

5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Euphorbia celastroides* var. *kaenana* ('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 celastroides* var. *kaenana* (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/3842>).

Review Analysis:

Please refer to the previous 5-year reviews for *Euphorbia celastroides* var. *kaenana* 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/1090.pdf, https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/13938.pdf, and https://ecos.fws.gov/docs/tess/species_nonpublish/2863.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. celastroides* var. *kaenana*.

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 celastroides* var. *kaenana* are provided in the tables below.

New Status Information:

- The wild individuals of *Euphorbia celastroides* var. *kaenana* continue to decline from 1,329 mature and 320 immature wild individuals in 2019 to 742 to 1,239 mature and 87 to 207 immature wild individuals remaining in 2022 at Ka‘ena, Mākua, and Wai‘anae Kai (Army Natural Resources Program of O‘ahu [ANRPO] 2023a appendices, p. 304; PEPP 2019–2023; USFWS 2019). In 2022, the two largest subpopulations (Pua‘akanoa and Ka‘ena) totaled 132 and 843 mature individuals, respectively (ANRPO 2023a appendices, p. 304). In 2022, a new population of three individuals was discovered at Mākua (PEPP 2019–2023).
- Three hundred seven founders from six populations are represented in seed collections and by nursery plants. This includes over 50 plants each from the Mākua, Pua‘akanoa, and Ka‘ena population units.
- Wildfire is becoming a greater threat with fires occurring annually in the Wai‘anae mountains. Populations of *E. celastroides* var. *kaenana* have been burned and killed in previous wildfires within the Mākua Military Reservation and also at Ka‘ena Point State Park and Kuaokalā Game Management Area (ANRPO 2023a). The June 2022 wildfire came within 1,300 m (4,265 ft) of a population of *E. celastroides* var. *kaenana* at ‘Ōhikilolo (ANRPO 2022 appendices, p. 97). ANRPO works to prevent and manage the invasion of nonnative invasive plant species in management areas; the presence of which is conducive to wildfires (ANRPO 2023, p. 75). Kaluakauila (Mākua) is the area most at risk of wildfire, with steep fuel-laden slopes that are difficult to manage (ANRPO 2022, p. 249).

New Threats:

- Drought is reported to be a threat to all populations of *Euphorbia celastroides* var. *kaenana* (Keir 2018; PEPP 2019–2023). 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—In 2022, a new population of three individuals was discovered at Mākua (PEPP 2019–2023).
- Feral ungulate monitoring and control—ANRPO manages feral ungulates at Ka‘ena, Mākua, Kaluakauila, and east Kahanahāiki (ANRPO 2020 p. 7, appendices p. 403; ANRPO 2022 appendices, p. 500; ANRPO 2023a appendices, p. 348).

- Nonnative invasive plant monitoring and control—ANRPO conducts nonnative plant control at Ka‘ena outside the State’s predator-proof fence, east of Alau, Pua‘akanoa, and Mākua (ANRPO 2020 pp. 46–47, 55; appendices pp. 403, 516; ANRPO 2021 appendices, pp. 386; ANRPO 2022 appendices, p. 500; ANRPO 2023a appendices, p. 348). Nonnative plant control methodology is adapted as needed for each area (ANRPO 2021 appendices, p. 149–150). ANRPO proposed to conduct trial UAV flights at Ka‘ena Point NAR to conduct vegetation monitoring and currently has a permit for the project (ANRPO 2022 appendices, p. 210; ANRPO 2023, p. iv).
- Fire prevention and management—ANRPO conducts grass control as a high priority at Pua‘akanoa and Mākua (ANRPO 2020, p. 55; ANRPO 2021 appendices, p. 386; ANRPO 2022 appendices, p. 500; ANRPO 2023 appendices, p. 348). ANRPO outplants common natives as a fuel break and buffers around *E. celastroides* var. *kaenana* at ‘Ōhikilolo (Mākua Military Reservation) (ANRPO 2020, p. 93, appendices p. 403). This minimizes the labor required for grass control and improves habitat (ANRPO 2020 appendices, p. 516).
- Predation and herbivory—ANRPO observed rodent (rats and mice) damage on plants at Ka‘ena, Keawa‘ula, Mākua, and east Alau, and conducts rodent control in these areas (ANRPO 2021, p. 386; ANRPO 2022, pp. 96, 192; ANRPO 2024, pers. comm, p. 2). Damage by feral pigs was also observed at Ka‘ena in both the State Park and Natural Area Reserve and the area will be monitored (ANRPO 2022, p. 96). In 2022, when rat damage was no longer observed at Ka‘ena, controls were discontinued although the area continued to be monitored (ANRPO 2022, p. 216). Currently, however, damage was reobserved and staff installed a rodent control grid surrounding the population of *E. celastroides* var. *kaenana* (ANRPO 2023, pp. 222–223, appendices p. 348).
- Collection and propagation for genetic storage and reintroduction—
 - In 2023, ANRPO reported collection and storage of more than 28,000 seeds representing 307 founders in two populations (Ka‘ena and Mākua) (ANRPO 2023b). One individual representing one population at Ka‘ena was propagated in the plant facility (ANRPO 2023b). Populations at Mākua and Ka‘ena have met the ANRPO’s genetic storage goals and populations at Pua‘akanoa and east Alau have more than 50 percent representation (ANRPO 2020 appendices, p. 442; ANRPO 2021 appendices, p. 425; ANRPO 2022 appendices, p. 539; ANRPO 2023a appendices, p. 387).
 - In 2018, the Waimea Arboretum reported storage of two individuals representing one founder from an unspecified location (Waimea Arboretum 2018).

Table 1. Status and trends of *Euphorbia celastroides* var. *kaenana* 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?
1991 (listing)	300	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)	>900	0	All threats managed in all 3 populations	Partial
			Complete genetic storage	Partial
			3 populations with 50 mature individuals each	Partial
2012 (5-year review)	792	0	All threats managed in all 3 populations	Partial
			Complete genetic storage	Partial
			3 populations with 50 mature individuals each	Yes

Table 1b.

Date	No. wild individuals	No. outplanted	*Preventing Extinction Targets identified by HPPRCC	*Preventing Extinction Targets Completed?
2019 (5-year review)	1,329 +320	0	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partial, for 2 populations

			Reproduction (i.e., viable seeds, seedlings) at all 3 populations	Partial, 1 small population
			3 populations with 50 mature individuals each	Yes
2024 (5-year review)	742–1,239 mature 87–207 immature	0	All threats managed in all 3 populations	Partial, feral ungulates and nonnative invasive plants managed for 2 populations
			Complete genetic storage	Yes
			Natural reproduction at all 3 populations	None reported
			3 populations with 50 mature individuals each	Yes, but limited data to confirm

* 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 celastroides* var. *kaenana* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Degradation and destruction of habitat and herbivory by feral ungulates	A, C	Ongoing	Partial, 2 managed populations; partial fencing
Established ecosystem altering invasive plant species destruction and degradation of habitat and competition	A, E	Ongoing	Partial, 2 managed populations
Drought destruction and degradation of habitat	A	Ongoing	None
Fire destruction and degradation of habitat	A	Ongoing	Partial, fire management plan and nonnative invasive plant management
Climate change degradation or loss of habitat	A	Ongoing	None
Predation and herbivory by rodents	C	Ongoing	Partial, rodent control at 1 population
Hybridization	E	Ongoing	None
Human impacts	E	Ongoing	Partial, recreational area fenced
Small populations	E	Ongoing	Partial, seed storage and propagation

Synthesis:

Currently, three populations (Ka‘ena, Mākuā, and Wai‘anae Kai) total 742 to 1,239 mature and 87 to 207 immature individuals. A portion of one subpopulation is within a fenced area. There is some feral ungulate control, nonnative invasive plant control, rodent control, and firebreaks for these areas. Three hundred seven founders from the six populations are represented in seed collections and by nursery plants.

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 celastroides var. *kaenana* is a short-lived perennial shrub. 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. While there are estimated to be 3 populations with over 50 mature plants, no recruitment is reported, and population monitoring data is not recent for several populations, and annual reproduction is not monitored (Table 1). Genetic storage goals have been met (Table 1). However, only part of one subpopulation is in a fenced area and has rodent control (Table 2). Nonnative invasive plants are controlled when possible. Drought and wildfire are increasing threats to the species (Table 2). Hybridization is a potential threat to this species (Table 2). Therefore, *Euphorbia celastroides* var. *kaenana* meets the definition of Endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

Drought is added as a threat to *Euphorbia celastroides* var. *kaenana*, 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 regularly monitor populations for reproduction and population stability, especially when population size is in decline.
- Ungulate monitoring and control—Continue to construct and maintain exclosures to provide protection from the negative impacts of habitat degradation and browsing by feral ungulates.
- Nonnative invasive plant monitoring and control—Continue to control established ecosystem-altering nonnative invasive plant species, and those that compete with *Euphorbia celastroides* var. *kaenana*, at all populations.
- Fire destruction and degradation of habitat—Continue to implement fire management plans and manage nonnative invasive plants for 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.
- Predator and herbivore monitoring and control—Continue to implement control methods for rodents at all populations.

- 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—Begin translocation efforts to establish new populations and augment existing populations of *E. celastroides* var. *kaenana* in suitable habitat within historical range 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 drought, climate change, human disturbance, and potential hybridization.
- 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 celastroides* var. *kaenana*
(‘akoko)

Pre-1996 DPS listing still considered a listable entity? N/A

Recommendation resulting from the 5-year review:

- Delisting
- Reclassify from Endangered to Threatened status
- Reclassify from Threatened to Endangered status
- X No Change in listing status

For Field Supervisor, Pacific Islands Fish and Wildlife Office

_____ Date _____