

Melicope christophersenii
(alani)

**5-Year Review
Summary and Evaluation**

**U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Honolulu, Hawai'i**

5-YEAR REVIEW
Species reviewed: *Melicope christophersenii* (alani)

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5-YEAR REVIEW
***Melicope christophersenii* (alani)**

1.0 GENERAL INFORMATION

1.1 Reviewers:

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Cooperating Field Office(s):

N/A

Cooperating Regional Office(s):

N/A

1.2 Methodology used to complete the 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 in October 2018. The review was based on the final rule listing this species; the final critical habitat designation; peer reviewed scientific publications; unpublished field observations by the USFWS, State of Hawai‘i, and other experienced biologists; unpublished survey reports; notes and communications from other qualified biologists; as well as a review of current, available information. The evaluation completed by Cheryl Phillipson, Biologist, was reviewed by Lauren Weisenberger, Plant Recovery Coordinator, and Megan Laut, Conservation and Restoration Team Manager.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2017. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 138 species in Hawaii, Oregon, Washington, and California. Federal Register 82(75): 18665-18668, April 20, 2017.

1.3.2 Listing history:

Original Listing

FR notice: [USFWS] U.S. Fish and Wildlife Service. 2012. Endangered and threatened wildlife and plants; Endangered status for 23 species on Oahu and

designation of critical habitat for 124 species; final rule. Department of the Interior, Federal Register 77 (181): 57648–57862, September 18, 2012.

Date listed: September 18, 2012
Entity listed: *Melicope christophersenii*
Classification: Endangered

Revised Listing, if applicable

FR notice: N/A
Date listed: N/A
Entity listed: N/A
Classification: N/A

1.3.3 Associated rulemakings:

N/A

1.3.4 Review History:

This is the first 5-year review for this species. *Melicope christophersenii* is a perennial shrub or tree listed as endangered on September 18, 2012 (77 FR 57648). Critical habitat was designated on O‘ahu for *M. christophersenii* at the same time, totaling six critical habitat units in the montane wet and wet cliff ecosystems of the Wai‘anae mountains (678 ac, 273 ha). The draft recovery plan for this species is in preparation.

1.3.5 Species’ Recovery Priority Number at start of this 5-year review:

5

1.3.6 Current Recovery Plan or Outline:

Name of plan or outline: Recovery Outline for the Island of O‘ahu
Date issued: July 2018
Dates of previous revisions, if applicable: N/A

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate?

Yes
 No

2.1.2 Is the species under review listed as a DPS?

Yes
 No

2.1.3 Was the DPS listed prior to 1996?

Yes

No

2.1.3.1 Prior to this 5-year review, was the DPS classification reviewed to ensure it meets the 1996 policy standards?

Yes
 No

2.1.3.2 Does the DPS listing meet the discreteness and significance elements of the 1996 DPS policy?

Yes
 No

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy?

Yes
 No

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

Yes
 No

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

Yes
 No

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery?

Yes
 No

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

A synthesis of the threats (Listing Factors A, C, D, and E) affecting this species is presented in section 2.3.2 and Table 2. Listing Factor B (overutilization for commercial, recreational, scientific, or educational purposes) is not known to be a threat to this species.

The recovery plan is currently being drafted. However, the Hawai'i and Pacific Plants Recovery Coordinating Committee (HPPRCC) has outlined the actions and goals for stages leading towards recovery (2011). These stages are described below.

Current information is lacking for many Hawaiian plant species on the status of the species and their habitats, breeding systems, genetics, and propagule storage options. The following downlisting and delisting criteria for plants have therefore been adopted from the revised recovery objective guidelines developed by the HPPRCC (2011). Many of the Hawaiian plant species are at very low numbers, so the USFWS also developed criteria for avoiding imminent extinction and an interim stage before downlisting, based on the recommendations of the HPPRCC, to assist in tracking progress toward the ultimate goal of recovery. These criteria are assessed on a species-by-species basis, especially as additional information becomes available.

In general, long-lived perennials are those taxa either known or believed to have life spans greater than 10 years; short-lived perennials are those known or believed to have life spans greater than one year but less than 10 years; and annuals are those known or believed to have life spans less than or equal to one year. When it is unknown whether a species is long- or short-lived, the USFWS has erred on the side of caution and considered the species short-lived. This will be revised as more is learned about the life histories of these species. Narrow extant range and broad contiguous range are recognized as not needing different numbers of individuals or populations, but that the populations will be distributed more narrowly or more broadly, respectively, across the landscape. Obligate outcrossers are those species that either have male and female flowers on separate plants or otherwise require cross-pollination to fertilize seeds, and therefore require equal numbers of individuals contributing to reproduction as males and females, doubling the number of mature individuals. Species that reproduce vegetatively may reproduce sexually only on occasion, resulting in the majority of the genetic variation being between populations, therefore requiring additional populations. Species that have a tendency to fluctuate in number from year to year require a larger number of mature individuals on average to allow for decline in years of extreme habitat conditions and recuperation in numbers in years of more normal conditions.

Preventing Extinction

Stabilizing (interim), downlisting, and delisting objectives have been updated according to the draft revised recovery objective guidelines developed by the 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 christophersenii is a long-lived perennial monoecious (male and female flowers on the same plant) shrub or tree. To prevent extinction, which is the first step 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 O‘ahu where they now occur or occurred historically. Each of these populations must be naturally reproducing (*i.e.*, viable seeds, seedlings, saplings) and increasing in number, with a minimum of 25 mature, reproducing individuals per population.

This recovery objective has not been met (see Table 1).

Interim Stage

To meet the interim stage of recovery of *Melicope christophersenii*, 100 mature individuals are needed in each of three populations and all major threats must be controlled around the populations designated for recovery at this stage. There should also be demonstrated regeneration of seedlings and growth to at least sapling stage for woody species and documented replacement regeneration within each of the target populations. The populations must be adequately represented in an *ex situ* collection as defined in the Center for Plant Conservation’s guidelines (Guerrant *et al.* 2004). Adequate monitoring must be in place and conducted to assess individual plant survival, population trends, trends of major limiting factors, and response of major limiting factors to management.

This recovery objective has not been met (see Table 1).

Downlisting Criteria

In addition to achieving 5 to 10 populations with 200 mature individuals per population and all of the goals of the interim stage, all target populations must be stable, secure, and naturally reproducing for a minimum of 10 years. Species-specific management actions are not ruled out. Downlisting should not be considered until an adequate population viability analysis (PVA) has been conducted to assess needed numbers more accurately based on current management and monitoring data collected at regular intervals determined by demographic parameters of the species, although they should only be one of the factors used in making a decision to downlist. Information necessary for the PVA that should be available through monitoring (ideally annually) includes major limiting factors, breeding system, population structure and density, and proven management methods for major threats.

This recovery objective has not been met (see Table 1).

Delisting Criteria

In addition to achieving 5 to 10 populations with 200 mature individuals per population and all of the goals of the interim and downlisting stages, all target populations must be stable, secure, naturally reproducing, and within secure and viable habitats for a minimum of 20 years. Species-specific management actions must no longer be necessary, but ecosystem-wide management actions are not ruled out if there are long-term agreements in place to continue management. These numbers are initial targets, but may be revised upward as additional information is available, including adequate PVAs for individual species based on current management and monitoring data collected at regular intervals determined by demographic parameters of the species, although they should only be one of the factors used in making a decision to delist. Genetic analyses should be conducted to ensure that adequate genetic representation is present within and among populations compared to the initial variation assessed in the interim stage. Numbers need to be considered on a species-by-species basis.

This recovery objective has not been met (see Table 1).

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

Little is known about the life history of *Melicope christophersenii*. Flowering cycles, pollination vectors, seed dispersal agents, specific environmental requirements, and limiting factors are unknown.

Melicope christophersenii, a member of the rue family (Rutaceae), is a shrub or tree 10 to 20 feet (ft) (3 to 6 meters (m)) tall, with hirtellous (hairy) branches and glabrate (somewhat smooth) petioles. The opposite leaves are coriaceous (leathery), elliptic to ovate or obovate, and sometimes suborbicular, 1.8 to 4.7 inches (in) (4.5 to 12 centimeters (cm)) long and 1 to 3 in (2.5 to 8 cm) wide. The upper leaf surface is glabrate with the lower surface glabrate or sparsely puberulent (covered with fine hairs). The separate staminate or pistillate (male or female) flowers number 3 to 15 in cymes (flower cluster with terminal flower developing first), 0.8 to 2 in (2 to 5 cm) long. Staminate flowers have densely puberulent sepals and deltate (triangular-shaped) petals 0.2 to 0.3 in (6 to 8 mm) long. Capsules are 1 to 1.6 in (25 to 40 mm) wide and 0.5 to 0.8 in (12 to 20 mm) long with 0.2 in- (6 mm-) long seeds (Stone *et al.* 1999). *Melicope christophersenii* is closely related to *M. kaalaensis* which it differs from in its shorter peduncles and pedicels and slightly less connate carpels. It is also closely related to *M. honoluluensis* (now *M. hosakae*, Wagner *et al.* 2012; which occurs only in the Ko'olau mountains) from which it differs from only in its larger fruit (Stone *et al.* 1999).

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

The type for this species was collected at the summit of Ka‘ala in 1931 (Hawai‘i Biodiversity and Mapping Program (HBMP) 2010; St. John 1944). At the time of listing in 2012, *Melicope christophersenii* was known from one population in the Ka‘ala summit area (approximately 250 individuals), one individual at Pu‘uhapapa, and one individual at Pu‘ukaua last observed in 1932 (HBMP 2010). Currently, there are about 150 individuals in the Ka‘ala summit area, about 50 to 60 individuals along the ridge at Ka‘ala–Pu‘u Kalena, one individual at North Kaluaa, and one individual at Pu‘ukaua (U.S. Army 2018; Ching 2019, in litt.; Kawelo 2019, in litt.).

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

N/A

2.3.1.4 Taxonomic classification or changes in nomenclature:

Melicope christophersenii was described by St. John in 1944. In 1989, Hartley and Stone placed *Pelea* A.Gray in synonymy of *Melicope* J.R. & G. Forster. Currently, this species is recognized as *Melicope christophersenii* in the most recent taxonomic treatment in the Manual of the Flowering Plants of Hawai‘i (Stone *et al.* 1999).

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species’ within its historic range, etc.):

See section 2.3.1.2 above for spatial distribution of the species.

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

Typical habitat for this species is montane wet *Metrosideros* (‘ōhi‘a) forest and cliff at 2,400 to 4,010 ft (731 to 1,222 m) elevation in the Wai‘anae mountains of O‘ahu, with the associated native species *Cheirodendron platyphyllum* (‘ōlapa), *C. trigynum* (‘ōlapa), *Coprosma longifolia* (pilo), *Cyanea membranaceae* (hāhā), *Dianella sandwicensis* (‘uki‘uki), *Diplazium sandwichianum* (hō‘i‘o), *Doodia kunthiana* (‘ōkupukupu), *Dryopteris fusco-atra* (‘i‘i), *D. unidentata* (‘akole), *Freycinetiana arborea* (‘ie‘ie), *Labordia kaalae* (kāmakahala), *Hydrangea arguta* (kanawao), *Lobelia yuccoides* (pānaunau), *Peperomia macraeana* (‘ala‘ala wai nui), *Perrottetia sandwicensis* (olomea), *Phyllostegia grandiflora* (kāpana), *Psychotria hathewayi* (kōpiko), and *P. mariniana* (kōpiko) (HBMP 2010).

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range (Factor A):

Ungulate degradation of habitat—Feral pigs and the effects of their activities have been observed at Pu‘u Kalena, along the Ka‘ala-Kalena ridge, and at North Kaluaa (HBMP 2010). Feral ungulates modify and degrade habitat by disturbing and destroying vegetative cover, trampling plants and seedlings, reducing or eliminating plant regeneration by damaging seeds and seedlings, and increasing erosion by creating large areas of bare soil (Loope 1998; van Riper and van Riper 1982).

Degradation of habitat by established ecosystem-altering invasive plant species—The nonnative plant species impact all locations where *Melicope christophersenii* occurs (HBMP 2010; ANRP 2018). *Rubus argutus* (prickly Florida blackberry) and *Psidium cattleianum* (strawberry guava) are reported to have the greatest impacts at Ka‘ala summit; *R. argutus*, and *Clidemia hirta* (Koster’s curse) are reported to have the greatest impacts at Pu‘u Kalena and Ka‘ala-Kalena ridge; and *Clidemia hirta*, *Schinus terebinthifolius* (Christmas berry), and *Passiflora suberosa* (corkystem passionflower) are reported to have the greatest impacts at North Kaluaa (HBMP 2010). Invasive nonnative plant species modify habitats occupied by native plant species by changing the availability of light, altering soil-water regimes, modifying nutrient cycling, and by changing the fire characteristics of the native plant community (Cuddihy and Stone 1990).

Climate change loss or degradation of habitat—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. The assessment concluded that *Melicope christophersenii* occurs at the highest elevations within its range along the Wai‘anae Mountain summit and is extremely vulnerable to the impacts of climate change with a vulnerability score of 0.901 (on a scale of 0 being not vulnerable to 1 being extremely vulnerable to climate change). Therefore, additional management actions are needed to conserve this taxon into the future, such as identifying suitable microsites where climate change is anticipated to occur more slowly and considering suitable habitat outside of its known range.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes (Factor B):

Not a threat.

2.3.2.3 Disease or predation (Factor C):

Not a threat.

2.3.2.4 Inadequacy of existing regulatory mechanisms (Factor D):

Not a threat.

2.3.2.5 Other natural or manmade factors affecting its continued existence (Factor E):

Invasive species—Established invasive plant species competition—Nonnative plant species including *Clidemia hirta*, *Passiflora suberosa*, *Psidium cattleianum*, *Rubus argutus*, and *Schinus terebinthifolius* compete with *Melicope christophersenii* for water, light, and nutrients, and prevent the establishment of seedlings (Cuddihy and Stone 1990; HBMP 2010; ANRP 2018).

Human disturbance—Human disturbance is noted as a threat to individuals of *Melicope christophersenii* that occur along Ka‘ala-Kalena ridge (HBMP 2010). No regeneration of individuals was noted as a threat at this location.

Stochastic events—Reduced viability due to low numbers—Combined pressures of loss of habitat due to modification and destruction by feral pigs and nonnative invasive plants, and competition with nonnative invasive plants can negatively affect the viability and reproduction of remaining individuals of *Melicope christophersenii*.

Current Management Actions:

- Ungulate degradation of habitat—The Army’s Natural Resources Program conducts ungulate control to benefit other plant species at Ka‘ala, and currently there is no pig activity observed in the summit area (Kawelo 2019, in litt.). This benefits the largest known population of *Melicope christophersenii*.
- Build resilience and redundancy—
 - The Army’s Natural Resources Program collected seeds of *Melicope christophersenii* from individuals at Mākaha gulch at Ka‘ala and propagated at least four individuals in 2015 (ANRP 2018). Two plants were reintroduced at Ka‘ala in 2003 and survived; however, their current status has not been reported.
 - The National Tropical Botanical Garden (NTBG) reported collection and storage of 30 seeds from Pu‘u Kalena in 1992 and collection and storage of 26 seeds from Ka‘ala-Kalena (NTBG 2018). The viability of these stored seeds is likely low.

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

Date	No. wild individuals	No. outplanted	Preventing Extinction Criteria identified by HPPRCC	Preventing Extinction Criteria Completed?
2012 (listing and critical habitat)	250	2	All threats managed in all three populations	No
			Complete genetic storage	No
			Three populations with 25 mature individuals each	No
2019 (5-year review)	>250	0	All threats managed in all three populations	No
			Complete genetic storage	Partial, some seed collection
			Three populations with 25 mature individuals each	Partial, two populations > 25

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

Threat	Listing Factor	Current Status	Conservation/Management Efforts
Ungulate degradation of habitat	A	Ongoing	Partial, pigs controlled at Ka‘ala summit
Degradation of habitat by established ecosystem-altering invasive plant species	A	Ongoing	Partial, nonnative plant control at Ka‘ala summit
Climate change degradation or loss of habitat	A	Ongoing	None
Established invasive plant species competition	E	Ongoing	Partial, nonnative plant control at Ka‘ala summit
Human disturbance	E	Ongoing	None
Stochastic events— Reduced viability due to low numbers and no regeneration	E	Ongoing	Partial, some seed collection and reintroduction conducted

2.4 Synthesis

There are four populations of *Melicope christophersenii*, the largest totaling approximately 150 individuals, with about 50 to 60 individuals in the second population, and only one individual each at the remaining populations. A landscape-based assessment of climate change vulnerability for native plants of Hawai'i using high resolution climate change projections was made by Fortini *et al.* (2013) and their analysis showed that *M. christophersenii* is extremely vulnerable to the effects of climate change. The largest population benefits are from management actions to control feral pigs and nonnative plants for other listed plant species.

Preventing extinction, interim stabilization, downlisting, and delisting objectives are provided in HPPRCC's Revised Recovery Objective Guidelines (2011). To prevent extinction, which is the first step 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 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 O'ahu where they now occur or occurred historically and each of these populations must be naturally reproducing (*i.e.*, viable seeds, seedlings, or saplings) with a minimum of 25 mature, reproducing individuals per population.

The preventing extinction goals for this species have not been met. There are two populations totaling more than 25 individuals. There are only four individuals represented in collections (Table 1) and all threats are not being sufficiently managed throughout the range of the species (Table 2). Therefore, *Melicope christophersenii* meets the definition of endangered as it remains in danger of extinction throughout its range.

3.0 RESULTS

3.1 Recommended Classification:

Downlist to Threatened

Uplist to Endangered

Delist

Extinction

Recovery

Original data for classification in error

No change is needed

3.2 New Recovery Priority Number:

Brief Rationale:

3.3 Listing and Reclassification Priority Number:

Reclassification (from Threatened to Endangered) Priority Number: _____

Reclassification (from Endangered to Threatened) Priority Number: _____

Delisting (regardless of current classification) Priority Number: _____

Brief Rationale:

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Surveys and inventories—Survey for *Melicope christophersenii* in historical locations and potentially suitable habitat.
- Ungulate monitoring and control—Continue to protect the largest occurrences against browsing and disturbances from feral ungulates. Construct and maintain fenced exclosures around other individuals to prevent their loss.
- Invasive plant monitoring and control—Continue to control established ecosystem-altering nonnative invasive plant species around all populations.
- Captive propagation for genetic storage and reintroduction—Continue collection of seeds for storage and propagation efforts for maintenance of genetic stock.
- Reintroduction and translocation—Continue to reintroduce individuals to suitable habitat within historic range that is being managed for known threats to this species.
- Climate change adaptation strategy—Research the suitability of habitat in the future due to the impacts of climate change
- Build resiliency and redundancy—Increase numbers of populations and individuals to reduce the impacts of low numbers.
- Alliance and partnership development—Contribute to implementation of ecosystem-level restoration and management to benefit this taxon.

5.0 REFERENCES

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Melicope christophersenii*
(alani)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: _____

Review Conducted By:

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FIELD OFFICE APPROVAL:

for

Field Supervisor, Pacific Islands Fish and Wildlife Office