5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Myrsine linearifolia* (Kōlea)

Current Classification: Threatened

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2015a. Endangered and threatened wildlife and plants; initiation of 5-year status reviews of 133 species in Hawaii, Oregon, Idaho, and Washington. Federal Register 80(30): 8100–8103.

Lead Region/Field Office:

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

Name of Reviewer(s):

Cheryl Phillipson, Biologist, PIFWO
Lauren Weisenberger, Plant Recovery Coordinator, PIFWO
Gregory Koob, 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 (USFWS) beginning in January 2016. The review was based on a review of current, available information since the last 5-year review for *Myrsine linearifolia* (USFWS 2010). The evaluation by Cheryl Phillipson, Biologist, was reviewed by Lauren Weisenberger, Plant Recovery Coordinator, and Gregory Koob, 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 review for *Myrsine linearifolia* published in the Federal Register on August 27, 2010 (USFWS 2010, available at *https://ecos.fws.gov/docs/five_year_review/doc3354.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. linearifolia*.

This long-lived, perennial shrub in the Primulaceae family is endangered and found on Kauai. The current status and trends for *Myrsine linearifolia* 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:

- At the time of the last 5-year review in 2010 there were 12 populations totaling between 164 and 197 individuals. Currently, individuals are reported from the same areas at Puu o Kila to Pihea (Kalalau), Hanakapiai, Limahuli, and Wahiawa drainage (NTBG 2011b, 2012a-f, 2013a, 2014b-d, 2015, 2016a-b). New occurrences have been found at Manono ridge (five individuals), Iole ridge (one individual), Waiahi (two individuals), and Koaie above Lonomea Camp (one individual) (NTBG 2012g, 2013b-e, 2014a). These occurrences total at least 100 individuals. In 2015, Edmonds reported 11 subpopulations totaling 750 individuals, with the largest "subpopulation" (considered as populations by USFWS) containing 50 total individuals (Edmonds 2015).
- In 2009, the Angiosperm Phylogeny Group updated classifications of plant orders and families. This moved the Hawaiian *Myrsine* species from the Myrsinaceae family to the Primulaceae family (APG 2009), including *M. linearifolia*. This change is recognized in Wagner *et al.* (2012), the most recent Hawaiian plant taxonomy. We accepted this change in the 2015 technical correction (USFWS 2015b).

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 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 *Myrsine linearifolia* is vulnerable to the impacts of climate change, with a vulnerability score of 0.467 (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.
- Fire destruction or degradation of habitat—Fire can destroy dormant seeds as well as individual plants. Successive fires burn farther and farther into native habitat and alter microclimate conditions to further alter habitat conditions to favor nonnative plants. Nonnative plants convert native plant communities to nonnative dominated plant communities D'Antonio and Vitousek 1992; Tunison *et al*. 2002). Fire is reported as a threat to *Myrsine linearifolia* at Puu o Kila, Koaie, and Wahiawa drainage-Kahili (NTBG 2012d-f, 2013b-c, 2014c-d, 2016a-b).
- Hurricanes—Loss and degradation of habitat—Hurricanes were omitted in the last five year review. In November 1982, Hurricane Iwa struck the Hawaiian Islands, with wind gusts exceeding 100 miles per hour (mph) (161 kilometers per hour (kph)), causing extensive damage, especially on the islands of Niihau, Kauai, and Oahu (Businger 1998). In September 1992, Hurricane Iniki, a category 4 hurricane with maximum sustained wind speeds recorded at 140 mph (225 kph), passed directly over the island of Kauai. Many forest trees were destroyed (Perlman 1992), which opened the canopy and facilitated the invasion of nonnative plants (Kitayama and Mueller-Dombois 1995). A destructive hurricane holds the potential of driving a localized endemic species to extinction in a single event, and 70 percent of all listed plant species on Kauai are only found on Kauai. Hurricanes pose an ongoing and ever-present threat because they can happen at any time, although their occurrence is not predictable. Tropical cyclone frequency and intensity are projected to change as a result of climate change over the next 100 to 200 years (Vecchi and Soden 2007; Emanuel *et al.* 2008; Yu *et al.* 2010). In

the central Pacific, modeling projects an increase of up to two additional tropical cyclones per year in the main Hawaiian Islands by 2100 (Murakami *et al.* 2013).

New Management Actions:

- Captive propagation for genetic storage and reintroduction—NTBG is currently germinating seeds and have plants in their nursery from Kalalau, Hono o Na Pali NAR and Upper Limahuli Preserve (NTBG 2017). This species has been difficult to determine if it is appropriate for long term seed storage and research is ongoing for other congeners (Keir and Weisenberger 2014, OANRP 2016; Lyon Arboretum 2017)

Synthesis:
Currently, there are at least 100 to as many as 750 individuals of *Myrsine linearifolia* in 11 populations, with the largest population consisting of 50 individuals. A landscape-based assessment of climate change vulnerability for native plants of Hawaii using high resolution climate change projections was made by Fortini *et al.* (2013) and their analysis showed that *M. linearifolia* is vulnerable to the effects of climate change. Seeds and seedlings are in propagation.

Stabilizing (interim), downlisting, and delisting objectives were provided in the Kauai II Addendum to the Kauai Plant Cluster Recovery Plan (USFWS 1998), and have been updated according to the draft revised recovery objective guidelines developed by the Hawaii 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 determination 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.

Myrsine linearifolia is a long-lived perennial shrub. To reach preventing extinction objectives, 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 Kauai where they now occur or occurred historically and each of these populations must be naturally reproducing (*i.e*. viable seeds, seedlings), with a minimum of 25 mature individuals per population.

The preventing extinction goals for this species have not been met (Table 1). Although some populations may have more than 25 individuals, only one is known with some certainty, genetic representation is incomplete (Table 1), and not all threats are being sufficiently managed throughout the range of the species (Table 2). Therefore, *Myrsine linearifolia* meets the definition of threatened as it is likely to become endangered throughout all or a significant portion of its range within the foreseeable future.

Recommendations for Future Actions:

Fire is reported as a new threat to *Myrsine linearifolia* at the Puu o Kila, Koaie, and Kahili (Wahiawa drainage) populations. No other significant new information regarding the species' biological status has been reported since the last 5-year review in 2010. Thus, the following recommendations for future actions are added or reiterated for the 5-year review for 2017.

- Surveys and inventories—Survey to determine the current status of the species and whether change in status from threatened to endangered is warranted.
- Ungulate monitoring and control—Construct fenced exclosures to protect all populations against feral ungulates. Protect all occurrences against browsing and disturbances from feral ungulates.
- Invasive plant monitoring and control—
    - Control established ecosystem-altering nonnative invasive plant species around all populations.
    - Control invasive nonnative species that compete with the species around all populations.
- Fire monitoring and control – Develop and implement fire prevention management plans.
- Captive propagation for genetic storage and reintroduction—Continue propagation efforts for maintenance of genetic stock.
- Reintroduction and translocation—Augment existing populations and create new populations in suitable protected habitat.
- Predator and herbivore monitoring and control—Implement effective measures to control predation by ungulates and rats.
- Population biology research—Study *Myrsine linearifolia* populations to determine viable population size and structure, geographical distribution, pollination vectors, seed dispersal agents, longevity, specific environmental requirements, limiting factors, and threats.

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

Date	No. wild individuals	No. outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization Criteria Completed?
1996 (listing)	1,000–1,500	0	All threats managed in all three populations	No
			Complete genetic storage	No
			Three populations with 25 mature individuals each	No

1998 (recovery plan)	1,000–1,500	0	All threats managed in all three populations	No
			Complete genetic storage	Partially
			Three populations with 25 mature individuals each	No
2003 (critical habitat)	490–564	0	All threats managed in all three populations	No
			Complete genetic storage	Partially
			Three populations with 25 mature individuals each	No
2010 (5-year review)	164–197	13	All threats managed in all three populations	No
			Complete genetic storage	Partially
			Three populations with 25 mature individuals each	No
Date	**No. wild individuals**	**No. outplanted**	***Preventing Extinction Criteria identified by HPPRCC**	***Preventing Extinction Criteria Completed?**
2016 (5-year review)	ca 100–750	0	All threats managed in all three populations	No
			Complete genetic storage	Partially
			Reproduction (*i.e.* viable seeds, seedlings) at all three populations	No

			Three populations with 25 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 after Preventing Extinction).

Table 2. Threats to *Myrsine linearifolia* and conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulate degradation of habitat	A	Ongoing	None
Established ecosystem altering invasive plant species degradation of habitat	A	Ongoing	None
Hurricane destruction and degradation of habitat	A	Ongoing	None
Climate change loss or degradation of habitat	A	Ongoing	None
Ungulate predation or herbivory	C	Ongoing	Partial, seed collection and propagation
Rodent predation or herbivory	C	Ongoing	Partial, seed collection and propagation

References:

See previous 5-year review in 2010 for a full list of references. Only references for new information are provided below.

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[NTBG] 2012a. NTBG database herbarium specimen detail for *Myrsine linearifolia*. 072731, 7 MAR 2012.

[NTBG] 2012b. NTBG database herbarium specimen detail for *Myrsine linearifolia*. 072684, 7 MAR 2012.

[NTBG] 2012c. NTBG database herbarium specimen detail for *Myrsine linearifolia*. 070487, 26 JUL 2011.

[NTBG] 2012d. NTBG database herbarium specimen detail for *Myrsine linearifolia*. 063919, 16 AUG 2012.

[NTBG] 2012e. NTBG database herbarium specimen detail for *Myrsine linearifolia*. 063925, 16 AUG 2012.

[NTBG] 2012f. NTBG database herbarium specimen detail for *Myrsine linearifolia*. 063930, 16 AUG 2012.

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[NTBG] 2013b. NTBG database herbarium specimen detail for *Myrsine linearifolia*. 072201, 19 MAR 2013.

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[NTBG] 2013d. NTBG database herbarium specimen detail for *Myrsine linearifolia*. 068007, 25 NOV 2013.

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SIGNATURE PAGE for 5-YEAR REVIEW of *Myrsine linearifolia* (Kōlea)

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**

GREGORY KOOB

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