

## 5-YEAR REVIEW

Short Form Summary

**Species Reviewed:** *Flueggea neowawraea* (mehamehame)

**Current Classification:** Endangered

### **FR 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 of for 91 species in Oregon, Washington, Hawai‘i, 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(s):**

Daniel Adamski, 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 February 2021. The review was based on a review of current, available information since the last 5-year review for *Flueggea neowawraea* (USFWS 2013). The evaluation completed by Daniel Adamski, 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](http://ecos.fws.gov/tess_public)).

### **Review Analysis:**

Please refer to the previous 5-year reviews for *Flueggea neowawraea* published in the Federal Register on April 7, 2009 (available at [https://ecos.fws.gov/docs/five\\_year\\_review/doc2469.pdf](https://ecos.fws.gov/docs/five_year_review/doc2469.pdf)) and August 9, 2013 (available at [https://ecos.fws.gov/docs/five\\_year\\_review/doc4213.pdf](https://ecos.fws.gov/docs/five_year_review/doc4213.pdf)) for a complete review of the species' status, threats, and management efforts. 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 *Flueggea neowawraea*.

This long-lived perennial tree occurs on the islands of Kaua‘i, O‘ahu, Maui, and Hawai‘i. The current status and trends for *Flueggea neowawraea* are provided in the tables below.

#### New Status Information:

- On Kaua‘i, the Plant Extinction Prevention Program (PEPP) reported 36 individuals in 6 populations (PEPP 2021, in litt.)
- On O‘ahu, the Army Natural Resource Program (ANRP) staff identified 4 populations on military lands with only 12 wild individuals remaining, and 11 populations on other lands with 17 mature wild individuals. An additional 108 outplanted individuals remain. None of the individuals have been observed reproducing (ANRP 2020).
- On Maui, the Auwahi *Flueggea* Restoration Project (AFRP) observed 2 wild individuals and 7 outplanted individuals from 1 population (AFRP 2020). There is one additional population with one individual (PEPP 2021).
- On the island of Hawai‘i, the Plant Extinction Prevention Program (PEPP) reported a total of 60 individuals, of which 37 were outplanted. The largest population included 16 individuals (PEPP 2019).
- Overall, the number of wild individuals has increased from approximately 76 in the last five-year review (USFWS 2013) to 91 currently remaining, due to additional surveys that discovered new individuals on Kaua‘i and Hawai‘i. In addition, there are currently 152 outplanted individuals.
- The critical habitat units designated on Kaua‘i in 2003 remain the same and include 6 critical habitat units in 2 ecosystems (dry and mesic forest) for *Flueggea neowawraea* in the Kalalau Valley, Kawaiiki Valley, Pu‘u Ki Summit, Kaalahina Ridge, Miloli‘i Ridge, Ku‘ia Valley, and Mahanaloa Valley of Kaua‘i (1471 acres (ac), 594 hectares (ha) (68 FR 9116, February 27, 2003). In 2012, 11 critical habitat units in 2 ecosystems (lowland mesic and dry cliff) were designated for *F. neowawraea* in the Wai‘anae Mountains on O‘ahu (7332 ac, 2967 ha) (77 FR 57648, September 18, 2012). In 2016, 1 critical habitat unit in 1 ecosystem (lowland mesic) was designated for *F. neowawraea* in the eastern side of Moloka‘i (8770 ac, 3549 ha) (81 FR 17790, March 30, 2016). In 2016, 4 critical habitat units in 1 ecosystem (lowland dry) were designated for *F. neowawraea* in Keauhou, and from Kanaio to Kahualau Gulch on east Maui (16,842 ac, 6355 ha) (81 FR 17790, March 30, 2016). In 2003, 2 critical habitat units in 1 ecosystem (mesic forest) was designated for *F. neowawraea* in the Ki‘ilae and Kaunā watersheds on the island of Hawai‘i (3645 ac, 1475 ha) (68 FR 39624, July 2, 2003).

#### New Threats:

- 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 p. 76) concluded that *Flueggea neowawraea* is vulnerable to the impacts of climate change, with a vulnerability score of 0.37 (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 identifying outplanting sites that overlap with current and future climate envelopes for *F. neowawraea*.

#### New Management Actions:

- Ungulate exclosures—
  - On Maui, AFRP began work in 2016, and completed an approximately 2-acre deer and ungulate exclusion fence protecting 2 wild *Flueggea neowawraea* trees (AFRP, 2020). The new exclusion fence replaced dilapidated smaller fences that previously protected the *F. neowawraea* trees.
  - On the island of Hawai‘i, two fences were constructed beginning in 2019 to protect *Flueggea neowawraea*, one at Pu‘u Wa‘awa‘a, and the other around TNC’s South Kona Preserve (PEPP 2019).
  
- Captive propagation for genetic storage and reintroduction—
  - One hundred thirty-nine individuals representing 33 founders are in the ANRPs’ nurseries on O‘ahu. In addition, 2,143 seeds representing 12 founders are maintained in storage. The ANRP also constructed a taller shade house in 2018, with a maximum height of 12 feet, to accommodate living collections of taller plants, including *Flueggea neowawraea* (ANRP 2019).
  - The Volcano Rare Plant Facility (VRPF) maintains 10 individuals in propagation representing 7 founders (VRPR 2020).
  - The Olinda Rare Plant Facility (ORPF) on Maui maintains 17 individuals in propagation representing 3 founders (ORPF 2019).
  - The AFRP on Maui collected 12 mature fruit from 1 plant in 2018 (AFRP 2020).
  - The Lyon Seed Conservation Laboratory reports 25,894 seeds representing 5 founders (Lyon Arboretum 2020).
  - The National Tropical Botanical Garden (NTBG) on Kaua‘i has 1,591 seeds maintained in storage representing 13 founders (NTBG 2020).
  
- Reintroduction and translocation—
  - The ANRP (2020) reports ongoing reintroductions with a total of 108 outplanted individuals remaining. Most recently, in December 2020, 27 *Flueggea neowawraea* were outplanted in the Kahanahāiki management unit on O‘ahu.
  - In October 2020, 7 *Flueggea neowawraea* seedlings were planted into the Auwahi ungulate exclusion fence on Maui (AFRP 2020).

**Table 1. Status and trends of *Flueggea neowawraea* listing through current 5-year review.**

<b>Date</b>	<b>Number wild individuals</b>	<b>Number out-planted</b>	<b>Stabilization Criteria identified in Recovery Plan</b>	<b>Stabilization criteria completed?</b>
1994 (Listing)	127-167	0	All threats managed in all three populations	No
			Complete Genetic Storage	No
			Three populations with 25 mature individuals each	No
1998 (recovery plan)	124-195	1	All threats managed in all three populations	No
			Complete Genetic Storage	No
			Three populations with 25 mature individuals each	No
2009 (5-year review)	108-128	72	All threats managed in all three populations	No
			Complete Genetic Storage	No
			Three populations with 25 mature individuals each	No
2013 (5-year review)	76	0	All threats managed in all three populations	No
			Complete Genetic Storage	Partial
			Three populations with 25 mature individuals each	No
2021 (5-year review)	91	152	All threats managed in all three populations	Partially, fencing for some populations
			Complete Genetic Storage	Partial
			Natural reproduction at all 3 populations	No
			Three populations with 50 mature individuals each	No

**Table 2. Status of threats to *Flueggea neowawraea* and ongoing conservation efforts.**

Threat	Listing Factor	Current Status	Conservation/Management Efforts
Ungulates habitat destruction and degradation	A	Ongoing	Partial, some fencing to exclude ungulates
Stochastic Events: hurricanes, landslides, and flooding	A	Ongoing	Partial, some outplanting ongoing
Established ecosystem altering invasive plant species degradation of habitat	A	Ongoing	Partial
Black twig borer ( <i>Xylosandrus compactus</i> )/fungus ( <i>Fusarium solani</i> ) and Chinese rose beetle ( <i>Adoretus sinicus</i> )	C	Ongoing	None
Rat predation and herbivory	C	Ongoing	Partial
Barriers to cross pollination leading to reduced reproduction	E	Ongoing	Partial, <i>ex situ</i> controlled breeding at ANRP nursery
Fire	E	Ongoing	Partial
Climate change	E	Increasing	None
Military training activity	E	Ongoing	Partial

**Synthesis:**

Currently there are 91 wild individuals of *Flueggea neowawraea* on Kaua‘i, O‘ahu, Maui, and the island of Hawai‘i. 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 *Flueggea neowawraea* is vulnerable to the effects of climate change. Some plants are provided protection from ungulates by fencing, there is some rodent and nonnative plant control. Seed collections, propagation, and outplanting are 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 (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.

*Flueggea neowawraea* is a long-lived, dioecious, perennial tree. 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 3 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 3 populations total should be documented on Kaua‘i, O‘ahu, Maui, and/or the island of Hawai‘i, where they now occur or occurred historically and each of these populations must be naturally reproducing (i.e., viable seeds, seedlings, and saplings), with a minimum of 50 mature, reproducing individuals per population.

The preventing extinction goals for this species have not been met. Genetic storage is not complete (Table 1), there are no single populations totaling at least 50 reproducing individuals, and all threats are not being managed (Table 1, Table 2). Therefore, *Flueggea neowawraea* 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 2013. Thus, the following recommendations for future actions are reiterated for the 5-year review for 2021.

- Surveys and inventories—Continue to survey geographical and historical range for a current assessment of the species' status.
- Ungulate monitoring and control—Continue to maintain fenced exclosures to protect individuals from the negative impacts of ungulates.
- Invasive plant monitoring and control—Continue control of established ecosystem-altering nonnative invasive plant species, and those that compete with *Flueggea neowawraea*, especially within fenced populations.
- Site and habitat protection—Develop and implement effective management measures to reduce the impact of drought.
- Fire monitoring and control—Continue to develop and implement fire prevention management plans.
- 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.
- Predator and herbivore monitoring and control—Determine and implement effective methods to control insect pests.
- Captive propagation for genetic storage and reintroduction—Continue collection and propagation efforts for maintenance of genetic stock and for reintroduction.
- Reintroduction and translocation—Continue to reintroduce individuals into suitable habitat within historic range that is being managed for known threats to this species and build resiliency in population and redundancy across the species range to reduce impacts from threats such as climate change and stochastic events.

- Population biology research—Determine limiting factors to increase survivability of reintroduced populations.
- Alliance and partnership development—Initiate planning and contribute to implementation of ecosystem-level management and restoration to benefit this species.
- Investigate techniques to improve natural recruitment, including development and implementation of methods to control black twig borer and other pests.
- Assess genetic variability within extant populations.
- Study *Flueggea neowawraea* populations with regard to population size and structure, geographical distribution, flowering cycles, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, limiting factors, and threats.

### References:

See previous 5-year reviews for a full list of references (USFWS 2009, 2013). Only references for new information are provided below.

[AFRP] Auwahi *Flueggea* Restoration Project. 2020. Annual Report, fiscal year 2020 (Oct 1, 2019-Sep 30, 2020). 9 pp.

[ANRP] Army Natural Resource Program- O‘ahu. 2020. Status report for the Makua and O‘ahu implementation plans. 217 pp.

[BioPac] 2020. BioPacifica database for the Pacific Islands Fish and Wildlife Office. Unpublished.

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. Hawai‘i Cooperative Studies Unit, University of Hawai‘i at Hilo, Hawai‘i. 134 pp.

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

Lyon Arboretum. 2020. 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, Hawaii.

[NTBG] National Tropical Botanical Garden. 2020. 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. 2019. Report on controlled propagation of listed and candidate 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, 2021. Notes and evaluation of multi-island species on PEPP list. Unpublished report submitted to U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawai'i. 192 pp.
- [USFWS] U.S. Fish and Wildlife Service. 1999. Recovery Plan for Multi-Island Plants. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. [https://ecos.fws.gov/docs/recovery\\_plan/990710.pdf](https://ecos.fws.gov/docs/recovery_plan/990710.pdf).
- [USFWS] 2003. Endangered and threatened wildlife and plants, final designation or nondesignation of critical habitat for 95 plant species from the islands of Kaua'i and Ni'ihau, HI; final rule. 68 FR 9116, February 27, 2003.
- [USFWS] 2003. Endangered and threatened wildlife and plants, final designation or nondesignation of critical habitat for 46 plant species from the island of Hawaii, HI; final rule. 68 FR 39624, July 2, 2003.
- [USFWS] 2009. *Flueggea neowawraea* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu. HI. [https://ecos.fws.gov/docs/five\\_year\\_review/doc2469.pdf](https://ecos.fws.gov/docs/five_year_review/doc2469.pdf).
- [USFWS] 2012. Endangered and threatened wildlife and plants; Endangered status for 23 species on Oah'u and designation of critical habitat for 124 species; final rule. Department of the Interior, 77 FR 57648, September 18, 2012.
- [USFWS] 2013. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 138 species in Hawai'i, Oregon, Washington, and California. Federal Register 82(75): 18665–18668, April 20, 2017.
- [USFWS] 2013 *Flueggea neowawraea* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu. HI. [https://ecos.fws.gov/docs/five\\_year\\_review/doc4213.pdf](https://ecos.fws.gov/docs/five_year_review/doc4213.pdf).
- [USFWS] 2016. Endangered and threatened wildlife and plants; designation and nondesignation of critical habitat on Moloka'i, Lana'i, Maui, and Kaho'olawe for 135 species; final rule. 81 FR 17790, March 30, 2016.
- [VRPF] Volcano Rare Plant Facility. 2020. 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.



**U.S. FISH AND WILDLIFE SERVICE**

SIGNATURE PAGE for 5-YEAR REVIEW on *Flueggea neowawraea* (mehamehame)

**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, Fish and Wildlife Service**

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Date \_\_\_\_\_