5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Lysimachia maxima* (no common name)

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, Acting 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 *Lysimachia maxima* (USFWS 2018). The evaluation by Cheryl Phillipson, Biologist, was reviewed by Lauren Weisenberger, Plant Recovery Coordinator, and Acting 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/4561*).

Review Analysis:

Please refer to the previous 5-year reviews for *Lysimachia maxima* published in the Federal Register on January 18, 2008, March 31, 2014, and October 23, 2018 (available at *https://ecos.fws.gov/docs/tess/species_nonpublish/1185.pdf, https://ecos.fws.gov/docs/tess/species_nonpublish/2195.pdf,* and *https://ecos.fws.gov/docs/tess/species_nonpublish/2642.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 *L. maxima*.

This short-lived perennial shrub in the Primulaceae (primrose) family is endangered and is endemic to Moloka‘i. The status and trends for *Lysimachia maxima* are provided in the tables below.

New Status Information:

- Currently, there are three wild populations of *Lysimachia maxima* totaling 18 mature and 3 immature individuals at east Kawela, ʻŌhiʻalele, and Olokuʻi on Molokaʻi (Coelho and Purdy 2020; Bakutis et al. 2019; Espanola et al. 2015). Translocations of 64 individuals at three sites now total approximately 58 individuals (Coelho 2012; Coelho and Bakutis 2016; Bakutis and Coelho 2017; Coelho and Purdy 2020).
- Currently, six founders (wild plants) from two populations are represented in *ex situ* storage and propagation.

New Threats:

- None reported.

New Management Actions:

- Monitoring and surveys—MoPEPP surveys and monitors wild and translocated populations (Bakutis et al. 2019; Bakutis and Coelho 2017; Coelho 2012; Coelho and Bakutis 2016; Coelho and Purdy 2020; Espanola et al. 2015; Plant Extinction Prevention Program [PEPP] 2020, p. 29).
- Ungulate monitoring and control—Wild and translocated individuals at east Kawela and Pēpēʻōpae are within a fenced area of Kamakou Preserve.
- Collection and propagation for genetic storage and translocation—
    - The Hawaiian Rare Plant Program of Lyon Arboretum initiated research for the cryopreservation of endangered Hawaiian plant taxa. The program reported that multiplication and cryopreservation protocols for *Lysimachia maxima* were established (Lyon Arboretum 2022a, p. 6). The Lyon Arboretum Micropropagation Laboratory reported storage of 411 explants representing four wild founders at Kawela and ʻŌhiʻalele, and 143 explants representing one translocated individual at Pēpēʻōpae (Lyon Arboretum 2022b). The Lyon Arboretum Seed Conservation Laboratory reported the maintenance of a collection of 97 seeds representing one translocated individual at Kawela (Lyon Arboretum 2022b).
    - From 2019 to 2023, the Olinda Rare Plant Facility (ORPF) reported propagation of 29 individuals representing three translocated plants at Kawela and five wild plants at ʻŌhiʻalele. At least 60 individuals (propagated before 2019) were sent out for translocation or other purposes. Currently, plants are being propagated in community trays representing five founders (ORPF 2019, 2020, 2023).
    - The Molokaʻi Plant Extinction Prevention Program (MoPEPP) reported collection of fruit from wild founders at ʻŌhiʻalele and Olokuʻi and from translocated plants at Kawela (Coelho 2016; Bakutis et al. 2019; Espanola et al. 2015).
- Translocation and augmentation—MoPEPP reintroduced 39 individuals to a new translocation site at Pēpēʻōpae; 12 individuals augmenting a population at Kawela (representing three wild founders at ʻŌhiʻalele), and augmentation of the population at ʻŌhiʻalele with seven individuals (PEPP 2020, p. 29; Bakutis and Coelho 2017; Coelho and Bakutis 2016).

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

Date	No. wild individuals	No. outplanted	Stability Criteria identified in Recovery Plan	Stability Criteria Completed?
1996 (listing)	20–40	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2008 (5-year review)	20	0	All threats managed in all 3 populations	No
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2014 (5-year review)	8	18	All threats managed in all 3 populations	No
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
Date	**No. wild individuals**	**No. outplanted**	***Preventing Extinction Criteria identified by HPPRCC**	***Preventing Extinction Criteria Completed?**
2018 (5-year review)	33–39	ca 100	All threats managed in all 3 populations	No
			Reproduction (i.e., viable seeds, seedlings) at all 3 populations	No
			Complete genetic storage	Partially, 9 founders represented

			3 populations with 50 mature individuals each	No
2023 (5-year review)	18 mature, 3 immature	39 added, 58 survive	All threats managed in all 3 populations	Partially, 2 populations within exclosure
			Complete genetic storage	Partially
			Natural reproduction at all 3 populations	Partially, seedlings observed at ʻŌhiʻalele and Olokuʻi
			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 *Lysimachia maxima* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Degradation and destruction of habitat by feral ungulates	A	Ongoing	Partial, 2 populations within exclosure
Established ecosystem altering invasive plant species degradation of habitat	A	Ongoing	Partial, some nonnative plant control
Climate change degradation or loss of habitat	A	Ongoing	None
Predation and herbivory by ungulates	C	Ongoing	Partial, 2 populations within exclosure
Predation and herbivory by rodents	C	Ongoing	None
Predation and herbivory by invertebrates	C	Ongoing	None

Reduced viability due to small populations	E	Ongoing	Partial, cryopreservation, seed collection, propagation, and translocation efforts are ongoing

Synthesis:
Currently, there are 18 mature and 3 immature wild individuals in three populations of *Lysimachia maxima* on Molokaʻi. Only one wild and one translocated population are within an exclosure that provides protection from feral ungulates; however, other threats, including competition by nonnative invasive plants and predation by rats and slugs, are not addressed. Genetic representation is complete for six founders. Thirty-nine individuals have been reintroduced to a new translocation site, with approximately half of all reintroductions since the last 5-year review currently surviving.

Stabilizing (interim), downlisting, and delisting objectives are provided in the Molokaʻi II: Addendum to the Recovery Plan for the Molokaʻi Plant Cluster (USFWS 1998) and have been updated according to the draft revised recovery objective guidelines developed by the Hawaiʻi 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.

Lysimachia maxima 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 Molokaʻi where they now occur or occurred historically. 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. Approximately 21 wild individuals are known (Table 1). Translocation is ongoing with moderate success and cryopreservation protocols for seeds has been successfully developed (Table 1). Although ungulate habitat degradation and predation is addressed by fencing for two populations, other threats are not being managed including competition by nonnative invasive plants, and predation and herbivory by rats and invertebrates (Table 2). Therefore, *Lysimachia maxima* 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 monitoring—Continue to survey known localities and suitable habitat areas on Molokaʻi to determine the current status of all individuals of *Lysimachia maxima.*
- Ungulate monitoring and control—Continue to construct and maintain exclosures to protect individuals from the negative impacts of habitat destruction and degradation, and herbivory, by feral ungulates.
- Invasive nonnative plant monitoring and control—Continue to control established ecosystem-altering nonnative invasive plant species within and around all wild and translocated populations of *L. maxima*.
- Climate change adaptation strategy—Research the 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 at all wild and translocated populations.
    - Develop and implement effective control methods for invertebrates at all populations.
- Captive propagation for genetic storage and reintroduction—
    - Continue collection and propagation efforts for maintenance of genetic stock and for translocation.
    - Implement long-term storage in cryopreservation due to this species' vulnerability to climate change.
- Translocation and augmentation—Continue to augment the wild populations and translocate individuals into suitable habitat within historic range that is being managed for known threats to this species.
- Build resiliency, redundancy, and representation—Increase numbers of populations and individuals throughout historic range to reduce impacts of predation and small 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 taxon.

References:

Bakutis, A. and K. Coelho. 2017. Hawaiʻi Rare Plant Restoration Group (HRPRG) Field Data Form *in* PEPP 2022: Plant Extinction Prevention Program, FY 2022 Annual Report (Oct 1, 2021-Sep 30, 2022), USFWS CFDA Program #15.657, Endangered Species Conservation-Recovery Implementation Funds, Coop Agreement F19AC00532 (Interim Report), December 29, 2022, UH Mānoa, PCSU, PEPP. 50 pp. BioPacifica database record for *Lysimachia maxima*, Pacific Islands Fish and Wildlife Office.

Bakutis, A., K. Coelho, and K. Adams. 2019. Hawaiʻi Rare Plant Restoration Group (HRPRG) Field Data Form *in* PEPP 2022: Plant Extinction Prevention Program,

FY 2022 Annual Report (Oct 1, 2021-Sep 30, 2022), USFWS CFDA Program #15.657, Endangered Species Conservation-Recovery Implementation Funds, Coop Agreement F19AC00532 (Interim Report), December 29, 2022, UH Mānoa, PCSU, PEPP. 50 pp. BioPacifica database record for *Lysimachia maxima*, Pacific Islands Fish and Wildlife Office.

Coelho, K. 2012. Hawai‘i Rare Plant Restoration Group (HRPRG) Field Data Form *in* PEPP 2022: Plant Extinction Prevention Program, FY 2022 Annual Report (Oct 1, 2021-Sep 30, 2022), USFWS CFDA Program #15.657, Endangered Species Conservation-Recovery Implementation Funds, Coop Agreement F19AC00532 (Interim Report), December 29, 2022, UH Mānoa, PCSU, PEPP. 50 pp. BioPacifica database record for *Lysimachia maxima*, Pacific Islands Fish and Wildlife Office.

Coelho, K. and A. Bakutis. 2016. Hawai‘i Rare Plant Restoration Group (HRPRG) Field Data Form *in* PEPP 2022: Plant Extinction Prevention Program, FY 2022 Annual Report (Oct 1, 2021-Sep 30, 2022), USFWS CFDA Program #15.657, Endangered Species Conservation-Recovery Implementation Funds, Coop Agreement F19AC00532 (Interim Report), December 29, 2022, UH Mānoa, PCSU, PEPP. 50 pp. BioPacifica database record for *Lysimachia maxima*, Pacific Islands Fish and Wildlife Office.

Coelho, K. and K. Purdy. 2020. Hawai‘i Rare Plant Restoration Group (HRPRG) Field Data Form *in* PEPP 2022: Plant Extinction Prevention Program, FY 2022 Annual Report (Oct 1, 2021-Sep 30, 2022), USFWS CFDA Program #15.657, Endangered Species Conservation-Recovery Implementation Funds, Coop Agreement F19AC00532 (Interim Report), December 29, 2022, UH Mānoa, PCSU, PEPP. 50 pp. BioPacifica database record for *Lysimachia maxima*, Pacific Islands Fish and Wildlife Office.

Espanola, J., H. Oppenheimer, and K. Bustamente. 2015. Hawai‘i Rare Plant Restoration Group (HRPRG) Field Data Form *in* PEPP 2022: Plant Extinction Prevention Program, FY 2022 Annual Report (Oct 1, 2021-Sep 30, 2022), USFWS CFDA Program #15.657, Endangered Species Conservation-Recovery Implementation Funds, Coop Agreement F19AC00532 (Interim Report), December 29, 2022, UH Mānoa, PCSU, PEPP. 50 pp. BioPacifica database record for *Lysimachia maxima*, Pacific Islands Fish and Wildlife Office.

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

Lyon Arboretum. 2022a. Lyon Arboretum—Hawaiian Rare Plant Program (HRPP) Micropropagation Laboratory. Interim report: Cryopreservation of endangered Hawaiian plant taxa, October 1, 2020-September 30, 2021. U.S. Fish and Wildlife Service—Pacific West Region, CDFA Program #15.657, F20AC00218-0000. 8 pp.

Lyon Arboretum. 2022b. 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 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] 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] 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] Plant Extinction Prevention Program. 2020. Plant Extinction Prevention Program fiscal year 2020 interim performance report (October 1, 2019-September 30, 2020), Cooperative Agreement F18AC00502 (Interim report), 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. 70 pp.

[USFWS] U.S. Fish and Wildlife Service. 1998. Molokai II: addendum to the recovery plan for the Molokai plant cluster. 52 pp.

[USFWS] 2008. *Lysimachia maxima* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. *https://ecos.fws.gov/docs/tess/species_nonpublish/1185.pdf.*

[USFWS] 2014. *Lysimachia maxima* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. *https://ecos.fws.gov/docs/tess/species_nonpublish/2195.pdf.*

[USFWS] 2018. *Lysimachia maxima* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. *https://ecos.fws.gov/docs/tess/species_nonpublish/2642.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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SIGNATURE PAGE for 5-YEAR REVIEW of *Lysimachia maxima* (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**

LAUREN WEISENBERGER

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