5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Melicope zahlbruckneri* (alani)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2018. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 156 species in Oregon, Washington, Hawaii, Palau, Guam, and the Northern Mariana Islands. Federal Register 88(83): 20088–20092, May 7, 2018.

Lead Region/Field Office:

Interior Region 12/Pacific Islands Fish and Wildlife Office (PIFWO), Honolulu, Hawai‘i

Name of Reviewer:

Cheryl Phillipson, 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 October 2019. The review was based on a review of current, available information since the last 5-year review for *Melicope zahlbruckneri* (USFWS 2015). The evaluation by Cheryl Phillipson, 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*).

Review Analysis:

Please refer to the previous 5-year reviews for *Melicope zahlbruckneri* published in the Federal Register on January 18, 2008 and August 3, 2015 (available at *https://ecos.fws.gov/docs/five_year_review/doc1839.pdf* and *https://ecos.fws.gov/docs/five_year_review/doc4556.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 *M. zahlbruckneri*.

This long-lived perennial tree in the Rutaceae (citrus) family is endangered. The status and trends for *Melicope zahlbruckneri* are provided in the tables below.

New Status Information:

- In 2016, there were 15 mature wild individuals at Kīpukapuaulu (Bird Park) on the island of Hawai‘i (PEPP 2016). There is one individual at Laupāhoehoe Natural Area Reserve, pending positive identification.

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 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. Vulnerability scores range from 0, not vulnerable to the impacts of climate change, to 1, extremely vulnerable to the effects of climate change. This assessment was not conducted specifically for *Melicope zahlbruckneri*; however, the analysis was conducted for 44 other endemic Hawaiian species of *Melicope*, 26 of which have vulnerability scores of 0.6 or higher. Considering that *M. zahlbruckneri* is endemic to three small areas on the island of Hawai‘i, its two wild populations total only 15 plants and one plant, respectively, and threats such as competition with invasive nonnative plants and seed predation by rats and insects are increasing, with continued low seed production or germination, it is likely that the effects of climate change could affect this species’ ability to persist. Therefore, additional management actions may be needed to conserve this taxon into the future, such as ensuring that adequate viable genetic material is stored, identifying suitable microsites where climate change effects are anticipated to occur more slowly, and considering suitable habitat for reintroduction in areas outside of its known range.

New Management Actions:

- Surveys and inventories—The Plant Extinction Prevention Program (PEPP) surveys for known and new populations of *Melicope zahlbruckneri* (PEPP 2015, 2016, 2017). In 2016, there were 15 wild individuals remaining at Kīpukapuaulu and one unidentified plant at Laupāhoehoe (PEPP 2016).
- Captive propagation for genetic storage and reintroduction—
    - Hawaii Volcanoes National Park (HAVO) reports collection and storage of six seeds (representing at least one plant from Kīpukapuaulu) (HAVO 2019).
    - The Volcano Rare Plant Facility (VRPF) reports one plant in inventory representing one individual from Kīpukapuaulu (VRPF 2019).
    - The Plant Extinction Prevention Program (PEPP) reports monitoring of five airlayers (two failed, one re-attempted) and collection of one fruit from plants at Kīpukapuaulu (PEPP 2017).

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

Date	No. wild individuals	No. outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization Criteria Completed?
1996 (listing)	30–35	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 25 mature individuals each	Partially
1998 (recovery plan)	30–35	0	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 25 mature individuals each	Partially
2003 (critical habitat)	30–45	0	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 25 mature individuals each	Partially
2008 (5-year review)	35	4	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 25 mature individuals each	Partially
2015 (5-year review)	25	38	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially

			3 populations with 25 mature individuals each	Partially
Date	**No. wild individuals**	**No. outplanted**	***Preventing Extinction Criteria identified by HPPRCC**	***Preventing Extinction Criteria Completed?**
2020 (5-year review)	15 + 1 unconfirmed	0	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			Reproduction (i.e. viable seeds, seedlings) at all 3 populations	Partially
			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 *Melicope zahlbruckneri* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulate degradation of habitat	A	Ongoing	Partial, one wild and two reintroduced populations fenced
Established ecosystem altering invasive plant species degradation of habitat and competition	A, E	Ongoing	None
Habitat degradation and destruction by fire	A	Potential	Partial, fire management plan for National Park
Climate change degradation or loss of habitat	A	Ongoing	None
Ungulate predation or herbivory	C	Ongoing	Partial, one wild and two reintroduced populations fenced
Rodent predation or herbivory	C	Ongoing	None

Herbivory by slugs	C	Ongoing	None
Invertebrate predation	C	Ongoing	None
Lack of adequate hunting regulations	D	Ongoing	Partial, one wild and two reintroduced populations fenced
Reduced viability due to low numbers	E	Ongoing	Partial, seed collection, air-layering, propagation, and reintroduction

Synthesis:
Currently, there are 15 mature wild individuals in one population and possibly one wild individual in a second population (pending identification) of *Melicope zahlbruckneri* on the island of Hawai‘i. This species is likely impacted by the effects of climate change. One wild population is provided protection from feral ungulates by fencing. Seed collection, air-layering, propagation, and reintroduction are ongoing. The 38 individuals planted at two locations are surviving since the last 5-year review; however, there is no natural reproduction observed.

Stabilizing (interim), downlisting, and delisting objectives were provided in the Big Island II: Addendum to the Recovery Plan for the Big Island Plant Cluster (USFWS 1998), 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.

Melicope zahlbruckneri is a long-lived perennial tree that is an obligate outcrosser. 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. In addition, a minimum of three populations should be documented on 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, 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 partially complete (Table 1), there are no populations totaling at least 50 reproducing individuals, and all threats are not being managed (Table 1, Table 2). Therefore, *Melicope zahlbruckneri* 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 other significant new information regarding the species' biological status since the last 5-year review in 2015. Thus, the following recommendations for future actions are reiterated for the 5-year review for 2020.

- Surveys and inventories—Continue to survey suitable habitat and historical range for a thorough assessment of the species' status.
- Ungulate monitoring and control—Continue to maintain existing fences and fence remaining populations to protect individuals from the negative impacts of feral ungulates.
- Invasive plant monitoring and control—Control established ecosystem-altering nonnative invasive plant species and those that compete with *M. zahlbruckneri* at all populations.
- Climate change adaptation strategy—Assess the modeled effects of climate change on this species to determine future landscape needed for its recovery.
- Predator and herbivore monitoring and control—
    - Implement effective control methods for rodents and slugs.
    - Research control methods for predation by the two-spotted leafhopper and native caterpillars and implement if necessary.
- Captive propagation for genetic storage and reintroduction—
    - Continue collection and propagation efforts for maintenance of genetic stock and for reintroduction.
    - Improve air-layering methodology for a better success rate.
- Reintroduction and translocation—Continue to reintroduce individuals into suitable habitat within historic range that is being managed for known threats.
- Alliance and partnership development—Continue to work with the Hawai‘i Volcanoes National Park, the Hawai‘i Division of Forestry and Wildlife, and other partners and land managers in planning and implementation of ecosystem-level restoration and management to benefit this species.

References:

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. 134 pp.

[HAVO] Hawai‘i Volcanoes National Park. 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, Hawaii.

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

[PEPP] 2015. PEPP annual report fiscal year 2015 (July 1, 2014-June 30, 2015). 179 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] 2017. Plant Extinction Prevention Program FY 2017 annual report (Oct 1, 2016-Sep 30, 2017), US FWS CFDA program #15.657; Endangered species conservation-recovery implementation funds, Cooperative Agreement F14AC00174, December 12, 2017, UH Manoa, PCSU, PEPP. 235 pp.

[USFWS] U.S. Fish and Wildlife Service. 2008. *Melicope zahlbruckneri* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. *https://ecos.fws.gov/docs/five_year_review/doc1839.pdf.*

[USFWS] 2015. *Melicope zahlbruckneri* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. *https://ecos.fws.gov/docs/five_year_review/doc4556.pdf.*

[USFWS] 2018. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 156 species in Oregon, Washington, Hawaii, Palau, Guam, and the Northern Mariana Islands. 88 FR 20088, May 7, 2018.

[VRPF] 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.

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SIGNATURE PAGE for 5-YEAR REVIEW of *Melicope zahlbruckneri* (alani)

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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