5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Tetramolopium arenarium* (no common name)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2018. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 156 species in Oregon, Washington, Hawaii, Palau, Guam, and the Northern Mariana Islands. Federal Register 88(83): 20088–20092, May 7, 2018.

Lead Region/Field Office:

Interior Region 12/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, Conservation & Restoration Team 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 2019. The review was based on a review of current, available information since the last 5-year review for *Tetramolopium arenarium* (USFWS 2012). The evaluation by Cheryl Phillipson, Biologist, was reviewed by Lauren Weisenberger, Plant Recovery Coordinator, and Megan Laut, Conservation and Restoration Team 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/tess_public*).

Review Analysis:

Please refer to the previous 5-year review for *Tetramolopium arenarium* published in the Federal Register on August 28, 2012 (available at *https://ecos.fws.gov/docs/five_year_review/doc4057.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 *T. arenarium*.

This short-lived perennial shrub in the Asteraceae (sunflower) family is endangered and found on the island of Hawai‘i, with historic occurrences on Maui. The current status and trends for *Tetramolopium arenarium* are provided in the tables below.

New Status Information:

- At the time of the 5-year review in 2012 there were estimated to be 12 wild individuals of *Tetramolopium arenarium* at one location in Pōhakuloa Training Area (PTA). Currently, there is one population in the same area on PTA totaling 420 individuals (253 mature, 145 immature, and 22 seedlings) (U.S. Army Garrison 2020, pp. 13, 28–29, 55). Seedling flushes have been observed and seem to support continued transition to immature and mature age classes (U.S. Army Garrison 2020, pp. 28–29). However, monitoring data from 2016 through 2019 show that numbers of mature and immature individuals vary widely, likely depending on environmental conditions, with a low of 89 mature individuals to as many as 398, and from more than 680 juveniles dropping to 200 and below (U.S. Army Garrison 2013, p. 10; U.S Army Garrison 2020, pp. 28–29).

New Threats:

- Climate change loss or degradation of habitat—Climate change may pose a threat to this species. Fortini *et al.* (2013) conducted a landscape-based assessment of climate change vulnerability for native plants of Hawai‘i 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. The assessment by Fortini *et al.* (2013) concluded that *Tetramolopium arenarium* is vulnerable to the impacts of climate change, with a vulnerability score of 0.388 (on a scale of 0 being not vulnerable to 1 being extremely vulnerable to climate change). Therefore, additional management actions may be needed to conserve this taxon into the future, such as locating key microsites that overlap with current and future climate envelopes for outplanting efforts.

New Management Actions:

- Surveys and inventories—Field surveys to monitor and confirm the status of wild and reintroduced populations of *Tetramolopium arenarium* are conducted within PTA (U.S. Army Garrison 2020, pp. 6, 13). Threats and their impacts are monitored (U.S. Army Garrison 2020, pp. 13, 28–29).
- Drought degradation and destruction—Between 2016 and 2019, water stress was the most significant stressor to *T. arenarium* (U.S. Army Garrison 2020, pp. 28–29).
- Nonnative invertebrate predation and herbivory— Between 2016 and 2019, aphids, spittlebugs, scale, and ants caused stress and damage to individuals of *T. arenarium* (U.S. Army Garrison 2020, pp. 28–29).
- Captive propagation for genetic storage and reintroduction—
    - In 2013, PTA reported collection of more than 26,000 seeds from the only wild population, representing 222 founders, for genetic storage (U.S. Army Garrison 2013, p. 14). At least 25 percent of seeds germinated readily and seeds can be stored and retain viability for eight years (U.S. Army Garrison 2013, p. 16).
    - In 2019, PTA reported a total of approximately 3,700 seeds collected for storage representing 25 founders (U.S. Army Garrison 2020, pp. 35, 67–

68). The total numbers of seeds in storage are: more than 71,000 from wild individuals, almost 4,000 from greenhouse plants, and more than 8,000 from reintroduced individuals (U.S. Army Garrison 2020, p. 37). In addition, there are 258 plants in inventory (U.S. Army Garrison 2020, p. 42).

  - Only two plants were propagated at Pu‘uwa‘awa‘a in 2018 (Pu‘uwa‘awa‘a 2018).

- Reintroduction—In 2013 and 2019, there were no reintroduction efforts (U.S. Army Garrison 2013, pp. 17; U.S. Army Garrison 2020, pp. 43–44).
- Population biology—PTA conducted 10 seed germination trials using 1,465 seeds that produced 179 seedlings (approximately 12 percent germination rate) (U.S. Army Garrison 2020, p. 40).

Table 1. Status and trends of *Tetramolopium arenarium* from listing through current 5-year review.

Date	No. wild individuals	No. outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization Criteria Completed?
1994 (listing)	29 mature 79 immature	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
1996 (recovery plan)	382	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2003 (critical habitat, excluded)	ca 400	330	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No

2012 (5-year review)	8 mature 4 immature	520	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No, stability of recruits unknown
Date	**No. wild individuals**	**No. outplanted**	***Preventing Extinction Criteria identified by HPPRCC**	***Preventing Extinction Criteria Completed?**
2020 (5-year review)	253 mature, 145 immature,	0	All threats managed in all 3 populations	Partially, population in exclosure
			Complete genetic storage	Yes
			Reproduction (i.e. viable seeds, seedlings) at all 3 populations	Yes
			3 populations with 50 mature individuals each	No, 1 population only

* 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 *Tetramolopium arenarium* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulate destruction and degradation of habitat and herbivory	A, C, D	Ongoing	Yes, wild population fenced
Established ecosystem altering invasive plant species degradation of habitat and competition	A, E	Ongoing	Partial, some nonnative plant control at PTA, planned for other areas

Drought destruction and degradation of habitat	A	Ongoing	Partial, some supplemental water at PTA 2010
Fire destruction and degradation of habitat	A	Ongoing	Partial, nonnative plant control efforts and firebreaks at PTA
Climate change degradation and loss of habitat	A	Ongoing	None
Invertebrate predation	C	Ongoing	None
Military training activities	E	Ongoing	Partial, management at PTA following ESA consultation
Loss of vigor due to low numbers	E	Ongoing	Partial, germination and propagation trials, reintroduction

Synthesis:
Currently, 398 wild individuals of *Tetramolopium arenarium* occur within PTA on the island of Hawai‘i in one population with recruitment observed. A landscape-based assessment of climate change vulnerability for native plants of Hawai‘i using high resolution climate change projections was made by Fortini *et al.* (2013) and their analysis showed that *T. arenarium* is vulnerable to the effects of climate change. The population is provided protection from feral ungulates by fencing and ungulate control, with some nonnative plant management. There have been no recent reintroductions on State or federal lands. Natural recruitment has been reported. Germination trials are ongoing.

Stabilizing (interim), downlisting, and delisting objectives were provided in the Recovery Plan for the Big Island Plant Cluster (USFWS 1996), and have been 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.

Tetramolopium arenarium 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. In addition, a minimum of three populations

should be documented on the islands of Hawai‘i and Maui (however, the Maui subspecies *laxum* is extinct with no propagative materials available) 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. Currently, there is only one population and it does have more than 50 mature individuals; natural recruitment is observed. Genetic representation goals for preventing extinction have been met (Table 1). All threats, including nonnative plant competition, drought, and invertebrate predation, are not being managed (Table 1, Table 2). Therefore, *Tetramolopium arenarium* meets the definition of Endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:
We are not aware of any new threats or significant new information regarding the species' biological status since the last 5-year review in 2012. Thus, the following recommendations for future actions are reiterated for the 5-year review for 2020.

- Site, area, and habitat protection—Continue to develop and implement effective measures to reduce the impact of military activities.
- Population viability monitoring—Continue to monitor wild and reintroduced populations at PTA. Determine viability and success of reintroductions at Pu‘uwa‘awa‘a.
- Ungulate monitoring and control—Continue to construct and maintain fenced exclosures to protect individuals from the negative impacts of habitat destruction and degradation, and browsing and trampling by ungulates.
- Established ecosystem-altering invasive plant monitoring and control—Control established ecosystem-altering nonnative invasive plant species, and those that compete with *Tetramolopium arenarium* at all populations.
- Fire management—Continue to develop and implement fire management plans for PTA and Pu‘uwa‘awa‘a.
- Drought management—Continue emergency hand-watering of the PTA population as necessary.
- Climate change adaptation strategy—Assess the modeled effects of climate change on this species and use to determine future landscape needed for the recovery of the species.
- Invertebrate monitoring and control—Monitor *T. arenarium* for evidence of plant disease and infestations by nonnative invertebrates, and develop and implement effective control methods if necessary.
- Captive propagation for genetic storage and reintroduction—Continue collection and propagation efforts for maintenance of genetic stock and for reintroduction into protected suitable habitat within historical range.
- Reintroduction and translocation—Determine optimal sites for reintroduction including sites outside of PTA and continue to reintroduce individuals into these areas that are managed for known threats to achieve recovery goals.

- Population biology research—
    - Study the reproductive biology of T. arenarium in the field to determine pollinators.
    - Research possible causes of low survivability of immature plants.
- Alliance and partnership development—Continue to work with the U.S. Army Garrison, Department of Land and Natural Resources-Division of Forestry and Wildlife, and other partners and land managers in planning and implementation of ecosystem-level restoration and management to benefit this species.

References:

Fortini, L., J. Price, J. Jacobi, A. Vorsino, J. Burgett, K. Brinck, F. Amidon, S. Miller, S. Gon II, G. Koob, and E. Paxton. 2013. A landscape-based assessment of climate change vulnerability for all native Hawaiian plants. Technical report HCSU-044. Hawaii Cooperative Studies Unit, University of Hawaii at Hilo, Hawaii. 134 pp.

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

Pu‘uwa‘awa‘a. 2018. 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.

[USFWS] U.S. Fish and Wildlife Service. 1996. Recovery Plan for the Big Island Plant Cluster. Portland. 176 pp. + appendices.

[USFWS] 2012. *Tetramolopium arenarium* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. *https://ecos.fws.gov/docs/five_year_review/doc4057.pdf.*

[USFWS] 2018. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 156 species in Oregon, Washington, Hawaii, Palau, Guam, and the Northern Mariana Islands. 88 FR 20088, May 7, 2018.

U.S. Army Garrison. 2013. Memorandum: FY 2012 annual report for the Natural Resources Office, Pōhakuloa Training Area, Island of Hawaii, Department of the Army, Headquarters, U.S. Army Garrison, Pōhakuloa, Hilo, HI 26 pp.

U.S. Army Garrison. 2020. 2019 annual report for Pōhakuloa Training Area, Hawai‘i Island, Hawai‘i. Recovery Permit TE-40123A-2. Prepared by Colorado State University, Center for Environmental Management and Military Lands. 190 pp.

U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of *Tetramolopium arenarium*
(no common name)

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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