

5-YEAR REVIEW

Short Form Summary

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

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2020. Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status reviews for 129 Species in Oregon, Washington, Idaho, Hawaii, Montana, California, and Nevada. Federal Register 85(48): 14240–14243, March 11, 2020.

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 or USFWS) beginning in October 2021. The review was based on a review of current, available information since the last 5-year review for *Phyllostegia wawrana* (USFWS 2017). 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 (<https://ecos.fws.gov/ecp/species/6730>).

Review Analysis:

Please refer to the previous 5-year reviews for *Phyllostegia wawrana* published in the Federal Register on July 21, 2009, and September 17, 2017 (available at http://ecos.fws.gov/docs/tess/species_nonpublish/1377.pdf and http://ecos.fws.gov/docs/tess/species_nonpublish/2486.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. wawrana*.

This short-lived perennial herb in the Lamiaceae (mint) family is listed as endangered and is known from the island of Kaua‘i. The status and trends for *Phyllostegia wawrana* are provided in the tables below.

New Status Information:

- In 2017, there were six wild individuals at three locations (USFWS 2017). In 2019, there were two wild mature and one immature individuals at Mōhihi, and in 2016, one wild individual remained at Koai'e (Perlman 2016, 2019). There are three reintroduction sites: Kalalau, Waimea Canyon Rim, and Alaka'i-Pihea (Kishida et al. 2018; PEPP 2020).

New Threats:

- Reintroduced individuals of *Phyllostegia wawrana* have been observed to be infested by powdery mildew (*Neoerysiphe galeopsidis*) (Kishida and Perlman 2018). 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* species. University of Hawai'i and Utah Valley University researchers conducted a study testing the effects of inoculation of propagules with a mycorrhizal fungi and an endophytic mycoparasite (a yeast, *Pseudozyma aphidis*) and effects on disease severity in a related species, *P. 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. Recently, reintroductions of *P. wawrana* at Kalalau were being treated with a different solution (Kishida and Perlman 2018).

New Management Actions:

- Surveys and monitoring—The Plant Extinction Prevention Program (PEPP) surveys for and monitors wild and reintroduced *Phyllostegia wawrana* on Kaua'i (Kishida et al. 2018; Perlman 2016, 2019; PEPP 2020).
- Captive propagation for genetic storage and reintroduction—
 - In 2019, the National Tropical Botanical Garden (NTBG) reported storage of 478 seeds representing one reintroduced plant at Kalalau, and 13 plants in the nursery representing the same individual (NTBG 2019). In 2020, NTBG collected and stored 399 seeds representing one founder at Mōhihi (NTBG 2020). In 2021, NTBG propagated six plants representing one reintroduced plant at Kalalau and two second-generation plants sourced from Mōhihi (NTBG 2021).
 - The Lyon Arboretum Micropropagation Laboratory reported propagation and storage of 152 explants representing two founders from Mōhihi (Lyon Arboretum 2022). The Arboretum's Seed Conservation Laboratory reported storage of 25 seeds representing one founder from Koai'e, 637 seeds from two founders at Mōhihi, and 4,435 seeds representing 20 reintroduced plants at the Kalalau Rim enclosure (Lyon Arboretum 2022).
 - In 2019, the Kōke'e Mid-Elevation Nursery (KMEN) reported propagation of 85 plants for reintroduction representing three reintroduced plants at Kalalau

(KMEN 2019). In 2021, KMEN propagated eight plants representing one founder from Mōhihi (KMEN 2021).

- In 2020, the Olinda Nursery propagated 110 individuals representing the two founders at Mōhihi (Olinda Nursery 2020).
- Reintroduction and augmentation—PEPP established a new reintroduction site at Alaka’i-Pihea, outplanting 33 *P. wawrana* (PEPP 2020).

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

Date	No. wild individuals	No. outplanted	Stability Criteria identified in Recovery Plan	Stability Criteria Completed?
1996 (listing)	25–36	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
1998 (recovery plan)	45–56	0	All threats managed in all 3 population	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2003 (critical habitat)	34–54	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2009 (5-year review)	45–55		All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
Date	No. wild individuals	No. outplanted	*Preventing Extinction Criteria identified by HPPRCC	*Preventing Extinction Criteria Completed?

2017 (5-year review)	3–6	ca 111	All threats managed in all 3 populations	No
			Complete genetic storage	Partially, 4 of 6 founders represented
			Reproduction (i.e., viable seeds, seedlings) at all 3 populations	No
			3 populations with 50 mature individuals each	No
2022 (5-year review)	ca 3 to 4	ca 70	All threats managed in all 3 populations	Partially, reintroductions in exclosures
			Complete genetic storage	Near complete, 3 founders 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 *Phyllostegia wawrana* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Destruction and degradation of habitat by feral ungulates	A	Ongoing	Partial, reintroductions in exclosures
Established ecosystem altering invasive plant species degradation of habitat	A	Ongoing	Partial, exclosures managed
Climate change degradation and destruction of habitat, including hurricanes	A	Ongoing	None
Predation and herbivory by rodents	C	Ongoing	None
Disease—Powdery mildew	C	Ongoing	Partial, treatment for reintroduced individuals
Reduced viability due to low numbers	E	Ongoing	Partial, seed storage, propagation, and reintroduction

Synthesis:

Currently, there are approximately four wild individuals of *Phyllostegia wawrana* on Kaua‘i. Seed collection, propagation, and reintroduction is ongoing with at least three founders represented. Reintroductions are within exclosures with some nonnative invasive plant management. Some reintroductions are negatively affected by the disease powdery mildew. These plants are being treated and research regarding possible effective control methods is ongoing.

Stabilizing (interim), downlisting, and delisting objectives are provided in the Kaua‘i Islandwide Recovery Plan (USFWS 2021) 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.

Phyllostegia wawrana is a short-lived perennial herb. 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 Kaua‘i where this species now occurs

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 *Phyllostegia wawrana* have not been met. There are approximately four wild individuals remaining (Table 1). Seeds and propagated plants are in storage representing three founders from two locations (Table 1, Table 2). This species is susceptible to the many threats, such as habitat destruction by feral ungulates, nonnative plant competition, predation by rodents, the disease powdery mildew, and hurricanes (Table 2). Therefore, *P. wawrana* meets the definition of Endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

Infestation with powdery mildew is a new threat to *Phyllostegia wawrana* but there is no other significant new information regarding the species' biological status reported since the last 5-year review in 2017. Thus, the following recommendations for future actions are reiterated, added, or updated for the 5-year review for 2022.

- Surveys and inventories—Continue to survey for populations of *Phyllostegia wawrana* in areas of potentially suitable habitat.
- Feral ungulate monitoring and control—Continue to construct and maintain exclosures to protect occurrences against disturbance by feral ungulates.
- Nonnative invasive plant monitoring and control—Control established ecosystem-altering nonnative invasive plant species and those that compete with *P. wawrana* at all populations.
- Climate change adaptation strategy—Research suitability of habitat for viability of species, including where to conduct translocations in the future due to impacts of climate change.
- Predator and herbivore monitoring and control—Implement effective control measures for rodents at all populations.
- Disease—Implement effective control measures for powdery mildew.
- Captive propagation for genetic storage and reintroduction—Continue collection and propagation efforts for maintenance of genetic stock.
- Reintroduction and augmentation—Continue reintroduction of individuals into protected suitable habitat that is being managed for known threats to this species.
- Build resiliency and redundancy—Increase numbers of individuals and populations through translocations and habitat restoration to reduce impacts of threats, including climate change, disease, and reduced viability due to small population size.
- Population biology research—Study *P. wawrana* populations to determine viable population size and structure, geographical distribution, flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, limiting factors, and threats.
- Genetic research—Assess genetic variability within extant populations.

- 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 species.

References:

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- Kishida, W. and S. Perlman. 2018. Hawai‘i Rare Plant Restoration Group (HRPRG) Field Data Form *in* PEPP 2019: Plant Extinction Prevention Program, FY 2019 Annual Report (Oct 1, 2018-Sep 30, 2019), USFWS CFDA Program #15.657, Endangered Species Conservation-Recovery Implementation Funds, Coop Agreement F18AC00502, December 26, 2019, UH Mānoa, PCSU, PEPP. 192 pp. + appendices. BioPacifica database record for *Phyllostegia wawrana*, Pacific Islands Fish and Wildlife Office.
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- [KMEN] 2021. 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.
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U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of *Phyllostegia wawrana*
(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 _____