

5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Melicope knudsenii* (alani)

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):

Chelsie Javar-Salas, Plant 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 *Melicope knudsenii* (USFWS 2009). The evaluation by Chelsie Javar-Salas, Plant Biologist, was reviewed by the Island Team Manager, and 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 *Melicope knudsenii* published on July 21, 2009 (available at http://ecos.fws.gov/docs/five_year_review/doc2449.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 *M. knudsenii*.

This perennial tree is endangered and known from the islands of Kauai and Maui (USFWS 1995). The current status and trends for *Melicope knudsenii* are provided in the tables below.

New status information:

In addition to those populations cited in the previous 5-year review, new observations include the following:

- In 2010, there were two populations containing two wild individuals of *M. knudsenii* on Kauai (Plant Extinction Prevention Program [PEPP] 2010).
- In 2011, there were a single mature wild individual of *M. knudsenii* on Kauai (PEPP 2011)
- In 2012, there were two populations containing two wild individuals of *M. knudsenii* on Kauai (PEPP 2012). At Puu Mahoe Arboretum on Maui, there is a single mature and eight immature individuals of *M. knudsenii* in captive propagation (PEPP 2012). A single wild mature individual of *M. knudsenii* remains at Auwahi on Maui (PEPP 2012). A second wild mature individual of *M. knudsenii* was discovered at Auwahi during pre-fence construction plant surveys (Leeward Haleakala Watershed Restoration Partnership [LHWRP] 2010).
- In 2013, there were two wild populations containing four individuals of *M. knudsenii* on Kauai (PEPP 2013). Two new individuals were found during a survey of the vicinity containing a single wild individual in Kuia Natural Area Reserve (NAR) on Kauai (PEPP 2013). At Kanaio NAR on Maui, there were two wild individuals (PEPP 2013).

Overall, the numbers of individuals have increased from approximately four wild mature individuals reported in the previous 5-year review to approximately eight wild mature individuals in 2013 on the islands of Kauai (four individuals) and Maui (four individuals) (PEPP 2012, 2013). Puu Mahoe Arboretum contains a single mature reintroduced individual (PEPP 2012).

New threats:

- Climate change destruction 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 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 *M. knudsenii* is highly vulnerable to the impacts of climate change. Therefore, additional management actions are needed to conserve this taxon into the future.
- Stochastic events – Drought mortality and reduced viability – Drought may exacerbate the effects of ungulates and has direct adverse impacts on *M. knudsenii* (PEPP 2011, 2013).
- Black twig borer herbivory – Damage by black twig borer has been reported at Kanaio NAR (PEPP 2013).
- Invertebrate predation or herbivory – Predation and herbivory by an unknown insect was reported on Kauai (PEPP 2012). The unknown insect damaged the leaves of the wild individual.

New management actions:

- Captive propagation for genetic storage and reintroduction

- The National Tropical Botanical Garden (2013) has a single individual of *M. knudsenii* in captive propagation and 40 seeds in storage.
- There are 12 seeds in storage at the Harold L. Lyon Arboretum Seed Conservation Laboratory (2013).
- Air layering of the wild individual on Kauai was conducted by the Plant Extinction Prevention Program (2012). No roots formed as of August 2012 (PEPP 2013).
- Ungulate monitoring and control
 - The Auwahi II fenced enclosure encompasses approximately 9 hectares (23 acres) and was completed in 2004 (LHWRP 2010). The fenced enclosure is maintained by the LHWRP and protects a single wild individual of *M. knudsenii*. The second wild individual discovered during pre-fence construction plant surveys for Auwahi III fenced enclosure was fenced individually to provide protection from ungulates (LHWRP 2010).
 - The Kanaio NAR perimeter fence was completed in 2012 and encloses approximately 650 hectares (1,600 acres). Staff of Kanaio NAR is working to remove feral ungulates in the fenced enclosure with public volunteer hunters and staff (State of Hawaii 2013).
- Surveys / inventories
 - The known wild population at East Kawela was surveyed by the Plant Extinction Prevention Program (2013). Three individuals were relocated and monitored.
 - Two individuals of *M. knudsenii* were discovered next to the wild individual located in Kuia NAR, increasing the total number of individuals in Kuia NAR to four (PEPP 2013). Another two individuals were discovered in 2013, but display different phenotypic (visible) features from known individuals of *M. knudsenii* and need further taxonomic review (PEPP 2013).
- Invasive plant monitoring and control
 - In 2012, LHWRP controlled introduced plants including *Bocconia frutescens* (bocconia) for the entire Auwahi region and systematically for *Schinus terebinthifolius* (Christmasberry), *Cinnamomum camphora* (camphor), *Pinus radiata* (pines), and *Psidium cattleianum* (strawberry guava) within the Auwahi III enclosure (LHWRP 2012).
 - *Schinus terebinthifolius*, *Bocconia frutescens*, and *Acacia mearnsii* (black wattle) were controlled at Kanaio NAR (State of Hawaii 2013).
- Population viability monitoring and analysis
 - The Plant Extinction Prevention Program monitored the wild population on Kauai (PEPP 2011, 2012, 2013). In 2012, the wild individual at Kawaiiki was severely damaged by goats, which broke branches and stripped the main trunk of the tree (PEPP 2013).
 - On Maui, the Plant Extinction Prevention Program monitored the outplanted population at Kanaio NAR (PEPP 2011, 2013), at Puu Mahoe Arboretum (PEPP 2012), and the wild individuals at Auwahi (PEPP 2012).
 - In 2013, the site containing a previously live wild individual of *M. knudsenii*, confirmed dead in 2011, in Koaie Canyon was revisited and reconfirmed to be dead (PEPP 2013).

- Listing and critical habitat designation – A single unit of unoccupied and occupied areas of critical habitat for *M. knudsenii* was proposed in the montane dry ecosystem on Maui (USFWS 2012). The final rule for critical habitat designations has not been published at the time of this review.

Synthesis:

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for the Kauai plant cluster (USFWS 1995), based on whether the species is an annual, a short-lived perennial (fewer than 10 years), or a long-lived perennial. *Melicope knudsenii* is a long-lived perennial, and to be considered stable, this species 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 total should be documented on the island of Kauai, and if possible on Maui, where they now occur or occurred historically. 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 there are no known populations containing more than 25 individuals (Table 1). In addition, all threats are not being sufficiently managed throughout all of the populations (Table 2). Therefore, *Melicope knudsenii* 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 collecting material for genetic storage and propagation for reintroduction.
 - 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 current natural populations to increase numbers of individuals.
- Ungulate monitoring and control – Fence remaining populations to protect them from the impacts of feral ungulates.
- Invasive plant monitoring and control – Continue controlling invasive introduced plant species within the vicinity of all known individuals.
- Surveys / inventories – Continue to survey the geographical and historical range of *M. knudsenii* for a current assessment of the species' status.
- Predator / herbivore monitoring and control – Control black twig borer and other invertebrate pests at all infected *M. knudsenii* populations.
- Reintroduced / translocated population management and monitoring – Improve irrigation system at Kanaio NAR to support reintroduced individuals of *M. knudsenii*.
- 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 *Melicope knudsenii* from listing through current 5-year review.

Date	No. wild indivs	No. outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization Criteria Completed?
1994 (listing)	23-33	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
1995 (recovery plan)	24-34	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2003 (critical habitat)	18	Unknown	All threats managed in all 3 populations	No
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2009 (5-year review)	4	8	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2012 (critical habitat-proposed)	2 (Maui only)	Unknown	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2014 (5-year review)	8	1	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No

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

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulates – degradation of habitat and herbivory	A, C, D, E	Ongoing	Partially, Auwahi and Kanaio NAR fenced
Invasive introduced plants	A, E	Ongoing	Partially, weeds controlled at Auwahi and Kanaio NAR
Black twig borer	C	Ongoing	None
Invertebrate predation or herbivory – unknown	C	Ongoing	None
Drought	E	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 2009). 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 Seed Conservation Laboratory. 2013. Seed storage database. University of Hawaii at Manoa, Honolulu, Hawaii. Unpublished.

[LHWRP] Leeward Haleakala Watershed Restoration Partnership. 2010. Final report for FY09 U.S. Fish and Wildlife Service projects protecting core watershed forests of Leeward Haleakala, progress from July 1, 2009-June 30, 2010. Makawao, Hawaii. 4 pages. Unpublished.

[LHWRP] Leeward Haleakala Watershed Restoration Partnership. 2012. Annual report for FY011 U.S. Fish and Wildlife Service projects grant for Auwahi III restoration and community based forest restoration on private lands, progress from July 1, 2011-June 30, 2012. Makawao, Hawaii. 13 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.

[PEPP] Plant Extinction Prevention Program. 2010. Plant Extinction Prevention Program annual report, fiscal year 2010 (July 1, 2009-June 30, 2010). 122 pages. Unpublished.

[PEPP] Plant Extinction Prevention Program. 2011. Plant Extinction Prevention Program annual report, fiscal year 2011 (July 1, 2010-June 30, 2011). 200 pages. Unpublished.

[PEPP] Plant Extinction Prevention Program. 2012. Plant Extinction Prevention Program annual report, fiscal year 2012 (July 1, 2011-June 30, 2012). 169 pages. Unpublished.

[PEPP] Plant Extinction Prevention Program. 2013. Plant Extinction Prevention Program annual report, fiscal year 2013 (July 1, 2012-June 30, 2013). 207 pages. Unpublished.

State of Hawaii, Department of Land and Natural Resources, Division of Forestry and Wildlife. 2013. Report to the twenty-seventh legislature regular session of 2014 relating to the natural area reserves system, natural area partnership program, and the financial condition of the natural area reserve fund. 50 pages. Available online <<http://files.hawaii.gov/dlnr/reports-to-the-legislature/2014/FW14-Nars.pdf>>.

[USFWS] U.S. Fish and Wildlife Service. 1995. Recovery plan for the Kauai plant cluster. U.S. Fish and Wildlife Service, Portland, Oregon. 270 pages.

[USFWS] U.S. Fish and Wildlife Service. 2009. *Melicope knudsenii* 5-year review short form summary. U.S. Fish and Wildlife Service, Honolulu, Hawaii. 8 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.

U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of *Melicope knudsenii* (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**

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Date 2014-03-31