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. 2007. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 71 species in Oregon, Hawaii, Commonwealth of the Northern Mariana Islands, and Territory of Guam. Federal Register 72(45):10547-10550.

Lead Region/Field Office:

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

Name of Reviewer(s):

Christian Torres-Santana, Student Trainee Biologist
Marie Bruegmann, Plant Recovery Coordinator
Marilet A. Zablan, Recovery Program Leader and acting Assistant Field Supervisor for Endangered Species
Gina Shultz, Deputy Field Supervisor

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 (USFWS) beginning on March 8, 2007. The review was based on the final critical habitat designation for *Melicope knudsenii* and other species from the islands of Kauai and Maui, as well as a review of current, available information (USFWS 2003a, b). The Bernice P. Bishop Museum provided an initial draft of portions of the 5-year review. The evaluation of the status of the species was prepared by our lead PIFWO biologist and reviewed by the Plant Recovery Coordinator. The document was then reviewed by the Recovery Program Leader and acting Assistant Field Supervisor for Endangered Species, and Deputy Field Supervisor, before submission to the Field Supervisor for approval.

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).

Application of the 1996 Distinct Population Segment (DPS) Policy:

This Policy does not apply to plants.

Review Analysis:
Please refer to the final critical habitat designations for a complete review of the *Melicope knudsenii* status (including biology and habitat), threats, and management efforts. Critical habitat was designated on the islands of Kauai and Maui and published in the Federal Register on February 27 and May 14, 2003, respectively (USFWS 2003a, b). No new threats and 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*.

At the time *Melicope knudsenii* was federally listed as endangered on Kauai, it was known from three populations, each containing a single individual, distributed across a distance of 2.6 kilometers (1.6 miles) in the Koaie drainage of Waimea Canyon. On Kauai, USFWS (2003a) reported ten populations with a total of ten individuals on State-owned land in Poopooiki Valley, Kuia Valley, Mahanaloa Valley, Makaha Ridge, Koaie Canyon, Koaie Falls, and Kawaiiki Valley within Kuia Natural Area Reserve and Na Pali-Kona Forest Reserve. In 2005, Steve Perlman of the National Tropical Botanical Garden) estimated four populations, each with a single individual (USFWS 2008). Ken Wood of the National Tropical Botanical Garden (pers. comm. 2008) reported that only three wild individuals remain; one each in Koaie Canyon, one mile east of Lonomea Camp; Kawaiiki Valley, and in Kuia drainage. Known individual plants in Poopooiki and at the twin falls side gulch of Koaie Stream have died.

On Maui, USFWS (2003b) listed four occurrences on State (Department of Hawaiian Home Lands) and privately-owned lands from Puu Mahoe to east of Puu Ouli. The Auwahi/Kanaio population in southwestern East Maui has experienced a treefall since being described by Joseph Rock in 1920 as "very common" in the area. Robert Hobdy noted 40 plants in 1970, but found that many plants that seemed vigorous then were dead by 1982, and Art Medeiros described a declining population in the 1980s with 20 to 30 unhealthy individuals. In 1999, Ken Wood cited only a single remaining wild individual of declining vigor, covered with lichens and with branch tips dying back (Hawaii Biodiversity and Mapping Program 2007). The only other mature individual of *M. knudsenii* on Maui is cultivated at D.T. Fleming Arboretum on the slopes of Puu Mahoe in Ulupalakua. While also in declining health, it produces healthy seeds.

In 2003, the arboretum reported about 1,200 mature seeds harvested, which were distributed locally to 16 nurseries, botanical gardens, and seed storage facilities, and nationally to the University of Kentucky for germination experiments and the U.S. Department of Agriculture National Center for Genetic Resources Preservation in Fort Collins, Colorado (Friends of D.T. Fleming Arboretum 2004). Subsequently, D.T. Fleming Arboretum reported that two seedlings were planted there in 2004, eight seedlings were outplanted into the fenced habitat at Auwahi in 2005, and by 2008, 39 seedlings had been outplanted or distributed to gardens on Kauai, Oahu, Maui, and Hawaii, but the status of those individuals is unknown (*e.g.*, National Tropical Botanical Garden, Waimea Arboretum) (Friends of D.T. Fleming Arboretum 2007, 2008). Currently, a total of only four mature individuals and eight seedlings are known.

Specimen vouchers at Bernice P. Bishop Museum (C. Imada, Bernice P. Bishop Museum, pers. comm. 2008) and data from Hawaii Biodiversity and Mapping (2007) reveal the following phenological patterns: on Kauai, flowering specimens were noted from March through May, and August to November; fruiting specimens were noted in March, May, August, and October. On Maui, flowering and fruiting were both noted between February and March, and July through November.

The major threats to *Melicope knudsenii* on Kauai include competition with the introduced invasive plants species, especially *Lantana camara* (lantana), *Rubus argutus* (Florida prickly blackberry), *Erigeron karvinskianus* (daisy fleabane), *Kalanchoe pinnatum* (airplant), *Melia azedarach* (Chinaberry), *Triumfetta semitriloba* (Sacramento bur), and *Psidium cattleianum* (strawberry guava) (Factor E); habitat degradation by feral goats (*Capra hircus*), pigs (*Sus scrofa*) (Factors A and D); fire (Factor E); black twig borer (*Xylosandrus compactus*) damage (Factor C); and the risk of extinction from naturally occurring events, such as landslides or hurricanes, and/or reduced reproductive vigor due to the small number of existing individuals and populations (Factor E) (USFWS 1994, 1995, 2003a; K. Wood, pers. comm., 2008). Threats to *Melicope knudsenii* on Maui include habitat degradation by feral ungulates such as goats, pigs and potentially by axis deer (*Axis axis*) (Factors A and D); grazing by cattle (*Bos taurus*) (Factors A, C, and D), reduced reproductive vigor (Factor E); seed infestation by larvae of an unidentified native moth (Factor C); fire (Factor E); and introduced invasive plant species, especially *Pennisetum clandestinum* (kikuyu grass) (Factor E) (USFWS 1994, 1995, 2003b). Although cattle are a threat to this population, they also reduce the density of *P. clandestinum*, which appears to be an even greater threat (Robert Hobdy, Hawaii Division of Forestry and Wildlife, pers. comm. 1995). Developing fruit from the two remaining mature individuals on Maui need to be protected (i.e., bagged) to prevent near total loss of seed caused by seed predation by the larvae of an endemic moth species (Medeiros 2006).

In addition to the threats listed above, species like *Melicope knudsenii* that are endemic to small portions of two islands are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations and localized catastrophes such as hurricanes, landslides and disease outbreaks (Factor E). When considered on their own, the natural processes associated with being a single island endemic do not affect *M. knudsenii* to such a degree that it is threatened or endangered with extinction in the foreseeable future, but these natural processes can exacerbate the threat from anthropogenic factors, such as habitat loss for human development or predation by introduced species (Factor E) (USFWS 1995).

To safeguard existing genetic material, propagation for genetic storage and reintroduction is occurring at the several botanical facilities. The National Tropical Botanical Garden (2008) reported 35 seeds in genetic storage; Harold L. Lyon Arboretum Micropropagation Laboratory (2008) reported five plants in micropropagation from source material at Auwahi, Maui and one plant from Waimea Canyon, Kauai. The Center for Conservation Research and Training Seed Storage Laboratory (2008) reported 200 seeds in genetic storage from one individual; Waimea Arboretum (2007) reported

two plants in genetic storage and research purposes from Maui. The D. T. Fleming Arboretum (Friends of D.T. Fleming Arboretum 2004, 2007, 2008) in Ulupalakua, Maui, which houses the only mature cultivated *M. knudsenii* plant on Maui, has been instrumental in the survival of this species. The Arboretum has widely distributed seeds for propagation and storage. D. T. Fleming Arboretum's inventory lists eight plants in 2006: the mother plant (planted in 1953) and seven seedlings planted in 2004 (Hobdy 2006).

The fencing of a 4-hectare (9.9-acre) dryland forest habitat at Auwahi in 1997 is instrumental in providing protected habitat for the single remaining wild individual and the cultivated seedlings that have been outplanted there (Medeiros 2006).

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for plants from the island of Kauai (USFWS 1995), based on whether the species is an annual, a short-lived perennial (fewer than ten years), or a long-lived perennial. *Melicope knudsenii* is a long-lived perennial, and to be considered stabilized, which is the first step in recovering the species, 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 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 stabilization goals for this species have not been met (see Table 1), as only four mature individuals are known and not all of the threats are being managed. Therefore, *Melicope knudsenii* meets the definition of endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

- Continue collection of genetic resources for storage, future propagation and reintroducing into protected suitable habitat within historical range.
- Enhance current natural populations to increase the number of individuals.
- Construct exclosure fences to protect individuals from the activities of feral pigs, and eradicate introduced invasive plant species within the exclosures.
- Survey geographical and historical range for unknown populations for a thorough current assessment of the status of populations.
- Initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this species.
- Assess genetic variability within wild and outplanted individuals.

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Imada, Clyde. 2008. Research Specialist, Department of Natural Science/Botany, Bernice P. Bernice P. Bishop Museum, e-mail communication to C. Torres-Santana (USFWS) on June 30, 2008.

Table 1. Status of *Melicope knudsenii* (Alani) from listing through 5-year review.

Date	No. wild individuals	No. outplanted	Stability Criteria identified in Recovery Plan	Stability Criteria Completed?
1994 (listing)	23-33	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 25 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 25 mature individuals each	No
2003 (critical habitat)	18	Unknown	All threats managed in all 3 populations	No
			Complete genetic storage	Partially
			3 populations with 25 mature individuals each	No
2008 (5-year review)	4	8	All threats managed	Partially
			Complete genetic storage	Partially
			3 populations with 25 mature individuals each	No

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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

Acting Field Supervisor, Pacific Islands Fish and Wildlife Office

Date 21 July 2009