

5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Brighamia rockii* (pua‘ala)

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 of 76 species in Hawaii, Oregon, Washington, Montana, and Idaho. Federal Register 81(29): 7571–7573.

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 (Service) beginning in August 2017. The review was based on a review of current, available information since the last 5-year review for *Brighamia rockii* (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 *Brighamia rockii* published in the Federal Register on January 18, 2008, and March 11, 2014 (available at http://ecos.fws.gov/docs/five_year_review/doc1768.pdf and https://ecos.fws.gov/docs/five_year_review/doc4385.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 *B. rockii*.

This long lived perennial stem succulent in the Campanulaceae (bellflower) family is endangered and currently known from Molokai. Historically, it was also occurred on Maui and Lāna‘i. The current status and trends for *Brighamia rockii* are provided in the tables below.

New Status Information:

- The previous 5-year review in 2014 reported three populations totaling 34 individuals on Molokai. Currently, there is one wild population at Waiehu totaling 45 individuals. The large majority of plants, however, are inaccessible. There are also two outplanted populations, one with seven individuals and another with 42 (PEPP 2017).
- In 2012, the Service proposed revision of critical habitat for *Brighamia rockii*, and the proposed rule identified three critical habitat units in the dry cliff ecosystem on Lānaʻi for this species (4,025 ac, 338 ha) (77 FR 34464, July 11, 2012). In the final rule the Service excluded critical habitat for this species on the island of Lānaʻi because the conservation activities by the landowner would provide greater long-term benefits to the species. Also, in the 2016 final rule, 10 critical habitat units were designated for *B. rockii* in the coastal and wet cliff ecosystems on Molokaʻi (8,106 ac, 3,277 ha), and 11 critical habitat units were designated in the coastal ecosystem on both east and west Maui (1,382 ac, 561 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 *Brighamia rockii* is highly vulnerable to the impacts of climate change, with a vulnerability score of 0.838 (on a scale of 0 being not vulnerable to 1 being extremely vulnerable to climate change). Therefore, additional management actions are needed to conserve this taxon into the future.

New Management Actions:

- Captive propagation for genetic storage and reintroduction—
 - NTBG has thousands of seeds in storage from founders at Huelo, Kaʻaloa to Waiohookalo, and Waiehu (NTBG 2013, 2017).
 - Waimea Arboretum had previously maintained two plants in storage; however, none are currently held in this facility (Waimea Arboretum 2013, 2014, 2015, 2017, 2018).
 - Maui Nui Botanical Garden (MNBG) reports one plant from an unknown source and hundreds of seeds from Kalaupapa in storage (MNBG 2018).
 - The Olinda Rare Plant Facility (ORPF) reported 52 plants in its nursery from Waiehu (ORPF 2018).
 - Lyon Arboretum Seed Conservation Laboratory reported 10,925 seeds in storage from plants at Waiehu (Lyon Arboretum 2017). Lyon Arboretum Micropropagation Laboratory reported 102 containers of propagules from Waiehu, Huelo, and Waiohookalo (Lyon Arboretum 2017). Of the 45 founders at Waiehu Cliffs, nine are represented in collections (Lyon

Arboretum 2017). These nine plants represent the only plants that are currently accessible and able to be collected from.

- Stochastic events—Build resilience and redundancy—
 - Of 11 outplanted individuals at Kūka‘iwa‘a, seven remain in 2017 (PEPP 2017). An additional 116 individuals were outplanted at Kalaupapa in 2016 (PEPP 2016).
 - All 12 outplanted individuals at Halawa Iki died, the likely cause is rat predation (PEPP 2017).
 - 42 individuals were outplanted on the Waiehu Cliffs representing five founders (PEPP 2017).

Synthesis:

Currently, there are 45 wild individuals of *Brighamia rockii* on Moloka‘i. Seed collections from wild and outplanted plants and propagation of greenhouse material are ongoing. 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 *Brighamia rockii* 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. All extant individuals have been collected from. Outplanting efforts are ongoing, with more than 200 individuals reintroduced.

Stabilizing (interim), downlisting, and delisting objectives were provided in the Recovery Plan for the Moloka‘i Plant Cluster (USFWS 1996), 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.

Brighamia rockii is a long-lived perennial stem succulent and an obligate outcrosser. 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 *ex situ* (secured off-site, such as a nursery or seed bank) collections. In addition, a minimum of three populations should be documented on Moloka‘i and at least one other island where they now occur or occurred historically. Each of these populations must be naturally reproducing (*i.e.*, viable seeds, seedlings, saplings) and 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 (Table 1), and all threats are not being sufficiently managed throughout the range of the species (Table 2). Therefore, *Brighamia*

rockii 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 2014. Thus, the following recommendations for future actions are reiterated for the 5-year review for 2018.

- Surveys and inventories—Survey for additional populations of *Brighamia rockii* in areas of potentially suitable habitat.
- Ungulate monitoring and control—Construct and maintain fenced exclosures to protect individuals from the negative impacts of feral ungulates. Protect all occurrences against browsing and habitat disturbances from feral ungulates.
- Invasive plant monitoring and control—
 - Control established ecosystem-altering nonnative invasive plant species around all populations.
 - Control invasive nonnative species that compete with the species around all populations.
- Captive propagation for genetic storage and reintroduction—
 - Evaluate genetic resources currently in storage to determine the need to place additional genetic resources in long-term storage due to this species' high vulnerability to climate change.
 - Continue collection of genetic resources for storage, propagation, and reintroduction into protected suitable habitat within historical range.
- Climate change adaptation strategy—Research the suitability of habitat for reintroducing this species in the future due to the impacts of climate change.
- Predator and herbivore monitoring and control—Implement effective control methods for rodents and slugs within the vicinity of all known *Brighamia rockii* populations.
- Stochastic events—Build resilience and redundancy—Increase numbers of populations and individuals scattered through historic range to reduce impacts from low numbers.

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

Date	No. wild individuals	No. outplanted	Stability Criteria identified in Recovery Plan	Stability Criteria Completed?
1992 (listing)	< 200	0	All threats managed in all three populations	No
			Complete genetic storage	No
			Three populations with 25 mature individuals each	No
1996 (recovery plan)	< 200	0	All threats managed in all three populations	No
			Complete genetic storage	No
			Three populations with 25 mature individuals each	No
2003 (critical habitat)	121–131 (Moloka‘i) 0 (Lāna‘i) 0 (Maui)	Unknown	All threats managed in all three populations	No
			Complete genetic storage	Unknown
			Three populations with 25 mature individuals each	No
2008 (5-year review)	1 (Moloka‘i)	3	All threats managed in all three populations	No
			Complete genetic storage	Yes
			Three populations with 25 mature individuals each	No
2014 (5-year review)	34 (Moloka‘i)	95	All threats managed in all three populations	No

			Complete genetic storage	Partially
			Three populations with 25 mature individuals each	No
2016 (critical habitat)	6 (Moloka'i)**	Unknown	All threats managed in all three populations	No
			Complete genetic storage	Partially
			Three populations with 25 mature individuals each	No
Date	No. wild individuals	No. outplanted	*Preventing Extinction Criteria identified by HPPRCC	*Preventing Extinction Criteria Completed?
2018 (5-year review)	45 (Moloka'i)	ca 160	All threats managed in all three populations	No
			Complete genetic storage	Complete (currently)
			Reproduction (<i>i.e.</i> viable seeds, seedlings) at all 50 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).

** The number of individuals estimated on Moloka'i during preparation of the critical habitat final rule between 2010-2012 was lower than provided for the 2014 five-year review.

Table 2. Threats to *Brighamia rockii* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulate degradation of habitat	A	Ongoing	None
Established ecosystem altering invasive plant species degradation of habitat	A	Ongoing	None
Landslides and flooding destruction or degradation of habitat	A	Ongoing	None
Climate change degradation or loss of habitat	A	Ongoing	None
Ungulate predation or herbivory	C	Ongoing	None
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, propagation, seed storage, and reintroduction efforts are 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.

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.

[MNBG] Maui Nui Botanical Garden. 2018. Controlled propagation report.

[NTBG] National Tropical Botanical Garden. 2013. Controlled propagation report.

[NTBG] 2017. Controlled propagation report.

[ORPF] Olinda Rare Plant Facility. 2018. Controlled propagation report.

[PEPP] Plant Extinction Prevention Program. 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] 2017. Statewide species totals *ex situ*, Excel table.

[USFWS] U.S. Fish and Wildlife Service. 2014. *Brighamia rockii* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. https://ecos.fws.gov/docs/five_year_review/doc4385.pdf.

[USFWS] 2012. Endangered and threatened wildlife and plants; listing 38 species on Molokai, Lanai, and Maui as Endangered and designating critical habitat on Molokai, Lanai, Maui, and Kahoolawe for 135 species; proposed rule. Department of the Interior, Federal Register 77 (112): 34464–34775, June 11, 2012.

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

[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.

Waimea Arboretum. 2013. Controlled propagation report.

Waimea Arboretum. 2014. Controlled propagation report.

Waimea Arboretum. 2015. Controlled propagation report.

Waimea Arboretum. 2017. Controlled propagation report.

Waimea Arboretum. 2018. Controlled propagation report.

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SIGNATURE PAGE for 5-YEAR REVIEW of *Brighamia rockii* (pua'ala)

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