

5-YEAR REVIEW
Short Form Summary
Species Reviewed: *Euphorbia herbstii* ('akoko)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2022. Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status reviews for 167 Species in Oregon, Washington, Idaho, Montana, California, Hawaii, Guam, and the Northern Mariana Islands. Federal Register 87(90):28031–28034, May 10, 2022.

Lead Region/Field Office:

Region 1/Pacific Islands Fish and Wildlife Office (PIFWO), Honolulu, Hawai'i

Name of Reviewer:

Cheryl Phillipson, Biologist, PIFWO
Lauren Weisenberger, Plant Recovery Coordinator, PIFWO
Megan Laut, Recovery Program Manager, PIFWO

Methodology used to complete this 5-year review:

This review was conducted by staff of the Pacific Islands Fish and Wildlife Office (PIFWO) of the U.S. Fish and Wildlife Service (Service) beginning in October 2023. The review was based on a review of current, available information since the last 5-year review for *Euphorbia herbstii* (USFWS 2019). The evaluation by Cheryl Phillipson, Biologist, was reviewed by Lauren Weisenberger, Plant Recovery Coordinator, and Megan Laut, Recovery Program Manager.

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/ecp/species/6481>).

Review Analysis:

Please refer to the previous 5-year reviews for *Euphorbia herbstii* published in the Federal Register on August 2, 2007, August 28, 2012, and September 25, 2019 (available at https://ecos.fws.gov/docs/tess/species_nonpublish/1092.pdf, https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/14005.pdf, and https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/2865.pdf) for a complete review of the species' status, threats, management efforts, and references cited. We are not aware of any significant new information regarding the species' biological status since listing to warrant a change in the Federal listing status of *E. herbstii*.

This short-lived perennial shrub in the Euphorbiaceae (spurge) family is endangered and is known from the island of O‘ahu. The status and trends for *Euphorbia herbstii* are provided in the tables below.

New Status Information:

- In 2019, there were seven mature and five immature wild plants at Kapuna-Pahole (USFWS 2019). In 2020, the population at Kapuna-Pahole totaled eight mature and five immature wild individuals (Army Natural Resources Program of O‘ahu [ANRPO] 2020 appendices, p. 306). In 2021, there were five mature and one immature individual at the same location (ANRPO 2021 appendices, p. 342). In 2022 and 2023, there were four mature and one immature individual (ANRPO 2022 appendices, p. 457; ANRPO 2023a appendices, p. 305). Recruitment has been reported at three reintroductions but is not currently ongoing (ANRPO 2020 appendices, p. 72).
- Currently, 35 founders from this one wild population are represented in *ex situ* collections (ANRPO 2023b).

New Threats:

- In 2018, drought was added as a new threat to *Euphorbia herbstii* (Bruegmann et al. 2018). Over the last 100 years, the islands of Hawai‘i have experienced an annual decline in precipitation of over 9 percent, increasing to as much as 15 percent within the last 20 years (US-NSTC 2008, p. 61; Chu and Chen 2005, pp. 4812–4813; Diaz et al. 2005, 4 pp.). Drought affects plants directly by desiccation. The increase in drought frequency and intensity leads to a self-perpetuating cycle of increase in cover of nonnative plants, an increase in the number of fires, and an increase in erosion (US-GCRP 2009, pp. 18, 24; Warren 2011).

New Management Actions:

- Surveys and monitoring—ANRPO monitors populations of *Euphorbia herbstii* (ANRPO 2020 appendices, p. 404; ANRPO 2021 appendices, p. 387; ANRPO 2022 appendices, pp. 412, 501; ANRPO 2023 appendices, p. 349).
- Invasive nonnative plant monitoring and control—ANRPO monitors and controls invasive nonnative plants at ‘Ōhikilolo, Kapuna-Pahole, and at the reintroduction sites at Kalua‘a and Mākaha (ANRPO 2020 appendix 3-12, appendices pp. 71–72, 404; ANRPO 2021 appendices, p. 387; ANRPO 2022 appendices, p. 501; ANRPO 2023 appendices, p. 349). Nonnative groundcover is controlled at Pahole to allow recruitment of native plants (ANRPO 2023 appendices, p. 82). Common native plants are planted to improve habitat around populations of *E. herbstii* at Pahole (ANRPO 2023, p. 103).
- Fire monitoring and management—ANRPO conducted fire prevention activities at Kapuna-Pahole (ANRPO 2021 appendices, p. 387).
- Rodent monitoring and control—ANRPO conducts rat control at Kapuna and Mākaha (ANRPO 2020 appendices, pp. 47, 404; ANRPO 2021 appendices, p. 387; ANRPO 2022 appendices, p. 501). In 2023, rodent control was conducted at Kalua‘a and Wai‘eli (Popouwela) (ANRPO 2023, pp. 207, 227, appendices, p.

108). Also in 2023, rat control grids at Pahole were maintained by the State’s Native Ecosystems Protection and Management (NEPM) program (ANRPO 2023 appendices, p. 64).

- Nonnative invertebrate monitoring and control—ANRPO controls slugs at Kapuna-Pahole (ANRPO 2020, p. 205, appendices, p. 404; ANRPO 2021, p. 196, appendices p. 387; ANRPO 2022, p. 217, appendices p. 501; ANRPO 2023, p. 244, appendices pp. 65, 349).
- Collection and propagation for genetic storage and reintroduction—
 - In 2023, ANRPO reported storage of 271 seeds representing three founders from Kapuna and 3,286 seeds representing 29 founders from Pahole, both locations make up a single population (ANRPO 2023b). In addition, there are three plants in the nursery representing one founder at Kapuna, and 18 plants representing two founders at Pahole (ANRPO 2023b).
 - In 2019, the Pahole Rare Plant Facility (Pahole RPF) reported propagation of one individual representing one founder at Kapuna (Pahole RPF 2019).
- Translocation and reintroduction—In 2020, ANRPO reported 55 mature and 146 immature individuals reintroduced at Kapuna-Pahole (the largest population), Kalua‘a, and Mākaha (ANRPO 2020 appendices, p. 306). In 2021, there were 78 mature and 88 immature individuals; in 2022 there were 86 mature and 55 immature individuals, and in 2023 there were 95 mature and 72 immature individuals at these sites (ANRPO 2021 appendices, p. 342; ANRPO 2022 appendices, p. 457; ANRPO 2023 appendices, p. 305). Out of the 351 individuals outplanted, 78 mature and 87 immature individuals survive (PEPP 2019–2013). A *ex situ* living collection site was established with 76 outplanted and 2 mature and 42 immature individuals surviving (PEPP 2019–2023).
- Research on seed storage and viability—The ANRPO’s current seed collection interval for *E. herbstii* is set for 15 years; however, seeds have only been tested at 10 years, a test at 15 years is planned (ANRPO 2021 appendices, p. 512).

Table 1. Status and trends of *Euphorbia herbstii* from listing through current 5-year review. Table 1a shows progress according to Interim Stabilization Goals; Table 1b shows progress according to Preventing Extinction Goals.

Table 1a.

Date	No. wild individuals	No. Outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization 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

2007 (5-year review)	56	0	All threats managed in all 3 populations	No
			Complete genetic storage	Partial
			3 populations with 50 mature individuals each	No
2012 (5-year review)	<60	0	All threats managed in all 3 populations	No
			Complete genetic storage	Partial
			3 populations with 50 mature individuals each	No

Table 1b.

Date	No. wild individuals	No. outplanted	*Preventing Extinction Targets identified by HPPRCC	*Preventing Extinction Targets Completed?
2019 (5-year review)	13	>160	All threats managed in all 3 populations	No
			Complete genetic storage	Partial
			Reproduction (i.e., viable seeds, seedlings) at all 3 populations	No
			3 populations with 50 mature individuals each	No
2024 (5-year review)	4 mature 1 immature	ca 516; 167 survive	All threats managed in all 3 populations	Partial, nonnative plants, predation and herbivory control ongoing

			Complete genetic storage	Partial, 35 founders from 1 population
			Natural reproduction at all 3 populations	Partial, recruitment observed at 3 reintroductions
			3 populations with 50 mature individuals each	No, observed recruitment not current

* The Preventing Extinction Stage was established in 2011. Prior to 2011, the Interim Stabilization Stage was the first stage towards recovery (now it is the second stage after Preventing Extinction).

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

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Established ecosystem altering invasive plant species destruction and degradation of habitat and competition	A, E	Ongoing	Partial, control at accessible wild and reintroduced subpopulations
Fire destruction and degradation of habitat	A	Ongoing	Partial, control of nonnative grasses at accessible subpopulations
Drought destruction and degradation of habitat	A	Ongoing	None
Climate change degradation or loss of habitat	A	Ongoing	None
Rodent predation and herbivory	C	Ongoing	Partial, control at 1 wild and 1 reintroduced subpopulation
Invertebrate predation and herbivory	C	Ongoing	Partial, control at 1 population
Small populations	E	Ongoing	Partial, seeds and propagules in storage, reintroduction efforts

Synthesis:

Currently, only four mature and one immature wild individuals remain. Nonnative plant control and predator control are ongoing. Approximately 35 founders are represented in seed collections, as propagules, and an estimated 40 founders are represented at reintroductions. Since the previous 5-year review a total of 516 individuals were

reintroduced with 95 mature and 72 immature individuals surviving. Recruitment had been observed at three different reintroductions but is not currently ongoing at any site. One *ex situ* living collection was established with 76 individuals, currently two mature and 42 immature individuals survive.

Stabilizing (interim), and downlisting and delisting criteria are provided in the Recovery Plan for the O‘ahu Plants (USFWS 1998) and preventing extinction targets have been added and criteria updated according to the draft revised recovery objective guidelines developed by the Hawai‘i and Pacific Plants Recovery Coordinating Committee (HPPRCC 2011). The HPPRCC identifies an additional initial objective, the Preventing Extinction Stage, in addition to the Interim Stabilization, Delisting, and Downlisting objectives. Furthermore, life history traits such as breeding system, population size fluctuation or decline, and reproduction type (sexual or vegetative), have been included in the calculation of goals for the number of populations and reproducing individuals for each stage. The goals for each stage remain grouped by life span defined as annual, short-lived perennial (fewer than 10 years), or long-lived perennial.

Euphorbia herbstii is a short-lived perennial small tree. To prevent extinction, which is the first milestone in recovering the species, the taxon must be managed to control threats (e.g., fenced) and have 50 individuals (or the total number of individuals if fewer than 50 exist) from each of three populations represented in *ex situ* (secured off-site, such as a nursery or seed bank) collections that are well managed. In addition, a minimum of a total of three populations should be documented on O‘ahu where they now occur or occurred historically and each of these populations must be naturally reproducing (i.e., viable seeds, seedlings) with a minimum of 50 mature, reproducing individuals per population.

The preventing extinction goals for this species have not been met. The number of wild individuals continues to decline with four mature and 1 immature individual surviving (Table 1). Genetic representation is close to completion for preventing extinction goals, with 35 founders represented in seed collections. Drought is added as a threat to this species (Table 2). Wildfire is an increasing threat to this species (Table 2). Control for predation by rodents and slugs are ongoing at some subpopulations. Therefore, *Euphorbia herbstii* meets the definition of Endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

Drought is added as a threat to *Euphorbia herbstii*, but no significant new information regarding the species’ biological status has been reported since the last 5-year review in 2019. Thus, the following recommendations for future actions are updated or reiterated for the 5-year review for 2024.

- Surveys and monitoring—Continue to monitor extant wild populations and translocations.

- Nonnative invasive plant monitoring and control—Continue to control established ecosystem-altering nonnative invasive plant species, and those that compete with *Euphorbia herbstii*, in accessible areas.
- Climate change adaptation strategy—Assess the modeled effects of climate change on this species and use to determine future landscape needed for its recovery.
- Fire monitoring and control—Continue to implement fire management plans for at-risk areas, especially implementing nonnative grass control and replacement with common native plant species.
- Captive propagation for genetic storage and reintroduction—
 - Continue collection and propagation efforts for maintenance of genetic stock and for reintroduction.
 - Continue to assess genetic variability within the extant populations and develop a plan for conserving the species’ genetic diversity in *ex situ* and reintroduced populations.
- Reintroduction and augmentation—Continue to augment and establish new populations within suitable and historical habitat that is being managed for known threats to this species.
- Build resiliency, redundancy, and representation—Increase species’ viability through habitat restoration, threat control, and reintroduction and translocation to reduce impacts of erosion, climate change, and wildfires.
- Alliance and partnership development—Continue to work with ANRPO, NEPM, and other land managers and partners to initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this species.

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U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of *Euphorbia 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
- No Change in listing status

For Field Supervisor, Pacific Islands Fish and Wildlife Office

_____ Date_____