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. 2016. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 76 species in Hawaii, Oregon, Washington, Montana, and Idaho. Federal Register 81(29): 7571–7573, February 12, 2016.

Lead Region/Field Office:

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

Name of Reviewers:

Cheryl Phillipson, Biologist, PIFWO
Lauren Weisenberger, Plant Recovery Coordinator, PIFWO
Gregory Koob, 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 (USFWS) beginning in August 2017. The review was based on a review of current, available information since the last 5-year review for *Lysimachia maxima* (USFWS 2014). The evaluation by Cheryl Phillipson, Biologist, was reviewed by Lauren Weisenberger, Plant Recovery Coordinator, and Gregory Koob, 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 *Lysimachia maxima* published in the Federal Register on January 18, 2008 and March 31, 2014 (available at *https://ecos.fws.gov/docs/five_year_review/doc1848.pdf* and *https://ecos.fws.gov/docs/five_year_review/doc4402.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 *L. maxima*.

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

New Status Information:

- The latest review of the species by IUCN in 2015 reported two subpopulations of one individual each (Chau *et al.* 2015). In 2017, the Plant Extinction Prevention program (PEPP) reported six plants at Kawela, seven plants at Olokuʻi, and 20 plant at ʻŌhiʻalele (PEPP 2017a).

- In 2016, critical habitat was designated in six units in two ecosystems (lowland wet and montane wet) on Molokaʻi for *L. maxima* (13,227 ac; 5,354 ha) (81 FR 17790, March 30, 2016).

New Threats:

- Climate change loss or degradation of habitat—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 Hawaiʻi 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) concluded that *Lysimachia maxima* is highly vulnerable to the impacts of climate change, with a vulnerability score of 0.876 (on a scale of 0 being not vulnerable to 1 being extremely vulnerable to climate change). In addition, this species has no overlap between current and future climate envelopes, and is unlikely to tolerate expected changes in climate at its current location. This means that this species must persist within suitable microrefugia, or move to newly available climate-compatible areas to avoid extinction. Therefore, additional management actions are needed to conserve this taxon into the future.

New Management Actions:

- Surveys and monitoring—The Plant Extinction Prevention Program (PEPP) surveys for and monitors populations of *Lysimachia maxima* on Molokaʻi (PEPP 2014, 2016, 2017b).
- Captive propagation for genetic storage and reintroduction—
    - In 2017, PEPP had collected from four of six founders from Kawela Gulch, three of 20 founders from ʻŌhiʻalele, and two of seven founders from Olokuʻi (PEPP 2017a).
    - The Lyon Arboretum Micropropagation Laboratory had almost 1,000 containers of propagules of *Lysimachia maxima* between 2001 and 2015. Currently, Lyon reports 66 containers of propagules from two individuals from ʻŌhiʻalele in storage. The Lyon Arboretum Seed Conservation Laboratory reports 57 seeds in storage from one individual from the Puʻukolekole outplanting, but they have not germinated and are suspected to not be viable (Lyon Arboretum 2017).
    - The Olinda Rare Plant Facility (ORPF) reports 11 cuttings made from five individuals at Kawela Gulch, four potted plants from three individuals at Kawela Gulch, and 19 potted plants from three individuals at ʻŌhiʻalele (ORPF 2014, 2015, 2017).

    - PEPP monitors wild individuals and collects fruit (PEPP 2014, 2016, 2017b). In 2016, there were seven individuals at ʻŌhiʻalele, and in 2017 there were five individuals at Kawela Gulch (PEPP 2016, 2017b).
- Stochastic events—Build resiliency and redundancy—PEPP reports reintroduction of plants at Puʻukolekole (ca 50) and Kawela Gulch (30) (PEPP 2014, 2016, 2017b).

Synthesis:
Currently, there are between 33 and 39 wild individuals of *Lysimachia maxima* on Molokaʻi. A landscape-based assessment of climate change vulnerability for native plants of Hawaiʻi using high resolution climate change projections was made by Fortini *et al.* (2013) and their analysis showed that *L. maxima* is highly vulnerable to the effects of climate change, in that there will be a smaller area of suitable habitat available for the species in the near future. Nine founders are represented in collections. Reintroduction is ongoing on Molokaʻi with more than 100 individuals outplanted.

Stabilizing (interim), downlisting, and delisting objectives were 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 step 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 an *ex situ* (secured off-site, such as a nursery or seed bank) collection. In addition, a minimum of three populations should be documented on Molokaʻi. Each of these populations must be naturally reproducing (*i.e.*, viable seeds, seedlings, saplings) increasing in number, with a minimum of 50 mature, reproducing individuals per population.

The preventing extinction goals for this species have not been met as there are no populations of at least 50 reproducing individuals, only partial genetic representation (Table 1), and all threats are not being sufficiently managed throughout the range of the species (Table 2). Therefore, *Lysimachia maxima* 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 2014. Thus, the following recommendations for future actions are reiterated for the 5-year review for 2018.

- Population viability and monitoring—Continue to survey known localities and suitable habitat areas on Moloka'i to determine the current status of all populations of *Lysimachia maxima.*
- Ungulate monitoring and control—Construct and maintain exclusion fences, or strategic fencing as appropriate, to protect *L. maxima* from the impacts of feral ungulates.
- Invasive plant monitoring and control—Control established ecosystem-altering nonnative invasive plant species around all populations.
- Captive propagation for genetic storage and reintroduction—
    - Continue collection of genetic resources for storage, propagation, and reintroduction into protected suitable habitat within historical range.
    - Evaluate genetic resources currently in storage to determine the need to place additional material into long-term storage due to this species' vulnerability to climate change.
- Reintroduction and translocation—Continue to augment current populations and reintroduce individuals into suitable habitat within historical range that is being managed for known threats to this species.
- Rodent predation or herbivory—Implement effective methods to control rats at known populations.
- Climate change adaptation strategy—Research the suitability of habitat for reintroducing this species in the future due to impacts of climate change. Develop a strategy for preventing the extinction of this species if no suitable habitat is predicted in the future.
- Alliance and partnership development—Initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this taxon.

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 three populations	No
			Complete genetic storage	No
			Three populations with 50 mature individuals each	No
1998 (recovery plan)	20–40	0	All threats managed in all three populations	No
			Complete genetic storage	Partially
			Three populations with 50 mature individuals each	No
2003 (critical habitat)	45–50	0	All threats managed in all three populations	No
			Complete genetic storage	Partially
			Three populations with 50 mature individuals each	No
2008 (5-year review)	20	0	All threats managed in all three populations	No
			Complete genetic storage	Partially
			Three populations with 50 mature individuals each	No
2014 (5-year review)	8	18	All threats managed in all three populations	No
			Complete genetic storage	Partially

			Three populations with 50 mature individuals each	No
2016 (critical habitat)	28	87	All threats managed in all three populations	No
			Complete genetic storage	Partially
			Three 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 three populations	No
			Complete genetic storage	Partially, nine founders represented
			Reproduction (*i.e.* viable seeds, seedlings) at all three populations	No
			Three 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 after Preventing Extinction).

Table 2. Threats to *Lysimachia maxima* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulate degradation of habitat	A	Ongoing	Partially, some ungulate management
Established ecosystem altering invasive plant species degradation of habitat	A	Ongoing	Partially, some nonnative plant control
Climate change degradation or loss of habitat	A	Ongoing	None
Ungulate predation or herbivory	C	Ongoing	Partially, some ungulate management
Rodent predation or herbivory	C	Ongoing	None
Invertebrate predation or herbivory	C	Ongoing	None
Stochastic events—Reduced viability due to low numbers	E	Ongoing	Partial, cuttings and seed collection, propagation, and reintroduction ongoing

References:

See the previous 5-year reviews for a full list of references (USFWS 2008, 2014). Only references for new information are provided below.

Chau, M., M. Sporck-Koehler, S.M. Gon, T. Portner, M. Keir, L. Weisenberger, V.L. Caraway, and J. Kwon. 2015. *Lysimachia maxima.* The IUCN Red List of Threatened Species 2015:*e.T80166801A80166827. http://dx.doi.org/10.2305/IUCN.UK.2015-4.RLTS.T80166801A80166827.en.*

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. 2017. Micropropagation and seed conservation laboratory databases.

[ORPF] Olinda Rare Plant Facility. 2014. Controlled propagation report.

[ORPF] 2015. Controlled propagation report.

[ORPF] 2017. Controlled propagation report.

[PEPP] Plant Extinction Prevention Program. 2014. PEPP annual report fiscal year 2014 (July 1, 2013-June 30, 2014). 185 pp.

[PEPP] 2016. Plant Extinction Prevention Program FY 2016 annual report (Oct 1, 2015-Sep 30, 2016), US FWS CFDA Program #15.657; Endangered Species Conservation-Recovery Implementation Funds, Coop Agreement F14AC00174, December 24, 2016, UH Manoa, PCSU, PEPP. 237 pp.

[PEPP] 2017a. Statewide species totals *ex situ*, excel table.

[PEPP] 2017b. PEPP annual report fiscal year 2017 (July 1, 2016-June 30, 2017). 235 pp.

[USFWS] U.S. Fish and Wildlife Service. 2014. *Lysimachia maxima* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. *https://ecos.fws.gov/docs/five_year_review/doc4402.pdf.*

[USFWS] 2016. Endangered and threatened wildlife and plants; initiation of 5-year status reviews of 76 species in Hawai‘i, Oregon, Washington, Montana, and Idaho. Federal Register 81(29): 7571–7573, February 12, 2016.

[USFWS] 2016. Endangered and threatened wildlife and plants; designation and nondesignation of critical habitat on Molokai, Lanai, Maui, and Kahoolawe for 135 species; final rule. Federal Register 81 (61): 17790–18110, March 30, 2016.

U.S. FISH AND WILDLIFE SERVICE
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**

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