

5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Gardenia brighamii* (Hawaiian gardenia, na'u)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2012. Endangered and threatened wildlife and plants; 5-year status reviews of 46 species in Idaho, Oregon, Washington, Nevada, Montana, Hawaii, Guam, and the Northern Mariana Islands. Federal Register 77(44):13248-13251.

Lead Region/Field Office:

Region 1/Pacific Islands Fish and Wildlife Office (PIFWO), Honolulu, Hawaii

Name of Reviewer(s):

Diane Sether, Ph.D., Fish and Wildlife Biologist, PIFWO
Maui Nui and Hawaii Island Team Manager, PIFWO
Marie Bruegmann, Plant Recovery Coordinator, PIFWO
Recovery Program Lead, PIFWO
Kristi Young, Programmatic Deputy Field Supervisor, PIFWO

Methodology used to complete this 5-year review:

This review was conducted by staff of the Pacific Islands Fish and Wildlife Office of the U.S. Fish and Wildlife Service (USFWS), beginning on March 6, 2012. The review was based on a review of current, available information since the last 5-year review for *Gardenia brighamii* (USFWS 2008). The evaluation by Diane Sether, Ph.D., Fish and Wildlife Biologist, was reviewed by the Island Team Manager and the Plant Recovery Coordinator, followed by the Recovery Program Lead. It was subsequently reviewed and approved by the Programmatic Deputy Field Supervisor.

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 review for *Gardenia brighamii* published on January 18, 2008 (available at http://ecos.fws.gov/docs/five_year_review/doc1822.pdf) for a complete review of the species' status, threats, and management efforts. No significant new information regarding the species' biological status have come to light since listing to warrant a change in the Federal listing status of *G. brighamii*.

This long-lived small perennial tree is endangered and currently occurs on the islands of Oahu and Lanai (USFWS 2008). This species is extirpated from the islands of Molokai, Maui, and Hawaii (PEPP 2012). The current status and trends for *Gardenia brighamii* are provided in the tables below.

New status information:

- In 2009, there was a single wild mature individual on Oahu and 2 populations containing 11 wild individuals on Lanai (Plant Extinction Prevention Program [PEPP] 2009).
- In 2010, there were 2 populations containing 13 wild individuals on Lanai (PEPP 2010).
- In 2011, there were five wild mature individuals, 81 reintroduced seedlings, and 58 augmented seedlings on Lanai; and a single wild mature individual, single mature reintroduced individual, and 20 immature reintroduced individuals on Oahu (PEPP 2011).
- In 2012, a single wild mature individual remained on Oahu (PEPP 2012). On Lanai, there are 3 populations containing 12 wild individuals (PEPP 2012).

Overall, the numbers of individuals have increased from approximately 11 wild individuals reported in the previous 5-year review to approximately 13 wild individuals in 2012 (PEPP 2012).

New threats:

- Stochastic events – Drought mortality or reduced viability – Unprecedented drought conditions threaten the survival of *G. brighamii* on Maui and Oahu (PEPP 2009, 2011, 2013), and Lanai (PEPP 2010, 2011, 2012, 2013).
- Black twig borer herbivory – Herbivory by black twig borer has been identified as a threat to this species on Lanai (PEPP 2013).
- Slug herbivory – Herbivory by slugs is a threat to the reintroduced individual on Molokai (PEPP 2012).
- Overutilization for commercial, recreational, scientific, or educational purposes – *Gardenia brighamii* that originated from natural populations, but is now grown from seed or vegetative propagules produced in nurseries, is available for sale by multiple nurseries and home improvement stores only within the State of Hawaii. Thus, a USFWS interstate permit under section 10(a)(1)(A) of the Endangered Species Act of 1973, as amended, is not required. The State of Hawaii Board of Land and Natural Resources regulates the commercial-use or sale of plants listed as threatened or endangered by the State of Hawaii through issuance of State licenses or permits, as authorized by the Hawaii Administrative Rules Chapter §13-104, §13-107, and §13-124, Hawaii Revised Statutes §195D, and all other applicable laws. Hawaii Revised Statutes §195D also known as the Hawaii Endangered Species Law, provides protection for all plants listed as threatened and endangered species by State and Federal laws on lands within the State of Hawaii.
- Climate change 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 Hawaii 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 *Gardenia brighamii*

is moderately vulnerable to the impacts of 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
 - The Harold L. Lyon Arboretum's Seed Conservation Laboratory (2013a) contains more than 30,000 seeds in genetic storage.
 - There are 634 propagules in genetic storage at Harold L. Lyon Arboretum Micropropagation Laboratory (2013b).
 - The Olinda Rare Plant Facility (2013) reported 74 individuals of *G. brighamii* in propagation at its nursery.
 - The National Tropical Botanical Garden (2013) reported containing more than 1,600 seeds of *G. brighamii* genetic storage from Kauai and Lanai.
 - Maui Nui Botanical Gardens (2013) contains 109 individuals in its garden and hundreds of seeds in genetic storage.
 - The Pahole Rare Plant Facility (2013) contained 95 individuals at its nursery, 30 of those individuals were used for reintroduction in the Waianae Mountains.
 - Waimea Valley (2013) reported containing 23 individuals of *G. brighamii* in its nursery from Oahu and Lanai stock.
 - Air layers of four wild individuals on Lanai were conducted by the PEPP (2013).
- Reintroduction / translocation
 - On Lanai, 104 individuals of *G. brighamii* were reintroduced into fenced units (PEPP 2010); an additional 23 individuals from three founders were reintroduced (PEPP 2012); and 12 individuals were reintroduced in 2013 (PEPP 2013).
 - On Hawaii Island, a single individual of *G. brighamii* was outplanted in Kohala on private land (PEPP 2010).
 - On Oahu, 20 individuals of *G. brighamii* were outplanted in the Waianae Mountains in a new fenced enclosure (PEPP 2011). In 2013, an additional 30 individuals were outplanted within the same enclosure (PEPP 2013).
 - On Molokai, a single individual from Molokai source material was outplanted in a living garden collection (PEPP 2012).
- Reintroduced / translocated population management and monitoring – Monitoring on Lanai by PEPP reported that the more than 200 individuals of *G. brighamii* outplanted in February 2000 were all dead as of October 2009 (PEPP 2010).
- Stochastic events – Build resilience and redundancy
 - The Plant Extinction Prevention Program (2010, 2011, 2012, 2013) watered outplanted individuals of *G. brighamii* on Lanai.
 - Water storage tanks and irrigation lines have been installed at *G. brighamii* fenced enclosures on Lanai (PEPP 2011).
- Population viability monitoring and analysis
 - The Plant Extinction Prevention Program monitors the naturally occurring founder populations on Oahu and Lanai to identify potential, imminent, and current threats so that they can be addressed accordingly (PEPP 2009, 2010, 2011, 2012, 2013).

- The fenced enclosure containing the dead wild individual on Molokai was monitored in 2009 for potential reintroduction of source material collected from Molokai (PEPP 2010).
- Predator / herbivore monitoring and control
 - The Plant Extinction Prevention Program (2009, 2010, 2011, 2012, 2013) conducted rat (*Rattus* spp.) trapping with snap traps to protect outplanted populations of *G. brighamii* on Lanai.
 - Outplantings on Lanai affected by mites were treated with Avid, a miticide or insecticide (PEPP 2010, 2012).
- Ungulate monitoring and control
 - A fence was constructed to protect the only existing *G. brighamii* plant on Oahu through a partnership between Hawaiian Springs and the Plant Extinction Prevention Program (2011).
 - The fenced enclosures on Lanai containing wild and reintroduced populations were inspected (PEPP 2010, 2012).
 - On Lanai, a fenced enclosure was completed in 2012 to provide additional protected area for reintroduction purposes (PEPP 2012).
 - On Oahu, a new 0.25-0.3 acre enclosure was constructed and 30 individuals of *G. brighamii* were outplanted in the enclosure in April 2013 with the assistance from conservation partners at the Hawaii State Division of Forestry and Wildlife, Waianae Mountains Watershed Partnership, Board of Water Supply, and Hawaiian Springs (PEPP 2013). The fence was partially funded by Hawaiian Springs.
 - The Plant Extinction Prevention Program (2011, 2012, 2013) and allied partners identified possible fence sites, cleared fence routes, constructed the fence, and maintained existing fences on Lanai.
- Invasive plant monitoring and control
 - The Plant Extinction Prevention Program (2011, 2012, 2013) conducted weed control around outplanted individuals of *G. brighamii* on Oahu.
 - On Lanai, weed control was conducted around wild and reintroduced individuals of *G. brighamii* removing *Andropogon virginicus* (broomsedge), *Bidens pilosa* (Spanish needle), *Cymbopogon refractus* (barbwire grass), *Lantana camara* (lantana), *Leucaena leucocephala* (koa haole), *Melinis minutiflora* (molasses grass), *Morella faya* (faya tree), *Passiflora suberosa* (passion flower), *Psidium cattleianum* (strawberry guava), and *Schinus terebinthifolius* (Christmasberry) (PEPP 2009, 2010, 2011, 2012, 2013).
- Surveys / inventories
 - In 2008, a survey was conducted in West Maui where *G. brighamii* was historically located; no individuals were observed (PEPP 2009).
 - In 2012, an aerial survey for excellent habitat to reintroduce *G. brighamii* was conducted on Maui (PEPP 2013).
- Outreach and education – Hawaiian Springs partnered with the PEPP to support the conservation of PEP species, including *G. brighamii* which is one of the native plants of Hawaii featured on their bottled water sold across the state (PEPP 2011).
- Conservation finance – Hawaiian Springs donated approximately 3,000 dollars to fence the only known wild individual of *G. brighamii* on Oahu (PEPP 2011).

Synthesis:

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for the Hawaiian Gardenia (*Gardenia brighamii*) (USFWS 1993). To be considered stable, the six populations remaining at the time the recovery plan was published (Lanai [3 populations], Molokai [1 population], and Oahu [2 populations]) must be composed of at least 20 reproductive individuals that are genetically representative of the original wild population. In addition, these populations must be fenced from herbivores and protected from seed predators, invasive introduced plant species, and disease. These plants must be able to complete their life cycle within fenced enclosures. All of the remaining known wild individuals at the time of the recovery plan (17 to 19 individuals) must be propagated within protected localities such as botanical gardens. In addition, all of the remaining individuals must be represented in an *ex situ* (at other than the plant's natural location, such as a nursery or arboretum) collection. A survey of the origin of all cultivated individuals must be undertaken to determine if there are cultivated progeny derived from other populations, particularly the North Kona population.

The interim stabilization goals for this species have not been met. Six populations of 20 mature individuals representative of the original wild population do not currently exist on the islands of Lanai (3 populations), Molokai (1 population), and Oahu (2 population) (Table 1), and all threats are not being sufficiently managed throughout its range (Table 2). Therefore, *Gardenia brighamii* meets the definition of endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

- 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 genetic resources in long-term storage due to this species' vulnerability to climate change.
- Reintroduction/translocation – Continue augmenting populations as genetically appropriate individuals become available in nurseries and as habitat is protected.
- Surveys / inventories – Continue to survey the geographical and historical range of *G. brighamii* to assess the status of known populations and possible additional populations.
- Ungulate monitoring and control – Continue to fence wild and reintroduced populations to protect them from the impacts of feral ungulates. Maintain fencing to exclude browsing by ungulates.
- Invasive plant monitoring and control – Control invasive introduced plants within the vicinity of *G. brighamii* populations and maintain the habitat free of invasive introduced plants.
- Predator / herbivore monitoring and control
 - Continue to control rodents and mites within the vicinity of all known *G. brighamii* populations.
 - Control slugs at the reintroduction site on Molokai.

- Stochastic events – Build resilience and redundancy – Continue to irrigate individuals of *G. brighamii* and maintain water storage tanks on Lanai to alleviate the impacts of drought.
- Population viability monitoring and analysis – Continue to monitor all known wild, augmented, and reintroduced individuals.
- Fire monitoring and control – Develop and implement a fire management plan for populations impacted by fire.
- Climate change adaptation strategy – Research the suitability of habitat for reintroducing this species in the future due to the impacts of climate change.
- 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 *Gardenia brighamii* from listing through current 5-year review.

Date	No. wild individuals	No. outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization Criteria Completed?
1985 (listing)	7	0	All threats managed in all 6 populations	No
			Complete genetic storage	No
			6 populations composed of 20 mature individuals must be present on each of the three islands	No
1993 (recovery plan)	17-19	64-66 and 207 plants in nursery	All threats managed in all 6 populations	No
			Complete genetic storage	Partially
			6 populations composed of 20 mature individuals must be present on each of the three islands	No
2008 (5-yr review)	11	Unknown	All threats managed in all 6 populations	No
			Complete genetic storage	Partially
			6 populations composed of 20 mature individuals must be present on each of the three islands	No
2014 (5-yr review)	13	1 (Oahu) ~195 (Lanai)	All threats managed in all 6 populations	Partially
			Complete genetic storage	Partially
			6 populations composed of 20 mature individuals must be present on each of the three islands	No

Table 2. Threats to *Gardenia brighamii* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulates – degradation of habitat, herbivory, and trampling	A, C, D, E	Ongoing	Partially, Lanai and Oahu populations are fenced
Invasive introduced plants	A, E	Ongoing	Partially, periodic weed control
Landslides and flooding – erosion	A	Ongoing	None
Overutilization for commercial purposes	B	Ongoing	None
Invertebrate predation or herbivory	C	Ongoing	Partially, applied an insecticide to control mites on Lanai
Black twig borer herbivory	C	Ongoing	None
Rodent predation or herbivory – rats	C	Ongoing	Partially, periodic rat snap-traps used on Lanai
Slug herbivory (Molokai)	C	Ongoing	None
Nonnative bird predation or herbivory	C	Ongoing	None
Low numbers	E	Ongoing	Partially, captive propagation for genetic storage and reintroduction
Drought	E	Ongoing	Partially, irrigation and water storage tanks installed on Lanai
Fire	E	Ongoing	None
Climate change	A, E	Increasing	None

References:

See previous 5-year review for a full list of references (USFWS 2008). 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. Hawaii Cooperative Studies Unit, University of Hawaii at Hilo, Hawaii. 141 pages.

Harold L. Lyon Arboretum Micropropagation Laboratory. 2013a. Micropropagation database. University of Hawaii at Manoa, Honolulu, Hawaii. Unpublished.

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- Maui Nui Botanical Gardens. 2013. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. 12 pages. Unpublished.
- National Tropical Botanical Garden. 2013. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. 30 pages. Unpublished.
- Olinda Rare Plant Facility. 2013. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. 5 pages. Unpublished.
- Pahole Rare Plant Facility. 2013. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. 16 pages. Unpublished.
- [PEPP] Plant Extinction Prevention Program. 2009. Annual report for Plant Extinction Prevention Program, fiscal year 2009 (July 1, 2008-June 30, 2009). 115 pages. Unpublished.
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- [PEPP] Plant Extinction Prevention Program. 2011. Plant Extinction Prevention Program annual report, fiscal year 2011 (July 1, 2010-June 30, 2011). 200 pages. Unpublished.
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- [PEPP] Plant Extinction Prevention Program. 2013. Annual report for Plant Extinction Prevention Program, Fiscal Year 2013 (July 1, 2012-June 30, 2013). 207 pages. Unpublished.
- [USFWS] U.S. Fish and Wildlife Service. 1993. Recovery plan for the Hawaiian *Gardenia* (*Gardenia brighamii*). U.S. Fish and Wildlife Service, Portland, Oregon. 69 pages.
- [USFWS] U.S. Fish and Wildlife Service. 2008. *Gardenia brighamii* 5-year review summary and evaluation. Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii. 12 pages.

[USFWS] U.S. Fish and Wildlife Service. 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. Federal Register 77(112):34464-34775.

Waimea Valley. 2013. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. 16 pages. Unpublished.

U.S. FISH AND WILDLIFE SERVICE
**SIGNATURE PAGE for 5-YEAR REVIEW of *Gardenia brighamii* (Hawaiian
gardenia, na'u)**

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

Appropriate Listing/Reclassification Priority Number, if applicable:

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

Maui M. Buegman

Date 2014-06-02