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. 2013. Endangered and threatened wildlife and plants; Initiation of 5-year status reviews of 44 species in Oregon, Hawaii, Guam, and the Northern Mariana Islands. Federal Register 78(24):8185-8187.

Lead Region/Field Office:

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

Name of Reviewer(s):

Chelsie Javar-Salas, Plant Biologist, PIFWO

Marie Bruegmann, Plant Recovery Coordinator, 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 4, 2013. The review was based on a review of current, available information since the last 5-year review for *Melicope zahlbruckneri* (USFWS 2008). The evaluation by Chelsie Javar-Salas, Plant Biologist, was reviewed by the Plant Recovery Coordinator. 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 at: *http://ecos.fws.gov/tess_public*.

Review Analysis:

Please refer to the previous 5-year review for *Melicope zahlbruckneri* published on January 18, 2008 (available at: *http://ecos.fws.gov/docs/five_year_review/doc1839.pdf*) for a complete review of the species' status, threats, and management efforts. No significant new information regarding the species' biological status has come to light since listing to warrant a change in the Federal listing status of *M. zahlbruckneri*.

This long-lived perennial tree is a member of the citrus family (Rutaceae) and is an endangered taxon endemic to Hawaii Island (USFWS 1998). Historically, *Melicope zahlbruckneri* was known from near Glenwood, Kipuka Puaulu, and Moaula in Kau (USFWS 1998). At the time of the previous 5-year review, *M. zahlbruckneri* was known to occur at three sites at Kipuka Puaulu, Kipuka Ki, and Laupahoehoe Natural Area Reserve (USFWS 2008). The status and trends for *M. zahlbruckneri* are provided in the tables below.

New status information:

- In 2009 and 2010, there were two populations containing 24 wild individuals of *Melicope zahlbruckneri* (Plant Extinction Prevention Program [PEPP] 2009, 2010). In 2010, there were four reintroduced individuals at Kipuka Ki and one reintroduced individual at Kipuka Ahi (Hawaii Volcanoes National Park 2010). In 2014, the wild population at Kipuka Puaulu contained 19 mature individuals of *M. zahlbruckneri* (J. VanDeMark, PEPP, pers. comm. 2014). There are approximately 34 reintroduced individuals at Kipuka Ahi and 4 individuals at Kipuka Ki (Hawaii Volcanoes National Park 2012, 2013a).
- There is one unconfirmed individual at Laupahoehoe Natural Area Reserve that is awaiting taxonomic identification based on fruit production (J. VanDeMark, pers. comm. 2014).
- Overall, the numbers of individuals have decreased from the 35 wild individuals reported in the previous 5-year review to approximately 25 wild individuals in 2015. There are two reintroduced populations containing approximately 38 individuals.

New threats:

- Climate change destruction or degradation of habitat – 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) did not include *M. zahlbruckneri*.
- Invertebrate predation or herbivory – Native Lepidoptera caterpillars (*Prays* spp.) have been found to destroy the few seeds that are produced by *M. zahlbruckneri* (Hawaii Volcanoes National Park 2010).

New management actions:

- Captive propagation for genetic storage and reintroduction
  - In 2012, the Volcano Rare Plant Facility (2012) had 20 plants growing in their nursery from Kipuka Puaulu. The Facility propagated 14 individuals for reintroductions to occur next year.
  - In 2013, the Volcano Rare Plant Facility (2013) had 22 individuals representing founders from Kipuka Puaulu growing in their nursery. The Facility propagated 13 individuals for reintroduction at Hawaii Volcanoes National Park in 2013 and additional 13 individuals for reintroduction efforts to occur next year.
  - In 2014, the Facility had 17 plants growing in their nursery representing founders from Kipuka Puaulu (Volcano Rare Plant Facility 2014). The Facility propagated 14 individuals for reintroductions to occur next year.
- Captive propagation protocol development – Very few seeds are produced by *M. zahlbruckneri* and germination is extremely low (Hawaii Volcanoes National Park 2010).
- Reintroduction / translocation
  - In 2012, 20 individuals of *M. zahlbruckneri* were reintroduced into Boundary Kipuka Ahi (Hawaii Volcanoes National Park 2012).

- In 2013, an additional 13 individuals were reintroduced to Boundary Kipuka Ahi from founders air layered at Kipuka Puaulu (Hawaii Volcanoes National Park 2013a). The plants were propagated by the Volcano Rare Plant Facility.

- Population viability monitoring and analysis
  - In July 2009, the wild population at Hawaii Volcanoes National Park Kipuka Puaulu was monitored and air layers were created on 17 of the 19 plants monitored (PEPP 2009). Seeds were collected and transported to the Volcano Rare Plant Facility for propagation (PEPP 2009). In November 2009, 15 of the 19 air layers were monitored for possible collection of material (PEPP 2010). Eight air layers were collected from 6 wild individuals at Kipuka Puaulu. In February 2010, an additional three air layers was collected from three founders. Five supplemental air layers were created from five founders at Kipuka Puaulu (PEPP 2010). In March 2010, a single air layer was collected from one founder (PEPP 2010). An additional 13 air layers was created on 8 founders at Kipuka Puaulu.
  - In November 2010, 11 air layers were collected on 7 founders at Kipuka Puaulu (PEPP 2011). Two supplemental air layers were created on a single founder. In December 2010, 10 air layers were created on 4 of the 12 founders that was visited (PEPP 2011). In May 2011, the air layers on 6 individuals were monitored for rooting but none was collected during this visit (PEPP 2011).
  - In November 2011, two air layers were collected from one founder and delivered to Volcano Rare Plant Facility for propagation (PEPP 2012).
  - The single plant at Kipuka Ahi planted in 2009 was monitored and is growing vigorously (Hawaii Volcanoes National Park 2013b).
  - In 2013, 15 individuals were monitored at Kipuka Puaulu and two green fruits were bagged (PEPP 2014). In January 2014, the bagged fruit was monitored for possible collection, however; the fruits was still green and not ready for collection (PEPP 2014). In addition, all known 19 individuals was observed during this monitoring trip (PEPP 2014).

Synthesis:
Stabilizing, downlisting, and delisting objectives are provided in the Big Island II: Addendum to the Recovery Plan for the Big Island plant cluster (USFWS 1998), based on whether the species is an annual, a short-lived perennial (fewer than 10 years), or a long-lived perennial. *Melicope zahlbruckneri* is a long-lived perennial, and to be considered stable, the taxon must be managed to control threats (e.g., fenced) and be represented in an *ex situ* (at other than the plant's natural location, such as a nursery or arboretum) collection. In addition, a minimum of three populations should be documented on the island of Hawaii. Each of these populations must be naturally reproducing and increasing in number, with a minimum of 25 mature individuals per population.

The interim stabilization goals for this species have not been met as only 25 wild individuals are known and the species continues to decline and the maturity of the reintroduced individuals is unknown (Table 1). Likewise, all of the threats are not being sufficiently managed throughout all of the populations (Table 2). Therefore, *Melicope*

zahlbruckneri meets the definition of endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

- Surveys / inventories – Survey geographical and historical range for a current assessment of the species' status.
- Captive propagation for genetic storage and reintroduction – Continue collection of genetic resources for storage, propagation, and reintroduction into protected suitable habitat within historical range.
- Ungulate monitoring and control – Maintain existing fences and fence remaining populations to protect them from the impacts of feral ungulates.
- Invasive plant monitoring and control – Eradicate invasive introduced plants within ungulate exclosures and maintain exclosures free of invasive plants.
- Population viability monitoring and analysis – Continue monitoring wild and reintroduced individuals.
- 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 *Melicope zahlbruckneri* from listing through current 5-year review.

Date	No. wild indivs	No. outplanted	Stability Criteria identified in Recovery Plan	Stability 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)	ca 40-45	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	n/a	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 25 mature individuals each	Partially
2008 (5-yr review)	ca 35	4	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 25 mature individuals each	Partially
2015 (5-yr review)	ca 25	38	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 25 mature individuals each	Partially

Table 2. Threats to *Melicope zahlbruckneri* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulates – degradation of habitat and herbivory	A, C, D, E	Ongoing	Partially, Kipuka Puaulu is fenced
Invasive introduced plants	A, E	Ongoing	None
Lava flow degradation of habitat	A	Ongoing	None
Rodent predation or herbivory – rats	C	Ongoing	None
Invertebrate predation or herbivory – two-spotted leafhopper and lepidoptera caterpillars	C	Ongoing	None
Slug herbivory	C	Ongoing	None
Fire	E	Ongoing	None
Low numbers	E	Ongoing	Partially, captive propagation for genetic storage and reintroduction
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.

Hawaii Volcanoes National Park. 2010. Annual permit report on threatened and endangered plants. Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii.

Hawaii Volcanoes National Park. 2012. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. Unpublished.

Hawaii Volcanoes National Park. 2013a. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. Unpublished.

Hawaii Volcanoes National Park. 2013b. Annual permit report on threatened and endangered plants. Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii.

[PEPP] Plant Extinction Prevention Program. 2009. Plant Extinction Prevention Program annual report, fiscal year 2009 (July 1, 2008-June 30, 2009). Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii.

[PEPP] Plant Extinction Prevention Program. 2010. Plant Extinction Prevention Program annual report, fiscal year 2010 (July 1, 2009-June 30, 2010). Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii.

[PEPP] Plant Extinction Prevention Program. 2011. Plant Extinction Prevention Program annual report, fiscal year 2011 (July 1, 2010-June 30, 2011). Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii.

[PEPP] Plant Extinction Prevention Program. 2012. Plant Extinction Prevention Program annual report, fiscal year 2012 (July 1, 2011-June 30, 2012). Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii.

[PEPP] Plant Extinction Prevention Program. 2014. Plant Extinction Prevention Program annual report, fiscal year 2014 (July 1, 2013-June 30, 2014). Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii.

[USFWS] U.S. Fish and Wildlife Service. 1998. Big Island II: addendum to the recovery plan for the Big Island plant cluster. U.S. Fish and Wildlife Service, Portland, Oregon. 80 pages + appendices.

[USFWS] U.S. Fish and Wildlife Service. 2008. 5-year review short form summary for *Hibiscadelphus giffardianus* (hau kuahiwi) and *Melicope zahlbruckneri* (alani). Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii. 7 pages.

Volcano Rare Plant Facility. 2012. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. Unpublished.

Volcano Rare Plant Facility. 2013. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. Unpublished.

Volcano Rare Plant Facility. 2014. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. Unpublished.

Personal communication

VanDeMark, Joshua R. 2014. Hawaii Island Coordinator, Plant Extinction Prevention Program. E-mail to Donna Ball, Pacific Islands Fish and Wildlife Office, dated September 26, 2014. Subject: status updates.

U.S. FISH AND WILDLIFE SERVICE
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

Appropriate Listing/Reclassification Priority Number, if applicable:_____

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

Maine M Brueggmann Date 2015-08-03