

## 5-YEAR REVIEW

Short Form Summary

**Species Reviewed:** *Phlegmariurus mannii* (wāwae‘iole)

**Current Classification:** Endangered

### **Federal Register Notice announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2023. Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status reviews for 133 Species in Oregon, Washington, Idaho, Montana, California, Nevada, Hawaii, Guam, and the Commonwealth of the Northern Mariana Islands. Federal Register 88(56):17611–17614, March 23, 2023.

### **Lead Region/Field Office:**

Region 1/Pacific Islands Fish and Wildlife Office (PIFWO), Honolulu, Hawai‘i

### **Name of Reviewer:**

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 *Phlegmariurus mannii* (USFWS 2020). The evaluation by Lauren Weisenberger, Plant Recovery Coordinator, was reviewed by 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 (<https://ecos.fws.gov/ecp/species/1215>).

### **Review Analysis:**

Please refer to the previous 5-year reviews for *Phlegmariurus mannii* published in the Federal Register on August 2, 2011, March 27, 2014, and September 30, 2020 (available at [https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public\\_docs/species\\_nonpublish/1754.pdf](https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/1754.pdf) and [https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public\\_docs/species\\_nonpublish/2190.pdf](https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/2190.pdf) and [https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public\\_docs/species\\_nonpublish/3166.pdf](https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/3166.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. mannii*.

This short-lived epiphytic lycophyte in the Lycopodiaceae (clubmoss) family is endangered and is known from the islands of Kaua‘i, Maui, and Hawai‘i. It was also recently discovered on the island of Moloka‘i. The status and trends for *Phlegmariurus mannii* are provided in the tables below.

#### New Status Information:

- A new population consisting of a single individual of *Phlegmariurus mannii* was discovered in Kumu‘eli on Moloka‘i in 2024. This is a new island record, as previously the species was only known from Kaua‘i, Maui, and Hawai‘i island. The Plant Extinction Prevention Program (PEPP) is working with the Bishop Museum on publishing the range expansion. (DLNR 2024).
- In 2020 we reported an estimate of 64 to 200 individuals in 5 populations on Maui. Currently, there are 48 individuals in 4 populations on Maui, 1 on Mauna Kahālāwai, and 3 on Haleakalā, in addition to the single individual on Moloka‘i (PEPP 2024). There are an unknown number of individuals at two additional populations in Haleakalā National Park, Lelekea and ‘Ohe‘o (HALE 2024). It is unknown if there remains an individual at Pu‘u Pili on Hawai‘i island.
- There are two wild plants represented in *ex situ* storage in a rare plant nursery and micropropagation laboratory, one from Maui and one from Moloka‘i.

#### New Threats:

- None reported.

#### New Management Actions:

- Monitoring and surveys—The Plant Extinction Prevention Program [PEPP] and Haleakalā National Park staff monitor individuals at Lihau and the National Park (PEPP 2019–2024; Mallinson, W. pers. comm. 2025).
- Ungulate monitoring and management—
  - Currently, two populations in Kīpahulu Forest Reserve and two populations in Haleakalā National Park are fenced and protected from ungulates, though one of these populations have not been observed recently (PEPP 2019–2024).
  - Haleakalā National Park monitors and maintains fences for the populations in Kīpahulu Valley and Kaukau‘ai. The Department of Land and Natural Resources Division on Forestry and Wildlife and East Maui Watershed Partnership (EMWP) monitors and maintains fences in Kīpahulu Forest Reserve (EMWP 2025).
- Invasive nonnative plant management—EMWP removes targeted invasive species in Kīpahulu Forest Reserve (EMWP 2025).
- Captive propagation for genetic storage and reintroduction—
  - In 2024, the Lyon Arboretum Micropropagation Laboratory reported propagation of one Petri dish of spores from a 2024 collection from the individual plant on Moloka‘i (Lyon Arboretum 2024).
  - There is one potted plant representing a wild plant from Kaukau‘ai (ORPF 2024).

**Table 1. Status and trends of *Phlegmariurus mannii* from listing through current 5-year review. Table 1a shows progress according to Interim Stabilization Goals; Table 1b show progress according to Preventing Extinction Goals.**

**Table 1a.**

<b>Date</b>	<b>No. wild individuals</b>	<b>No. outplanted</b>	<b>Stabilization Criteria Identified in Recovery Plan</b>	<b>Stabilization Criteria Completed?</b>
<b>1992 (listing)</b>	ca 35	0	All threats managed in all 3 populations	Partially
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
<b>2011 (5-year review)</b>	61-71	41	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
<b>2014 (5-year review)</b>	29-34	0	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No

**Table 1b.**

<b>Date</b>	<b>No. wild individuals</b>	<b>No. outplanted</b>	<b>Preventing Extinction Criteria Identified by HPPRCC*</b>	<b>Preventing Extinction Criteria* Completed?</b>
<b>2020 (5-year review)</b>	64-200 (maui) Unknown Hawai'i	82 planted	All threats managed in all 3 populations	Partially, 3-4 populations fenced
			Complete genetic storage	Limited
			Reproduction (i.e., viable seeds, seedlings) at all 3 populations	Partially, recruitment observed in Haleakalā NP
			3 populations with 50 mature individuals each	No
<b>2025 (5-year review)</b>	49 (48 Maui, 1 Moloka'i)	0	All threats managed in all 3 populations	Partially, 3-4 populations fenced
			Complete genetic storage	Limited
			Natural reproduction at all 3 populations	None reported
			3 populations with 50 mature individuals each	No; uncertain

\*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 *Phlegmariurus mannii* and ongoing conservation efforts.**

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Degradation and destruction of habitat by feral ungulates	A	Ongoing	Partial, fencing at Kīpahulu FR & Valley, Kaukau‘ai
Established ecosystem altering invasive plant species degradation of habitat	A	Ongoing	Partial, nonnative plant control efforts at Haleakalā NP and Kīpahulu FR
Climate change degradation or loss of habitat, including drought	A	Ongoing	None
Predation and herbivory by rodents and invertebrates	C	Ongoing	None
Lack of adequate hunting regulations	D	Ongoing	Partial, fencing at Haleakalā NP, Manawainui, Nuanuaaloo
Reduced viability due to low numbers	E	Ongoing	Partial, limited collection, and propagation

**Synthesis:**

Currently, there are possibly fewer than 50 wild individuals of *Phlegmariurus mannii* with 48 individuals in four populations on Maui, and a newly discovered individual on Moloka‘i, which represents an island range expansion for the species. There are an additional two populations on Maui that have not been recently observed and their status is unknown, as well as an additional potential individual at Pu‘u Pili on Hawai‘i island. Four populations are fenced and there is some invasive plant control ongoing. Collection and propagation are ongoing.

Interim stabilization targets, and Downlisting and Delisting objectives are provided in the Final Recovery Plan for the Maui Plant Cluster, 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, USFWS 1997). The HPPRCC identifies an additional initial objective, the Preventing Extinction Stage, in addition to the Interim Stabilization, Downlisting, and Delisting 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.

*Phlegmariurus mannii* is a short-lived epiphytic lycophyte. 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 the islands of Kaua‘i, Moloka‘i, Maui, Hawai‘i where the species occurred historically and each of these populations must be naturally reproducing (i.e., viable spores, sporelings) with a minimum of 50 mature, reproducing individuals per population.

The preventing extinction goals for this species have not been met. The status of *Phlegmariurus mannii* populations is uncertain as there is no recent monitoring of larger known populations and no recently observed populations with 50 or more reproducing individuals. There are only two wild plants represented in *ex situ* collections. Threats, especially drought, predation by rodents and invertebrates, and low numbers of individuals per population are not being addressed (Tables 1a, 1b, Table 2). Therefore, *P. mannii* 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 2020. Thus, the following recommendations for future actions are updated or reiterated for the 5-year review for 2025.

- Surveys and monitoring—
  - The historical range of *Phlegmariurus mannii* should be surveyed intensively, considering the new discovery on Moloka‘i.
  - All known populations should be monitored to determine population structure and primary threats.
  - Determine sites that have the highest likelihood of successful reintroductions.
- Ungulate monitoring and control—Construct and maintain exclosures and strategic fencing to protect individuals from the negative impacts of feral ungulates.
- Invasive nonnative plant monitoring and control—Control established ecosystem-altering nonnative invasive plants and those that compete with *P. mannii* at all populations.
- Species and habitat protection—Develop and implement effective control measures to reduce the impacts of drought.
- 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—Implement effective controls against predation and herbivory by rodents and slugs.
- Captive propagation for genetic storage and reintroduction—Continue collection and propagation efforts for maintenance of genetic stock and for reintroduction.
- Reintroduction and translocation— Identify suitable reintroduction sites and continue to establish new populations and augment wild populations on Maui and the island of Hawai‘i.

- Build resiliency, redundancy, and representation—Increase species’ viability through habitat restoration, threat control, and translocations into suitable habitat that is being managed for known threats.
- Alliance and partnership development—Continue to work with partners in planning and implementation of ecosystem-level restoration and management to benefit this species.

## References:

[DLNR–DOFAW] Department of Land and Natural Resources—Division of Forestry and Wildlife 2024. Rare Plant Program 2024 Island Highlights. 14 pp.

[https://dlnr.hawaii.gov/ecosystems/files/2025/03/Highlights\\_20250318.pdf](https://dlnr.hawaii.gov/ecosystems/files/2025/03/Highlights_20250318.pdf)

East Maui Watershed Partnership [EMWP] 2025. Explore the Watershed Management.

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

Lyon Arboretum. 2024. 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.

[ORPF] Olinda Rare Plant Facility. 2024. 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] Plant Extinction Prevention Program. 2019–2024. Plant Extinction Prevention Program fiscal years 2019 to 2023 interim performance report (October 1, 2018–September 30, 2023). U.S. Fish and Wildlife Service CFDA Program \$15.657 Endangered Species Conservation—Recovery Implementation Funds, Cooperative Agreement: F18AC00502 (Final performance report), University of Hawaii at Manoa, Pacific Cooperative Studies Unit. 105 pp. and interim performance report for F22AC02205, F23AC01766. 56 pp.

[USFWS] U.S. Fish and Wildlife Service. 1997. Final Recovery Plan for the Maui Plant Cluster. Portland, OR. 198 pp.

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- [USFWS] 2014. *Phlegmariurus mannii* (wāwae‘iole) 5-year review summary and evaluation. Pacific Islands Fish and Wildlife Office, Honolulu. 8 pp.  
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- [USFWS] 2020. *Phlegmariurus mannii* (wāwae‘iole) 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. 10 pp.  
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- [USFWS] 2023. Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status reviews for 133 Species in Oregon, Washington, Idaho, Montana, California, Nevada, Hawaii, Guam, and the Commonwealth of the Northern Mariana Islands. Federal Register 88(56):17611–17614, March 23, 2023.

**U.S. FISH AND WILDLIFE SERVICE**  
SIGNATURE PAGE for 5-YEAR REVIEW of *Phlegmariurus mannii* (wāwae‘iole)

**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
- No Change in listing status

**For Field Supervisor, Pacific Islands Fish and Wildlife Office**

\_\_\_\_\_ Date \_\_\_\_\_