5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Geranium arboreum* (nohoanu, Hawaiian red-flowered geranium)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2021. Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status reviews for 77 Species in Oregon, Washington, Idaho, and Hawaii. Federal Register 86(120):33726–33728, June 25, 2021.

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 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 2022. The review was based on a review of current, available information since the last 5-year review for *Geranium arboreum* (USFWS 2018). The evaluation by Cheryl Phillipson, Biologist, was reviewed by Lauren Weisenberger, Plant Recovery Coordinator, and Megan Laut, Recovery 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/ecp/species/6346*).

Review Analysis:

Please refer to the previous 5-year reviews for *Geranium arboreum* published in the Federal Register on August 29, 2011, and October 23, 2018 (available at *https://ecos.fws.gov/docs/tess/species_nonpublish/1779.pdf* and *https://ecos.fws.gov/docs/tess/species_nonpublish/2631.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 *G. arboreum*.

This short-lived perennial shrub in the Geraniaceae (geranium) family is endangered and is endemic to Haleakalā, east Maui. The status and trends for *Geranium arboreum* are provided in the tables below.

New Status Information:

- Haleakalā National Park (HALE NP) reported two wild individuals present on the west slope of the park last observed in 2021 (Waikamoi Gulch) (HALE NP 2019, p. 293; Gates 2021, pers. comm.). Currently, there are four wild populations at Kanaio, Waiakoa, Waikamoi Gulch (including HALE NP), and Waiohuli, totaling fewer than 65 individuals (PEPP 2022; Maui Plant Extinction Prevention Program [Maui PEPP] 2016-2022). There are five translocated or augmented populations at Honomanu, Waiakoa, Waiopai, Waikamoi Gulch, and Waiohuli totaling approximately 118 individuals and 189 translocated individuals in subpopulations within HALE NP (PEPP 2022; Maui PEPP 2016-2022; Gates 2021, pers. comm.). No single population totals more than 50 individuals and natural seedling recruitment is rarely observed (HALE NP 2019, p. 301).
- Currently, there are approximately 14 founders (wild plants) from five populations represented in *ex situ* storage and propagation.

New Threats:

- None reported.

New Management Actions:

- Monitoring and surveys—Maui PEPP surveys for individuals and monitors wild, translocated, and augmented populations of *Geranium arboreum* (Maui PEPP 2016-2022). Haleakalā National Park (HALE NP) also monitors subpopulations within the park (HALE NP 2019; Gates 2021, pers. comm.). The Department of Land and Natural Resources-Division of Forestry and Wildlife discovered 5 individuals in a new subpopulation at Waiohuli in 2018 (Maui PEPP 2018).
- Monitoring and management of feral ungulates—All translocated or augmented subpopulations are within exclosures. At least seven wild subpopulations are within exclosures. Maui PEPP conducts fence monitoring and repair (Maui PEPP 2020, 2022).
- Control of nonnative invasive plants—Maui PEPP controls nonnative invasive at all wild and translocated subpopulations (Maui PEPP 2017-2022).
- Collection and captive propagation for genetic storage and translocation—
    - In 2023, the Olinda Rare Plant Facility (ORPF) reported propagation and storage of 57 plants representing six founders at Waiohuli (ORPF 2023).
    - In 2022, the Lyon Arboretum Micropropagation Laboratory reported propagation of 72 explants representing one founder at Waiakoa (Lyon Arboretum 2022). The Lyon Arboretum Seed Conservation Laboratory reported storage of 36 seeds representing one founder at Waikamoi Gulch collected in 2021, and 300 seeds collected from 2014-2017 representing six founders from Waiohuli (Lyon Arboretum 2022).
    - In 2022, HALE NP reported propagation and storage of 18 plants: 8 plants representing from 1 to 5 founders at Waikamoi Gulch, 3 plants representing 3 founders at Waiohuli, 2 plants representing 1 founder at Kanaio, 4 plants representing 1 founder at Waiakoa, and 1 plant representing 1 extirpated founder at Kailua Gulch (HALE NP 2022).

    - Maui PEPP reported collection of cuttings representing 3 founders at Waiakoa and 41 founders at Waiohuli, for propagation at ORPF and HALE NP, and collection of seeds at Waiohuli for storage at Lyon Arboretum (Maui PEPP 2016, 2017, 2021).
- Translocation and augmentation—
    - Between 2018 and 2022, ca 188 individuals were translocated or augmented to Honomanu, Waiakoa, Waiopai, Waiohuli, and Waikamoi Gulch (PEPP 2022).
    - By 2021, HALE NP had translocated 189 individuals mostly representing founders outside the park (Gates 2021, pers. comm.).

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

Date	No. wild individuals	No. outplanted	Stability Criteria identified in Recovery Plan	Stability Criteria Completed?
1992 (listing)	300	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 25 mature individuals each	No
2011 (5-year review)	<50	54	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 25 mature individuals each	No
Date	**No. wild individuals**	**No. outplanted**	***Preventing Extinction Criteria identified by HPPRCC**	***Preventing Extinction Criteria Completed?**
2018 (5-year review)	ca 60	ca 300	All threats managed in all 3 populations	Partially
			Reproduction (i.e., viable seeds, seedlings) at all 3 populations	No
			Complete genetic storage	Partially
			3 populations with 25 mature individuals each	No
2023 (5-year review)	<65	189 HALE NP; ca 118 outside HALE NP	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			Natural reproduction at all 3 populations	Rarely
			3 populations with 50[1] 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).

[1]We have increased the number of individuals required in the criteria for preventing extinction because of uncertainty regarding the longevity of this species.

Table 2. Threats to *Geranium arboreum* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Degradation and destruction of habitat by feral ungulates	A	Ongoing	Partial, 7 wild and all translocated subpopulations within exclosures
Established ecosystem altering invasive plant species degradation of habitat	A	Ongoing	Nonnative plant control at all subpopulations
Drought and erosion destruction and degradation of habitat	A	Ongoing	None
Fire destruction and degradation of habitat	A	Ongoing	Partial, fire-prone areas of Waiohuli and Kanaio are managed by the Leeward Haleakalā Watershed Restoration Partnership
Climate change degradation or loss of habitat	A	Ongoing	None
Predation and herbivory by feral ungulates	C	Ongoing	Partial, 7 wild and all translocated subpopulations within exclosures
Predation and herbivory by rodents	C	Ongoing	Partial, some trapping at 1 subpopulation
Predation and herbivory by invertebrates	C	Ongoing	None
Inadequacy of regulatory mechanisms–lack of adequate hunting regulations	D	Ongoing	Partial, 7 wild and all translocated subpopulations within exclosures
Loss of mutualists—loss of pollinators and seed dispersers	E	Ongoing	None
Reduced viability due to small populations	E	Ongoing	Partial, seed collection, propagation, and translocation and augmentation ongoing

Synthesis:
Currently there are fewer than 65 wild individuals of *Geranium arboreum* in four populations on Haleakalā (east Maui). Seven subpopulations of wild plants are within exclosures and all translocated and augmented subpopulations are within exclosures. Nonnative plants are controlled at all subpopulations. Cuttings and seeds have been collected from most of the known founders with storage and some propagation at three facilities representing at least 14 founders. More than 300 individuals were translocated or added to existing populations; however, little natural recruitment is observed.

Stabilizing (interim), downlisting, and delisting objectives are provided in the Recovery Plan for the Maui Plant Cluster (Hawai‘i) (USFWS 1997) 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.

Geranium arboreum 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 Maui 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. There are fewer than 65 wild individuals remaining on Haleakalā (Table 1). Although propagation and translocation are ongoing, there are no populations totaling at least 50 reproducing individuals and natural recruitment is rarely observed. Some wild subpopulations are within exclosures and all translocated or augmented populations are within exclosures with invasive nonnative plant management, but not all threats are being sufficiently managed throughout the range of the species including drought, fire, and predation and herbivory (Table 2). Therefore, *Geranium arboreum* meets the definition of Endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:
No significant new information regarding the species' biological status has been reported since the last 5-year review in 2018. Thus, the following recommendations for future actions are added or reiterated for the 5-year review for 2023.

- Surveys and population monitoring—Continue to monitor the wild and translocated individuals and survey for additional populations of *Geranium arboreum* in areas of potentially suitable habitat.
- Ungulate monitoring and control—Continue to construct and maintain fencing to protect individuals from the negative impacts of feral ungulates.
- Invasive nonnative plant monitoring and control—Continue control of established ecosystem-altering nonnative invasive plant species within and around populations of *G. arboreum*.
- Fire prevention and management—Continue to implement fire management plans for areas managed by the East Maui Watershed Partnership where *G. arboreum* occurs.
- Climate change adaptation strategy—Research suitability of habitat for translocation of this species in the future due to the impacts of climate change.
- Predator and herbivore monitoring and control—
    - Implement effective control methods for rodents within the vicinity of all individuals of *G. arboreum*.
    - Develop and implement effective control methods for slugs at accessible individuals of *G. arboreum*.
- Captive propagation for genetic storage and translocation—Continue collection of genetic resources for storage, propagation, and translocation.
- Translocation and augmentation—Continue to augment the population and translocate individuals into suitable habitat that is managed for known threats.
- Build resiliency, redundancy, and representation—Continue to augment populations and translocate individuals into suitable habitat that is being managed for known threats to this species to reduce impacts of drought, fires, predation and herbivory, and loss of mutualists.
- Alliance and partnership development—Continue to work with partners and other land managers in planning and implementation of ecosystem-level restoration and management to benefit this taxon.

References:

Gates, N.B. 2021, Haleakalā National Park Superintendent, Haleakalā National Park comments on the initiation of 5-year status reviews for 77 species in Oregon, Washington, Idaho, and Hawai‘i. 19 AUG 2021, 8 pp.

[HALE NP] Haleakalā National Park. 2019. Natural resource condition assessment Haleakalā National Park, natural resource report NPS/HALE/NRR—2019/1977, National Park Service, U.S. Department of the Interior, Natural Resource Stewardship and Science. 386 pp.

[HALE NP] 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.

[HPPRCC] Hawai‘i 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.

[Maui PEPP] Maui Plant Extinction Prevention Program. 2016-2022. Monthly Maui Nui plant species monitoring reports. Excel data tables.

[ORPF] Olinda Rare Plant Facility. 2023. 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] 2022. Plant Extinction Prevention Program fiscal year 2022 interim performance report (October 1, 2021-September 30, 2022), 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. 50 pp.

[USFWS] U.S. Fish and Wildlife Service 1997. Recovery Plan for the Maui Plant Cluster (Hawai‘i). Portland. 130 pp. + appendices.

[USFWS] 2011. *Geranium arboreum* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. *https://ecos.fws.gov/docs/tess/species_nonpublish/1779.pdf.*

[USFWS] 2018. *Geranium arboreum* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. *https://ecos.fws.gov/docs/tess/species_nonpublish/2631.pdf*.

[USFWS] 2021. Endangered and Threatened wildlife and plants; initiation of 5-year status reviews for 77 Species in Oregon, Washington, Idaho, and Hawaii. Federal Register 86(120): 33726–33728, June 25, 2021.

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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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