5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Euphorbia rockii* (‘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 rockii* (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/6024*).

Review Analysis:

Please refer to the previous 5-year reviews for *Euphorbia rockii* published in the Federal Register on August 2, 2011 (as *Chamaesyce rockii*), and September 25, 2019 (available at *https://ecos.fws.gov/docs/tess/species_nonpublish/1752.pdf,* and *https://ecos.fws.gov/docs/tess/species_nonpublish/2867.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. rockii*.

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

New Status Information:

- In 2019, there were fewer than 100 individuals of *Euphorbia rockii* along the Koʻolau mountain summits of Oʻahu (USFWS 2019). Survey data from 2006 through 2020 counted 149 mature and 47 immature individuals in approximately 8 populations at Waimano-Waiawa, Helemano, Kawai Nui, Kīpapa, Kōloa-Kaipapaʻu, Kaluanui, ʻŌpaeʻula, , and Punaluʻu (Army Natural Resources Program of Oʻahu [ANRPO] 2023a; Plant Extinction Prevention Program [PEPP] 2019–2023). However, only 48 individuals at 5 populations have been observed in the last 10 years, and populations that have been monitored more than once have declined. For example, the Waimano Stream population (two individuals) has become extirpated over the last 10 years; The Waiawa population has had a 50% reduction during this time (13 to 6 individuals); and over the 20 year period from 1997 to 2017, a subpopulation in Kawaiʻiki has decline from 43 to only 2 individuals. The largest population at Kōloa had over 100 individuals, none of which have been monitored in over 10 years, and none that can be counted as contributing to the total current population size for this species (PEPP 2019–2023; ANRPO 2022 appendices, p. 266).
- Currently, approximately six founders from one population at Helemano are represented in seed collections, and one founder at Punaluʻu is represented in a seed collection (Lyon Arboretum 2022).

New Threats:

- Hybridization—Hybridization may be a potential threat as, on a survey at ʻŌpaeʻula in 2020, five individuals were observed that were possibly hybrids with *Euphorbia clusiifolia* (PEPP 2019–2023). Hybridization can lead to loss of species diversity, loss of local adaptations, and genetic representation (Todesco et al. 2016, pp. 892, 901–901).

New Management Actions:

- Surveys and monitoring—
  - ANRPO monitors populations of *Euphorbia rockii* in Kōloa (ANRPO 2022 appendices, p. 266; ANRPO 2023a; ANRPO 2023b, p. 208).
  - In 2020 and 2021, PEPP reported surveying for and collecting from *Euphorbia rockii* (PEPP 2021, p. 27).
- Invasive nonnative plant monitoring and control—A subpopulation at Kōloa of *E. rockii* occurs in an area the ANRPO determined to be a high priority for nonnative invasive plant control (ANRPO 2022 appendices, pp. 265–266).
- Rodent monitoring and control—ANRPO conducts small vertebrate control at a subpopulation of *E. rockii* at Kōloa (ANRPO 2023b, p. 208).
- Collection and propagation for genetic storage and reintroduction—In 2020–2021, the Lyon Seed Conservation Laboratory reported storage of 88 seeds collected from six founders at Helemano, and 1 seed collected from one founder at Punaluʻu (Lyon Arboretum 2022).

Table 1. Status and trends of *Euphorbia rockii* 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)	200–400	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	Unknown
2011 (5-year review)	141	0	All threats managed in all 3 populations	Partial
			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)	<100	0	All threats managed in all 3 populations	Partial
			Complete genetic storage	No
			Reproduction (i.e., viable seeds, seedlings, saplings) at all 3 populations	No
			3 populations with 50 mature individuals each	Partial, 1 population

2024 (5-year review)	48	0	All threats managed in all 3 populations	Partial, 7 populations fenced, nonnative plant and rodent control ongoing for 2 populations
			Complete genetic storage	Partial, 7 founders from 2 wild populations represented
			Natural reproduction at all 3 populations	No
			3 populations with 50 mature individuals each	No

* 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 rockii* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulate destruction and degradation of habitat	A	Ongoing	Partial, 7 populations fenced
Established ecosystem altering invasive plant species destruction and degradation of habitat and competition	A, E	Ongoing	Partial, control within fenced areas
Climate change degradation or loss of habitat	A	Ongoing	None
Rodent predation and herbivory	C	Ongoing	Partial, control at 1 wild subpopulation
Invertebrate predation and herbivory	C	Ongoing	None
Hybridization	E	Potential	None

Synthesis:
Currently, there are estimated to be 48 wild individuals of *Euphorbia rockii* in 5 populations. There could be more individuals within and at other populations, however these have not been monitored in over 10 years. Populations continue to decline in size. Seven of the populations (or portions of them) are protected from the negative effects of feral ungulates by fencing. Nonnative plant control is ongoing directly for at least one subpopulation. Rodent control is ongoing directly for *E. rockii* at one subpopulation. Only seven founders from two populations are represented in seed collections. Hybridization with *E. clusiifolia* was noted to be a potential threat at one subpopulation.

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 rockii is a short-lived perennial shrub or 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 *Euphorbia rockii* have not been met. There are no populations of 50 reproducing individuals. Fencing provides protection from feral ungulates at seven populations (Table 1, Table 2). Genetic representation is incomplete, only seven founders from two populations are represented in seed collections, with no propagation or translocation efforts (Table 1). Hybridization is a potential threat at one subpopulation (Table 2). Control for predation by rodents is ongoing at one subpopulation. Therefore, *E. rockii* meets the definition of Endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:
Hybridization is added as a potential threat to *Euphorbia rockii*, 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 known populations.
- Ungulate monitoring and control—Continue to fence and monitor all populations to provide protection against the negative impacts of feral ungulates.
- Nonnative invasive plant monitoring and control—Continue to control established ecosystem-altering nonnative invasive plant species, and those that compete with *Euphorbia rockii*, at all populations.
- Climate change adaptation strategy—Assess the modeled effects of climate change on this species and use to determine future landscape needed for its recovery.
- Rodent predation and herbivory control—Implement effective control methods at all populations.
- Invertebrate predation and herbivory control—Determine effective control methods and implement at populations where necessary.
- Captive propagation for genetic storage and reintroduction—Continue collection and propagation efforts for maintenance of genetic stock and for reintroduction.
- Reintroduction and augmentation—Begin 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 predation, climate change, and hybridization.
- Alliance and partnership development—Continue to work with ANRPO, the State's Native Ecosystems Protection and Management division, and other land managers and partners to initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this species.

References:

[ANRPO] Army Natural Resources Program of Oʻahu. 2022. 2022 Status report for the Mākua and Oʻahu Implementation Plans. Office of the Vice President for Innovation and Research, University of Hawaiʻi. 228 pp. + appendices, 690 pp.

[ANRPO] 2023a. Report on controlled propagation of listed species, as designated under the U.S. Endangered Species Act. Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaiʻi.

[ANRPO] 2023b. 2023 Status report for the Mākua and Oʻahu Implementation Plans. Prepared by Army Natural Resources Program, Oʻahu, Office of the Vice President for Innovation and Research, University of Hawaiʻi. 255 pp. + appendices, 534 pp.

[HPPRCC] Hawaiʻi and Pacific Plants Recovery Coordinating Committee. 2011. Revised recovery objective guidelines. 8 pp.

Lyon Arboretum. 2022. Report on controlled propagation of listed species, as designated under the U.S. Endangered Species Act. Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawai‘i.

[PEPP] Plant Extinction Prevention Program. 2019–2023. Plant Extinction Prevention Program fiscal years 2019 to 2023 interim performance report (October 1, 2018-September 30, 2023). U.S. Fish and Wildlife Service CFDA Program $15.657 Endangered Species Conservation—Recovery Implementation Funds, Cooperative Agreement: F18AC00502 (Final performance report), University of Hawai‘i at Mānoa, Pacific Cooperative Studies Unit. 105 pp.

[PEPP] 2021. Plant Extinction Prevention Program fiscal year 2021 interim performance report (October 1, 2020-September 30, 2021), Cooperative Agreement F19AC00532 (Interim report), U.S. Fish and Wildlife Service CFDA Program #15.657 Endangered Species Conservation—Recovery Implementation Funds, University of Hawai‘i at Mānoa, Pacific Cooperative Studies Unit, Plant Extinction Prevention Program. 46 pp.

Todesco, M., M.A. Pascual, G.L. Owens, K.L. Ostevik, B.T. Moyers, S. Hubner, S.M. Heredia, M.A. Hahn, C. Caseys, D.G. Bock, and L. H. Rieseberg. 2016. Hybridization and extinction. Evolutionary Applications 9: 892–908.

[USFWS] U.S. Fish and Wildlife Service. 1998. Recovery Plan for the O‘ahu Plants. Portland. 207 pp. + appendices.

[USFWS] 2011. *Euphorbia rockii*. 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. *https://ecos.fws.gov/docs/five_year_review/doc/1752.pdf.*

[USFWS] 2019. *Euphorbia rockii*. 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. *https://ecos.fws.gov/docs/five_year_review/doc/2867.pdf.*

[USFWS] 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.

U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of *Euphorbia rockii* (‘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

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

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