1 to 6 millimeters (mm) (0.04 to 0.24 inch (in)) in diameter. The leaves are oppositely arranged with each succeeding pair set at right angles to the previous pair, and are elliptic to oblong or broadly lanceolate in shape. The blades are 35 to 165 mm (1.4 to 6.5 in) long and 15 to 75 mm (0.6 to 3.0 in) wide. This variety has many-branched cymose (flat-topped flower cluster in

which the main and branch stems each end in a flower that opens before those below it or to its side) inflorescences and glabrous (smooth) capsules scarcely protruding beyond the top of the cyathia (an inflorescence consisting of a cuplike cluster of modified leaves enclosing a female flower and several male flowers) (Koutnik 1999).

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:

Little is known about the historic range of *Euphorbia remyi* var. *kauaiensis*; however, two collections made on private lands at Kaholuamano and near Hanapepe Falls in 1916 and 1926, respectively, indicate that its range likely extended south and west from its currently known locations on Kauai (HBMP 2010). In the 1990s, *E. remyi* var. *kauaiensis* was known from three locations on Kauai, and totaled approximately 750 individuals. At the time of listing, *E. remyi* var. *kauaiensis* was found in five populations totaling at least 920 to 1,000 individuals (Wood 2005; HBMP 2010). Currently, only three populations have been monitored, with 50 to 100 individuals at Lumahai in 2000, 125 individuals from the “Blue Hole” of Wailua river (down from about 300 individuals in 1992), and about 50 to 100 individuals currently in Wainiha Preserve (PEPP 2015; Williams 2017, pers. comm.). The status of individuals at Iliiliula Stream, Hanapepe Falls, and Kaholuamano is unknown. Current estimates total 225 to 325 individuals of varying size classes.

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

No new information.

2.3.1.4 Taxonomic classification or changes in nomenclature:

This variety was described by Degener and Sherff as *Euphorbia remyi* var. *kauaiensis* (Sherff 1936). It was later moved to the genus *Chamaesyce* by Degener and Degener (1959), and recognized as a distinct taxon by Koutnik (1999). Steinman and Porter (2002) studied the phylogenetic relationship of the tribe Euphorbieae, in the Euphorbiaceae (spurge family). As a result of their work, *Chamaesyce* is no longer recognized as a separate genus from *Euphorbia*. This change in genus is recognized in the most recent treatment of the Hawaiian flora (Wagner *et al.* 2012). In 2015, the Service published a technical correction for this and other plant and wildlife species, recognizing the taxonomic change from *Chamaesyce remyi* var. *kauaiensis* to *Euphorbia remyi* var. *kauaiensis*, and the List of

Endangered and Threatened Plants (50 CFR 17.12) has been updated to reflect the new taxonomy (USFWS 2015b). This change does not affect the range or status of the species.

Euphorbia remyi var. *kauaiensis* differs from *E. remyi* var. *hanaleiensis* and *E. remyi* var. *remyi* by its many-branched cymose inflorescences and glabrous capsules scarcely exerted beyond the top of the cyathia (Koutnik 1999).

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.):

See section 2.3.1.2 above for spatial distribution of the species.

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

Euphorbia remyi var. *kauaiensis* is found in *Metrosideros polymorpha* (ohia) wet forest at elevations between 600 and 700 meters (1,970 and 2,300 feet) (Koutnik 1999; HBMP 2010). Associated native plant species include *Antidesma platyphyllum* (hame), *Bidens* spp. (kookoolau), *Boehmeria grandis* (akolea), *Broussaisia arguta* (kanawao), *Cheirodendron* spp. (olapa), *Coprosma kauensis* (koi), *Cyanea* spp. (haha), *Cyrtandra* spp. (haiwale), *Dicranopteris linearis* (uluhe), *Diospyros* spp. (lama), *Diplazium sandwichianum* (hoio), *Dubautia* spp. (naenae), *Freycinetia* spp. (ie ie), *Kadua* spp. (manono, uiwi), *Perrottetia sandwicensis* (olomea), *Pipturus* spp. (mamaki), *Polyscias* spp. (ohe), *Psychotria* spp. (kopiko), and *Syzygium sandwicensis* (ohia ha) (NTBG 1992b, 2009, 2015; HBMP 2010).

2.3.1.7 Other:

N/A

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 (Factor A):

Ungulate degradation of habitat—Feral pigs (*Sus scrofa*) and goats (*Capra hircus*) modify and degrade habitat by disturbing and destroying vegetative cover, trampling plants and seedlings, reducing or eliminating plant regeneration by damaging seeds and seedlings, and increasing

erosion by creating large areas of bare soil. Feral pigs and goats are noted to be a threat to individuals of *Euphorbia remyi* var. *kauaiensis* that occur at Lumahai and Wainiha (Wood 2000; HBMP 2010; NTBG 2015).

Established ecosystem-altering invasive plant modification and degradation of habitat—Invasive introduced plant species modify habitats occupied by native plant species by changing the availability of light, altering soil-water regimes, modifying nutrient cycling, and changing the fire characteristics of the native plant community. Invasive introduced plants with the greatest impacts on *Euphorbia remyi* var. *kauaiensis* are: *Andropogon glomeratus* (bushy beardgrass), *Angiopteris evecta* (mule's foot fern), *Axonopus fissifolius* (narrow-leaved carpetgrass), *Buddleja asiatica* (dog tail), *Clidemia hirta* (Koster's curse), *Conyza bonariensis* (hairy horseweed), *Cyperus meyenianus* (NCN), *Erigeron karvinskianus* (daisy fleabane), *Juncus planifolius* (bog rush), *Kalanchoe pinnata* (air plant), *Paspalum conjugatum* (Hilo grass), *P. urvillei* (vasey grass), *Pluchea carolinensis* (sourbush), *Psidium guajava* (common guava), *Rubus rosifolius* (thimbleberry), *Setaria gracilis* (yellow foxtail), and *Sphaeropteris cooperi* (Australian tree fern) (Kokee Resource Conservation Program (KRCP) 2014; NTBG 2009, 2015).

Landslides and flooding destruction or degradation of habitat—The only known individuals of *Euphorbia remyi* var. *kauaiensis* occur on cliffs at Blue Hole and Wainiha (Wood 2000; HBMP 2010; NTBG 2015). Large herds of feral goats browse and cause erosion in the area where *E. remyi* var. *kauaiensis* occurs (Wood 2000; HBMP 2010; NTBG 2015). Landslides destabilize substrates, damage and destroy individual plants, and alter hydrological patterns (Stearns 1985).

Hurricanes—Loss and degradation of habitat—In November 1982, Hurricane Iwa struck the Hawaiian Islands, with wind gusts exceeding 100 miles per hour (mph) (161 kilometers per hour (kph)), causing extensive damage, especially on the islands of Niihau, Kauai, and Oahu (Businger 1998). In September 1992, Hurricane Iniki, a category 4 hurricane with maximum sustained wind speeds recorded at 140 mph (225 kph), passed directly over the island of Kauai. Many forest trees were destroyed (Perlman 1992), which opened the canopy and facilitated the invasion of nonnative plants (Kitayama and Mueller-Dombois 1995). A destructive hurricane holds the potential of driving a localized endemic species to extinction in a single event. Hurricanes pose an ongoing and ever-present threat because they can happen at any time, although their occurrence is not predictable. Tropical cyclone frequency and intensity are projected to change as a result of climate change over the next 100 to 200 years (Vecchi and Soden 2007; Emanuel *et al.* 2008; Yu *et al.* 2010). In the central Pacific, modeling projects an increase of up to two additional

tropical cyclones per year in the main Hawaiian Islands by 2100 (Murakami *et al.* 2013).

Climate change loss or degradation of habitat—Fortini *et al.* (2013) conducted a landscape-based assessment of climate change vulnerability for native plants of Hawaii using high resolution climate change projections. Climate change vulnerability is defined as the relative inability of a species to display the possible responses necessary for persistence under climate change. This assessment concluded that *Euphorbia remyi* var. *kauaiensis* is vulnerable to the impacts of climate change with a vulnerability score of 0.498 (on a scale of 0 being not vulnerable to 1 being extremely vulnerable to climate change). Therefore, additional management actions are needed to conserve this taxon into the future.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes (Factor B):

Not a threat.

2.3.2.3 Disease or predation (Factor C):

Ungulate predation or herbivory—Herbivory by feral ungulates is a threat to *Euphorbia remyi* var. *kauaiensis* (Wood 2000; HBMP 2010; NTBG 2015).

Rodent predation or herbivory—Herbivory by rats is noted to be a threat to *Euphorbia remyi* var. *kauaiensis* at the Wainiha population (HBMP 2010; NTBG 2015). Rats eat virtually every part of plants and at every stage: fleshy fruits, seeds, flowers, stems, leaves, shoot, seedlings, and roots (Russell 1980; Cuddihy and Stone 1990). The effects on plants range from reduced vigor and decreased reproduction to mortality of individuals and complete lack of recruitment.

2.3.2.4 Inadequacy of existing regulatory mechanisms (Factor D):

Lack of adequate hunting regulations—Historic populations of *Euphorbia remyi* var. *kauaiensis* at Kaholuamano were within a state hunting area. The currently known individuals of this species at Wailua (Blue Hole) are within a state hunting area. Feral pigs and goats and the effects of their activities are noted to be a threat to *E. remyi* var. *kauaiensis*. Nonnative feral ungulates pose a major ongoing threat to native species through destruction and modification of habitat, and by direct herbivory or predation. Only those occurrences within Wainiha Preserve are provided some protection from ungulates by fencing. Public hunting areas are not fenced and game mammals have unrestricted access to most areas across

the landscape, regardless of underlying land use designation; therefore, any unfenced populations are at risk (DLNR 2010).

Lack of adequate biosecurity legislation—Introduction of invasive nonnative plant species to the State of Hawaii and destruction of habitat and competition by nonnative plants are threats to *Euphorbia remyi* var. *kauaiensis*. Pest species have caused the extinction of native species, the destruction of native forests, and the spread of disease. The U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, is authorized to prevent the introduction or dissemination of animal and plant pests on all ships, aircraft, and their cargo and baggage arriving in the U.S. and its territories; however, pest species continue to enter the State. In addition, Federal import regulations do not address many species that could be pests in Hawaii (CGAPS 2009; Ikuma *et al.* 2002).

2.3.2.5 Other natural or manmade factors affecting its continued existence (Factor E):

Invasive species—Established invasive plant species competition—Nonnative plant species including *Andropogon glomeratus*, *Angiopteris evecta*, *Axonopus fissifolius*, *Buddleja asiatica*, *Clidemia hirta*, *Conyza bonariensis*, *Cyperus meyenianus*, *Erigeron karvinskianus*, *Juncus planifolius*, *Kalanchoe pinnata*, *Paspalum conjugatum*, *P. urvillei*, *Pluchea carolinensis*, *Psidium guajava*, *Rubus rosifolius*, *Setaria gracilis*, and *Sphaeropteris cooperi* compete with *Euphorbia remyi* var. *kauaiensis* for space, water, light, and nutrients (Australian tree fern) (KRCP 2014; NTBG 2009, 2015).

Current Management Actions:

- Captive propagation for genetic storage and reintroduction—
 - In 2006 this species was in an *ex situ* collection at Lyon, but by 2008 it was no longer in storage (Lyon Arboretum 2006, 2008, 2017).
 - There are currently nine plants in the NTBG nursery from the “Blue Hole” population (NTBG 2017).
- Invasive plant monitoring and control—
 - Since 2004, the Nature Conservancy of Hawaii has conducted eradication efforts to control invasive *Sphaeropteris cooperi* in Lumahai Valley (TNCH 2008).
 - The Kokee Resource Conservation Program conducts nonnative plant removal at occurrences of *E. remyi* var. *kauaiensis* at Blue Hole (KRCP 2014).
- Ungulate monitoring and control—

- The Waipa Foundation (2005), a nonprofit grassroots community organization, controlled ungulates in Lumahai Valley for two years.
- The Nature Conservancy of Hawaii received funding from 2009 through 2015 for installation of fencing for ungulate control in Wainiha Preserve (TNCH 2015).

Table 1. Status and trends of *Euphorbia remyi* var. *kauaiensis* from listing through 5-year review.

Date	No. wild individuals	No. outplanted	Preventing Extinction Criteria identified by HPPRCC	Preventing Extinction Criteria Completed?
2010 (listing and critical habitat)	920–1,000	0	All threats managed in all three populations	Partially
			Complete genetic storage	No
			Three populations with 50 mature individuals each	No
2016 (5-year review)	225–325	0	All threats managed in all three populations	Partially
			Reproduction (<i>i.e.</i> , viable seeds, seedlings) at all three populations	Unknown
			Complete genetic storage	No
			Three populations with 50 mature individuals each	No

Table 2. Threats to *Euphorbia remyi* var. *kauaiensis* and conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulate degradation of habitat	A	Ongoing	None
Established ecosystem-altering invasive plant modification and degradation of habitat	A	Ongoing	Partially
Landslides and flooding destruction or degradation of habitat	A	Ongoing	None

Climate change loss or degradation of habitat	A	Ongoing	None
Ungulate predation or herbivory	C	Ongoing	Partially
Rodent predation or herbivory	C	Ongoing	None
Inadequacy of existing regulatory mechanisms— Lack of adequate hunting regulations	D	Ongoing	None
Inadequacy of existing regulatory mechanisms— Lack of adequate biosecurity legislation	D	Ongoing	None
Invasive species—Established invasive plant species competition	E	Ongoing	Partially

2.4 Synthesis

Preventing extinction, interim stabilization, downlisting, and delisting objectives are provided in HPPRCC’s Revised Recovery Objective Guidelines (2011). To prevent extinction, which is the first step in recovering the species, the taxon must be managed to control threats (*e.g.*, fenced) and have 50 individuals from each of three populations 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 Kauai where they now occur or occurred historically and each of these populations must be naturally reproducing (*i.e.*, viable seeds, seedlings, or saplings), and increasing in number, with a minimum of 50 mature individuals per population.

The preventing extinction goals for this species have not been met, as, although some populations may total 50 individuals (Table 1), the data is not current, and the estimates are for the total number of individuals and not for mature individuals. All threats are not being sufficiently managed throughout the range of the species and limited material exists in *ex situ* collections (Table 2). Therefore, *Euphorbia remyi* var. *kauaiensis* meets the definition of endangered as it remains in danger of extinction throughout its range.

3.0 RESULTS

3.1 Recommended Classification:

- Downlist to Threatened**
- Uplist to Endangered**
- Delist**
 - Extinction*
 - Recovery*

____ Original data for classification in error
X 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

- Surveys and inventories—Survey for populations of *Euphorbia remyi* var. *kauaiensis* in areas of potentially suitable habitat.
- Ungulate monitoring and control—Fence wild populations to prevent further damage from feral ungulates. Protect all occurrences against browsing and disturbances from feral ungulates.
- Invasive plant monitoring and control—
 - Control established ecosystem-altering nonnative invasive plant species around all populations.
 - Control invasive nonnative plant species around all populations that compete with the species.
- Predator and herbivore monitoring and control—Construct small-scale fences around all currently unprotected populations until larger areas are fenced and ungulate-free.
- Predator and herbivore monitoring and control—Implement effective measures to control rodents around any populations found.
- Captive propagation for genetic storage and reintroduction—Collect material for genetic storage for maintenance of genetic stock.
- Reintroduction and translocation—Reintroduce individuals into suitable habitat within historic range that is being managed for known threats to this species.
- Population biology research—Study *Euphorbia remyi* var. *kauaiensis* populations to determine viable population size and structure, geographical distribution, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, limiting factors, and threats.
- Stochastic events—Build resilience and redundancy—Increase numbers of populations and individuals scattered through historic range to reduce impacts from landslides and storms.
- Based on the recovery criteria above, consider development of a recovery plan.

5.0 REFERENCES

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U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of *Euphorbia remyi* var. *kauaiensis*
(‘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:

For **Field Supervisor, Pacific Islands Fish and Wildlife Office**
