

5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Phyllostegia parviflora* (no common name)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2019. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 91 species in Oregon, Washington, Hawaii, and American Samoa. Federal Register 84(112): 27152–27154, June 11, 2019.

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 2020. The review was based on a review of current, available information since the last 5-year review for *Phyllostegia parviflora* (USFWS 2015). 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 reviews for *Phyllostegia parviflora* in the Federal Register on January 18, 2008 and August 6, 2015 (available at https://ecos.fws.gov/docs/tess/species_nonpublish/1155.pdf and https://ecos.fws.gov/docs/tess/species_nonpublish/2286.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 *P. parviflora*.

This short-lived perennial herb in the Lamiaceae (mint) family is endangered and is known from the islands of O‘ahu, Maui, and Hawai‘i. Currently, three varieties are recognized: *P. parviflora* var. *glabriuscula* (island of Hawai‘i), *P. parviflora* var. *parviflora* (Maui and O‘ahu-Ko‘olau mountains), and *P. parviflora* var. *lydgatei* (O‘ahu-

Wai‘anae mountains). The status and trends for *P. parviflora* are provided in the tables below.

New Status Information:

- As reported in the 5-year review for 2015, plants at Hawai‘i Volcanoes National Park (HAVO) were determined to be *Phyllostegia stachyoides*. In addition, occurrences of *P. stachyoides* at the South Kona Forest Reserve show different characteristics than those at HAVO, and their taxonomy has not yet been resolved. Possibly an occurrence at Hualālai may have been the only true *P. parviflora* var. *glabriuscula* (the variety known only from the island of Hawai‘i), but when the species was rediscovered there in the early 2000s it was believed to be *P. stachyoides* (PEPP 2019). As recently as 2015, there were estimated to be 100 individuals of *P. parviflora* var. *glabriuscula* on the island of Hawai‘i (possibly including reintroductions); however, there are no more recent observations of wild plants (Sugii et al. 2015). In the Ko‘olau mountains of O‘ahu, one population of *P. parviflora* var. *parviflora* was estimated to consist of about 100 individuals in 2001 (Perlman 2001). When monitored again in 2012, there were 21 mature and 2 immature individuals (Ching-Harbin and Portner 2012). Currently, there are no reported wild individuals of *Phyllostegia parviflora* var. *lydgatei* in the Wai‘anae mountains on O‘ahu.

New Threats:

- Disease—powdery mildew—Powdery mildew is a threat to *P. parviflora* var. *lydgatei* at Palikea (O‘ahu) (PEPP 2017). This fungal disease has been noted as a threat to other species of *Phyllostegia* in Hawai‘i, for example, *P. stachyoides* (Koko et al. 2018, 4 pp.; Zahn and Amend 2017, pp. 1–2). Powdery mildew grows as thin layers of mycelium (fungal tissue) on the surface of the affected plant parts appearing as white, powdery spots. This fungus causes leaves to turn chlorotic, necrotic, and to fall off (Davis et al. 2008, p. 2). Spores, which are the primary means of dispersal for the fungus, make up the bulk of the visible, white, powdery growth (Davis et al. 2008, p. 2). This fungal disease can impede growth or destroy wild and reintroduced populations of *Phyllostegia*.

New Management Actions:

- Monitoring and surveys—The Plant Extinction Prevention Program (PEPP) monitors reintroduced populations of both varieties on O‘ahu (PEPP 2017).
- Ungulate monitoring and management—Reintroduction sites for *P. parviflora* var. *lydgatei* at Pahole and Palikea (O‘ahu) are fenced (PEPP 2018).
- Nonnative plant management—Nonnative plants are managed by PEPP in cooperation with NEPM at the reintroduction sites of *P. parviflora* var. *lydgatei* at Pahole and Palikea, O‘ahu (PEPP 2018; Togikawa et al. 2018; Tsuneyoshi and Ching-Harbin 2013).
- Control of powdery mildew disease—University of Hawai‘i researchers conducted a study testing the effects of inoculation of propagules with a mycorrhizal fungi and an endophytic mycoparasite and effects on disease severity in a related species, *Phyllostegia kaalaensis* (Koko et al. 2018). They found that

- the endophyte alone performed well in protecting plants from powdery mildew, and that the best time to treat plants would be while they were grown in the greenhouse. Probiotic fungal cultures have been applied at reintroduction sites for other native *Phyllostegia* species with some success at protecting individuals from powdery mildew (Zahn and Amend 2017, p. 1).
- Collection and propagation for genetic storage and reintroduction—
 - The Lyon Arboretum Micropropagation Laboratory reported 87 explants in storage representing two founders of *P. parviflora* var. *lydgatei* from Pālāwai (O‘ahu) and 75 explants representing one founder of *P. parviflora* var. *glabriuscula* from Pu‘uwa‘awa‘a Forest Bird Sanctuary (Hawai‘i) (Lyon Arboretum 2020). The Lyon Seed Conservation Laboratory reported 113 seeds in storage representing one founder of *P. parviflora* var. *glabriuscula* from the Pu‘uwa‘awa‘a Forest Bird Sanctuary (Hawai‘i; identification remains questionable and likely *P. stachyoides*) and 1,155 seeds in storage representing eight founders of *P. parviflora* var. *lydgatei* from Pālāwai (O‘ahu) (Lyon Arboretum 2020).
 - From 2018 to 2020, the Pahole Rare Plant Facility reported storage of eight plants representing one founder of *P. parviflora* var. *lydgatei* at Puali‘i (O‘ahu) (Native Ecosystems Protection and Management [NEPM] 2020).
 - Between 2015 and 2019, the Volcano Rare Plant Facility (VRPF) reported storage of three individuals of *P. parviflora* var. *glabriuscula* representing three founders at Kīpukamauna‘iu and one individual representing one founder from Keauhou (VRPF 2020). However, the population at Kīpukamauna‘iu was determined to be *P. stachyoides* (National Park Service (NPS) 2019, p. 18).
 - Reintroduction and translocation—
 - In 2019, the VRPF reported propagation of three individuals of *P. parviflora* var. *glabriuscula* for reintroduction at Pu‘uwa‘awa‘a Forest Bird Sanctuary, however identification is questionable and likely represents *P. stachyoides* (VRPF 2020).
 - In 2016, 50 individuals of *P. parviflora* var. *lydgatei* were reintroduced at Palikea, with another 69 added in 2017 (PEPP 2017). From 2017 to 2019, PEPP monitored reintroductions of *P. parviflora* var. *lydgatei* in the Wai‘anae mountains (O‘ahu) at Kapuna (5 mature, 7 immature), Pahole (17 out of 35 planted remaining), Palikea (10 mature remaining), and at a second site at Palikea (1 mature and 47 immature) (PEPP 2017; Togikawa and Hardy 2017; Togikawa 2019; Togikawa et al. 2019, Togikawa et al. 2017).

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

Date	No. wild individuals	No. outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization Criteria Completed?
1996 (listing)	4 var. <i>parviflora</i> (O'ahu) 19 var. <i>lydgatei</i> (O'ahu)	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
1999 (recovery plan)	4 var. <i>parviflora</i> (O'ahu) 19 var. <i>lydgatei</i> (O'ahu)	0	All threats managed in all 3 populations	No
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2003 (critical habitat, O'ahu)	ca 30 var. <i>parviflora</i> (O'ahu) 4 var. <i>lydgatei</i> (O'ahu)	0	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2008 (5-year review)	ca 100 var. <i>parviflora</i> (O'ahu) ca 150 var. <i>glabriuscula</i> (Hawai'i)	100 var. <i>lydgatei</i> (O'ahu)	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially

			3 populations with 50 mature individuals each	No
2012 (critical habitat, O'ahu)	0 var. <i>lydgatei</i> ca 100 var. <i>parviflora</i> (O'ahu)	100 var. <i>lydgatei</i> (O'ahu)	All threats managed in all 3 populations	Partially
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2015 (5-year review)	ca 100 var. <i>parviflora</i> (O'ahu) ca 75 var. <i>glabriuscula</i> (Hawai'i)	>100 var <i>lydgatei</i> (O'ahu)	All threats managed in all 3 populations	Partially
			Complete genetic storage	No
			3 populations with 50 mature individuals each	Partially
Date	No. wild individuals	No. outplanted	*Preventing Extinction Criteria identified by HPPRCC	*Preventing Extinction Criteria Completed?
2021 (5-year review)	21 mature, 2 immature var. <i>parviflora</i> (O'ahu) 0 var. <i>lydgatei</i> (O'ahu) 0 var. <i>glabriuscula</i> (Hawai'i)	119 var. <i>lydgatei</i> ; ca 33 mature, 54 immature remain (O'ahu)	All threats managed in all 3 populations	Partially, ungulate exclosures at Pahole and Palikea with some nonnative plant control (O'ahu); ungulate management at Pu'uwa'awa'a (Hawai'i)
			Complete genetic storage	Partial
			Natural reproduction at all 3 populations	None reported

			3 populations with 50 mature individuals each	No
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* 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 *Phyllostegia parviflora* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Degradation and destruction of habitat by feral ungulates	A	Ongoing	Partial, exclosures at Pahole and Palikea (O‘ahu), ungulate management at Pu‘uwa‘awa‘a (Hawai‘i)
Established ecosystem altering invasive plant species degradation of habitat	A	Ongoing	Partial, nonnative plants controlled at Pahole and Palikea (O‘ahu)
Degradation and destruction by fire	A	Ongoing	Partial, fire management plan for military training area on O‘ahu
Degradation and destruction by landslides and flooding	A	Ongoing	None
Drought degradation and destruction	A	Ongoing	None
Predation and herbivory by rats	C	Ongoing	Partial, some rat control conducted for other species at Pahole and Palikea (O‘ahu)
Predation and herbivory by invertebrates—white fly, mites, mealy bugs, slugs	C	Ongoing	None
Disease—powdery mildew	C	Ongoing	Partial, mildew control trials
Reduced viability due to low numbers	E	Ongoing	Partial, seed collection, propagation, and reintroduction
Climate change	E	Ongoing	Partial, reintroduction efforts

Synthesis:

Currently, there are 21 mature and two immature wild *Phyllostegia parviflora* var. *parviflora* on O‘ahu, all other wild plants of variety *lydgatei* and variety *glabriuscula* are not locatable or are extirpated. Seed collections from wild and reintroduced plants are ongoing, with propagation and some reintroductions on O‘ahu (and efforts on Hawai‘i but likely misidentification). The last known founders of variety *lydgatei* from O‘ahu are currently represented in collections, but collections are ongoing for variety *parviflora*. If the Hawai‘i collections are of variety *glabriuscula*, then this variety is also represented in *ex situ* collections and reintroductions, however botanists believe this is more likely *P. stachyoides*. More than 100 individuals of variety *lydgatei* were reintroduced on O‘ahu. Two populations on O‘ahu are in enclosures with some nonnative plant control. Research for effective powdery mildew control methods is ongoing.

Stabilizing (interim), downlisting, and delisting objectives were provided in the Recovery Plan for the Multi-Island Plants (USFWS 1999) and have been updated according to the draft revised recovery objective guidelines developed by the Hawai‘i and Pacific Plants Recovery Coordinating Committee a (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.

Phyllostegia parviflora is a short-lived perennial herb with three varieties. 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, Hawai‘i, and/or 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. These goals should be for each variety as managed separately.

The preventing extinction goals for this species have not been met. There are 21 wild mature individuals remaining of the variety *parviflora* on O‘ahu and numbers continue to decline. Although several hundred individuals were reintroduced on Hawai‘i and O‘ahu many if not all believed to be variety *glabriuscula* are actually *P. stachyoides*, and less than half of the reintroduced individuals of variety *lydgatei* are surviving. There is genetic representation for variety *lydgatei* and variety *glabriuscula* (possibly), but no recent collections of variety *parviflora* are reported (Table 1). Not all threats are being addressed (Table 2). Therefore, *Phyllostegia parviflora* meets the definition of Endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

The disease powdery mildew is a new threat but no significant new information regarding the species' biological status has been reported since the last 5-year review in 2015. Thus, the following recommendations for future actions are added or reiterated for the 5-year review for 2021.

- Surveys and inventories—Continue surveys of geographical and historical range for a current assessment of the species' status.
- Ungulate control—Maintain existing exclosures and monitor for incursions.
- Invasive nonnative plant monitoring and control—Eradicate invasive introduced plants within exclosures and maintain exclosures to be free of invasive nonnative plants.
- Predator and herbivore monitoring and control—Implement effective measures to control rats and slugs and determine and implement effective control methods for nonnative insects.
- Fire prevention and control—Implement existing fire management plan for O'ahu and develop and implement fire management plans for occurrences on Hawai'i.
- Control of powdery mildew—Continue research for effective control methods for powdery mildew.
- Captive propagation for genetic storage and reintroduction—Continue collection of genetic resources of all varieties for storage, propagation, and reintroduction into managed suitable habitat within historical range.
- Reintroduction and translocation—
 - Continue reintroductions and augmentations into suitable habitat in areas that are managed for known threats.
 - Increase numbers of populations and individuals within suitable habitat to reduce impacts from drought, landslides, and disease.
- Climate change adaptation strategy—Research suitability of habitat for reintroduction of this species in the future due to impacts of climate change, including drought.
- Taxonomic research—Determine which occurrences on the island of Hawai'i are *P. parviflora* var. *glabriuscula* and which are *P. stachyoides*.
- 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.

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U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of *Phyllostegia parviflora*
(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

_____ Date _____