Species Report of *Myrsine fosbergii* (kōlea)
Version 1.0

Myrsine fosbergii at Moanalua on O‘ahu (Photo Credit: Susan Ching, State of Hawai’i Division of Forestry and Wildlife)

September 2022

Pacific Islands Fish and Wildlife Office
U.S. Fish and Wildlife Service
Honolulu, HI

This document was prepared by the staff at the Pacific Islands Fish and Wildlife Office, Honolulu, Hawai‘i. We received valuable input and assistance from the following expert: Susan Ching, DLNR DOFAW. We greatly appreciate their guidance and support, which resulted in a more robust report.

Suggested reference:
U.S. Fish and Wildlife Service. 2022. Species Report for *Myrsine fosbergii* (kōlea). Pacific Islands Fish and Wildlife Office, Pacific Islands Interior Region 12, Portland OR. 33 pages.

EXECUTIVE SUMMARY

This Species Report was completed to assess the overall viability of *Myrsine fosbergii* by using the three conservation biology principles of resiliency, representation, and redundancy. To accomplish this, a description of this species and identifying its ecological requirements for survival and reproduction at the individual, population, species levels, stressors and conservation actions were compiled. This information was then used to evaluate this species in its current condition.

Myrsine fosbergii is a branched shrub or small tree in the Myrsine family (Primulacaeae) (Wagner et al. 1999, p. 940). This species was known to occur in wet forest habitats on the summit ridges of the Koʻolau Mountains on the island of Oʻahu, and in wet and mesic forest habitats throughout Kauaʻi. Currently, there are nine extant wild population units, and another nine with unknown status. Pollination and seed dispersal of *M. fosbergii* are unknown, but species in the genus are presumably pollinated by insects and dispersed by birds (Sakai et al. 1995, p. 2,526).

The main threats to *Myrsine fosbergii* are hybridization, nonnative plants, and habitat degradation and direct predation from ungulates and rats, as well as consequences of small population sizes, inadequate regulatory mechanisms, and climate change. Conservation actions include management activities implemented by watershed partnerships and include fencing, ungulate control, and nonnative plant removal. *M. fosbergii* occurs on lands that are part of the Koʻolau Mountains Watershed Partnership on the island of Oʻahu, and the Kauaʻi Watershed Alliance on the island of Kauaʻi.

Resiliency, or the ability of a species to withstand stochastic disturbance, of this species is based on the metrics of population size (number of individuals) and the quality of habitat factors that support the species. Redundancy, or the ability of a species to withstand catastrophic events, of this species is evaluated on the metrics of the number of resilient populations and their distribution across the known range of the species. Representation, or the ability of a species to adapt to changing environmental conditions over time, of this species is based on how well genetic diversity is secured among multiple resilient populations and the number of resilient populations occupying the different habitat types where *Myrsine fosbergii* occurs.

The current condition of *Myrsine fosbergii* is described as having nine extant populations on two islands. Overall, it is likely that populations have generally been decreasing in size due to existing threats such as hybridization, nonnative plants, and pigs. *Ex situ* seed storage is minimal, and propagation has been largely unknown or unsuccessful. At the species level, *M. fosbergii* has very low resiliency across all populations, very low redundancy, and very low representation. Therefore, the overall viability of this species is very low in the current condition.

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INTRODUCTION

Myrsine fosbergii (kōlea) is a small tree in the Myrsine family (Primulacaeae) known from the islands of Kauaʻi and Oʻahu (Wagner et al. 1999, p. 940). On Kauaʻi, there are five known remaining individuals in wet forest and mesic forest, with an unknown or likely extirpated status for another estimated 50 individuals. On Oʻahu, there were fewer than 100 individuals in wet forest, but only 15 are known to be extant currently. The Hawaiʻi Mesic Forests habitat status assessment (Lowe et al. 2019, entire) and Hawaiian Islands Wet Forest habitat status assessment (Clark et al. 2019, entire), should be referred to for further description and discussion on mesic and wet forests and the threats to these habitats on Kauaʻi and Oʻahu.

Species Report Overview
This Species report summarizes the biology and current status of *Myrsine fosbergii* and was conducted by Pacific Islands Fish and Wildlife Office. It is a biological report that provides an in-depth review of the species' biology, factors influencing viability (threats and conservation actions), and an evaluation of its current status and viability.

The intent is for the Species Report to be easily updated as new information becomes available, and to support the functions of the U.S. Fish and Wildlife Service's (USFWS) Endangered Species Program. As such, it will serve as a living document and biological foundation of other documents such as recovery plans, status in biological opinions, and 5-year reviews.

Regulatory History
Myrsine fosbergii was listed as an endangered species on September 30, 2016 (USFWS 2016a p. 67,786) under the Endangered Species Act (Act) of 1973 [16 U.S.C. 1531-1544 et seq.], as amended. Critical habitat has not yet been designated for this species.

Methodology
We used the best scientific data available to us, including peer-reviewed literature, grey literature (government, academic), and expert elicitation. Because little information is available about *Myrsine fosbergii*, we used basic plant biology to identify needs of individuals, populations, and species. To the best of our ability, we used the current taxonomy at the time this report was drafted.

To assess the current status and viability of *Myrsine fosbergii*, we identified population units. The classic definition of a population is a self-reproducing group of conspecific individuals that occupies a definite area over a span of evolutionary time, possesses an assemblage of genes (the gene pool) of its own, and has its own ecological niche. However, due to information gaps, we could not assess the viability of *M. fosbergii* using this definition. The Hawaiʻi and Pacific Plants Recovery Coordinating Committee (HPPRCC) revised its recovery objectives guidelines in 2011 and included a working definition of a population for plants: "a group of conspecific individuals that are in close spatial proximity to each other (i.e., less than 1,000 meters apart), and are presumed to be genetically similar and capable of sexual (recombinant) reproduction" (HPPRCC 2011, p. 1).

Based on this working definition, maps were created to display population units. In an effort to protect the sensitivity of species data, we created maps with symbol markers rather than displaying species points or polygons. We created the symbols in steps. First, we added a 500-meter buffer around each individual species point and polygon. We then dissolved all buffer areas intersecting each other into a single shape. Next, we created a centroid (i.e., point representing the center of a polygon) within each dissolved buffer area. The symbol marker represents the centroid. Finally, the Disperse Marker toll in ArcGIS Pro was used to shift the symbol markers that were overlapping so they would all be visible at the scale of the map. All points and polygons were used in this process, regardless of observation date or current status (historical, current, extant, or extirpated), to represent the known range of the species.

Species Viability

The Species Report assesses the ability of *Myrsine fosbergii* to maintain viability over time. Viability is the ability or likelihood of the species to maintain populations over time, i.e., likelihood of avoiding extinction. To assess the viability of *M. fosbergii*, we used the three conservation biology principles of resiliency, redundancy, and representation, or the "3Rs" (Figure 1; USFWS 2016, entire). We will evaluate the viability of a species by describing what the species needs to be resilient, redundant, and represented, and compare that to the status of the species based on the most recent information available to us.

Definitions

Resiliency is the capacity of a population or a species to withstand the more extreme limits of normal year-to-year variation in environmental conditions such as temperature and rainfall extremes, and unpredictable but seasonally frequent perturbations such as fire, flooding, and storms (i.e., environmental stochasticity). Quantitative information on the resiliency of a population or species is often unavailable. However, in the most general sense, a population or species that can be found within a known area over an extended period of time (e.g., seasons or years) is likely to be resilient to current environmental stochasticity. If quantitative information is available, a resilient population or species will show enough reproduction and recruitment to maintain or increase the numbers of individuals in the population or species, and possibly expand the range of occupancy. Thus, resiliency is positively related to population size and growth rate, and may also influence the connectivity among populations.

Redundancy is having more than one resilient population distributed across the landscape, thereby minimizing the risk of extinction of the species. To be effective at achieving redundancy, the distribution of redundant populations across the geographic range should exceed the area of impact of a catastrophic event that would otherwise overwhelm the resilient capacity of the populations of a species. In the report, catastrophic events are distinguished from environmental stochasticity in that they are relatively unpredictable and infrequent events that exceed the more extreme limits of normal year-to-year variation in environmental conditions (i.e., environmental stochasticity), and thus expose populations or species to an elevated extinction risk within the area of impact of the catastrophic event. Redundancy is conferred upon a species when the geographic range of the species exceeds the area of impact of any anticipated catastrophic event. In general, a wider range of habitat types, a greater geographic distribution, and connectivity across the geographic range will increase the redundancy of a species and its ability to survive a catastrophic event.

Representation is having more than one population of a species occupying the full range of habitat types used by the species. Alternatively, representation can be viewed as maintaining the breadth of genetic diversity within and among populations, in order to allow the species to adapt to changing environmental conditions over time. The diversity of habitat types, or the breadth of the genetic diversity of a species, is strongly influenced by the current and historic biogeographical range of the species. Conserving this range should take into account historic latitudinal and longitudinal ranges, elevation gradients, climatic gradients, soil types, habitat types, seasonal condition, etc. Connectivity among populations and habitats is also an important consideration in evaluating representation.

The viability of a species is derived from the combined effects of the 3Rs. A species is considered viable when there are a sufficient number of self-sustaining populations (resiliency) distributed over a large enough area across the range of the species (redundancy) and occupying a range of habitats to maintain environmental and genetic diversity (representation) to allow the species to persist indefinitely when faced with annual environmental stochasticity and infrequent catastrophic events. Common ecological features are part of each of the 3Rs. This is especially true of connectivity among habitats across the range of the species. Connectivity sustains dispersal of individuals, which in turn greatly affects genetic diversity within and among populations. Connectivity also sustains access to the full range of habitats normally used by the species, and is essential for re-establishing occupancy of habitats following severe environmental stochasticity or catastrophic events (see Figure 1 for more examples of overlap among the 3Rs). Another way the three principles are inter-related is through the foundation of population resiliency. Resiliency is assessed at the population level, while redundancy and representation are assessed at the species level. Resilient populations are the necessary foundation needed to attain sustained or increasing representation and redundancy within the species. For example, a species cannot have high redundancy if the populations have low resiliency. The assessment of viability is not binary, in which a species is either viable or not, but rather on a continual scale of degrees of viability, from low to high. The health, number and distribution of populations were analyzed to determine the 3Rs and viability. In broad terms, the more resilient, represented, and redundant a species is, the more viable the species is. The current understanding of factors, including threats and conservation actions, will influence how the 3Rs and viability are interpreted for *Myrsine fosbergii.*

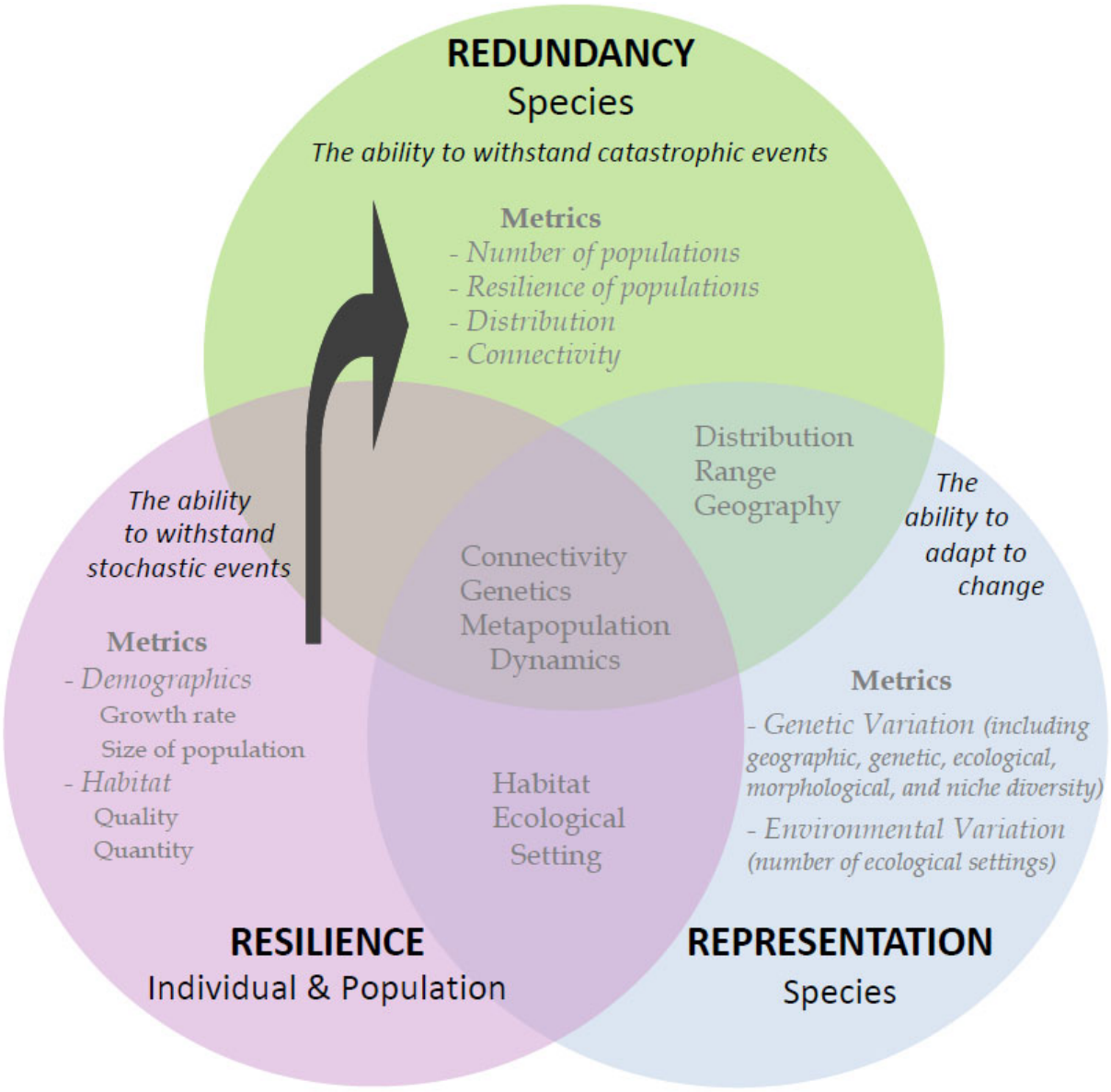

Figure 1. The three conservation biology principles of resiliency, redundancy, and representation, or the "3Rs".

SPECIES ECOLOGY

Species Description

The genus *Myrsine* occurs throughout most of the Pacific Basin. There are roughly 150–200 species in this genus. The Hawaiian species were derived from one or two independent colonizations that likely arrived from the South Pacific. There are 20 species of *Myrsine* in Hawai‘i, all of which are endemic to the Hawaiian islands, the majority of which are restricted to Kaua‘i (half are restricted to Kaua‘i) and O‘ahu (Wagner et al. 1999, p. 940).

Myrsine fosbergii are branched shrubs or small trees measuring 6 to 13 feet (ft) (2 to 4 meters [m]) tall. The branches are dark reddish brown with clusters of leaves near the tip of each branch. The leaves are predominantly dark green with a dark purple base, and measure 3 to 5 in (8 to 13 cm) long and 0.4 to 1 in (1 to 3 cm) wide, giving them a narrow, elliptical shape (Wagner et al. 1999, p. 940).

Individual Needs

The life history characteristics of *Myrsine fosbergii* have not been well studied. Little is known about the phenology and reproduction of *M. fosbergii*. Pollination and seed dispersal of *M. fosbergii* are unknown, but the species in this genus are presumably pollinated by insects and dispersed by forest birds (Sakai et al. 1995, p. 2,526).

There are known differences in elevation, average rainfall, and slope between all 21 population units of *Myrsine fosbergii* (See Table 1). Across *M. fosbergii* range, this species occurred at elevations from 961 ft (293 m) to 4,767 ft (1,453 m), with annual rainfall between 44 in (1,136 mm) to 341 in (8,670 mm), and on slopes of 2 to 109 percent (Table 1). *Myrsine fosbergii* often occurs along watercourses (HBMP 2010) and at summit ridges where rainfall is most frequent, which may suggest a dependency on wetter habitats or where water may be more readily available.

There are known differences in soil types between *Myrsine fosbergii* population units on the different islands (Table 1). *Myrsine fosbergii* on the island of Kauaʻi are found in seven different soil types (See Table **2**) that occur in three different habitat types (Table 1). These locations vary from gulches and mountainsides, to mountain summits and ridges. Oʻahu populations are found in four different soil types (Table **2**) that occur in two different habitat types (Table 1). These locations are typically all high elevation ridgetops.

Myrsine fosbergii is known to occur in dense to open forest canopies comprised of *Metrosideros* (lehua)*, Diospyros* (lama)*, Cheirodendron* (ʻōlapa)*, Syzygium sandwicense* (ʻōhiʻa hā)*,* and *Antidesma* (hame) species (USFWS 2016 p. 67,800; HBMP 2010).

Population Needs

To be resilient, a population needs to be healthy, which means it consists of abundant individuals within habitat patches of adequate area and quality. The population also needs to be stable or increasing in population growth and able to maintain survival and reproduction in spite of disturbance. The population structure of *Myrsine fosbergii* consists of multiple wild populations on the islands of Oʻahu and Kauaʻi that have declining population growth (decrease in number of mature individuals and lack of all age classes (population structure)). Resiliency is the capacity of a population (or a species) to withstand stochastic disturbance events. We define resiliency for *M. fosbergii* based on the metric of population size (number of individuals) and the quality of habitat factors that support the species.

Resilient populations of *Myrsine fosbergii* need enough space and suitable habitat to maintain stable populations, the ability to cross-pollinate, and maintain connectivity between populations to persist and survive over many generations. Suitable habitat for populations of *M. fosbergii* on Oʻahu occur along the ridgeline of the Koʻolau Mountains in wet forests. On the island of

Kauaʻi, suitable habitat is found in mesic forest and wet forest habitat types. Descriptions of the viability of mesic forest and wet forest habitat types are described in the Historical Condition section below. The wet forest habitats on Oʻahu and Kauaʻi are either relatively stable in size and distribution, or are potentially slightly decreasing in size and distribution (Clark et al. 2020, pp. 16–17). The mesic forest habitats on Kauaʻi are potentially slightly decreasing in size and distribution (Lowe et al. 2020, pp. 23–24). Decrease in habitat availability decreases recruitment and replacement of individuals, as well as decreases connectivity between populations. Decrease in habitat availability will eventually lead to reduced levels of genetic variability and reproductive vigor. Therefore, sufficient suitable habitat is needed for *M. fosbergii* in order for populations to persist and survive.

Species Needs

Species need resilient populations that are redundant and represented.

Redundancy is defined as the ability of a species to withstand catastrophic events. We define redundancy for *Myrsine fosbergii* based on the number of populations and the distribution of populations across the species' range. In order to achieve redundancy, the distribution of *M. fosbergii* populations across the geographic range should exceed the area of impact of a catastrophic event that would otherwise overwhelm the resilient capacity of the populations. Essentially, the more populations of *M. fosbergii* and the broader the distribution of those populations, the more redundancy the species will exhibit, thereby increasing its ability to survive a catastrophic event. There is only a single individual of *M. fosbergii* in cultivation, and seed collection is limited. For *M. fosbergii*, redundancy requires the presence of multiple, increasing populations distributed across its different habitat types on Kauaʻi and Oʻahu.

Representation is the ability of *Myrsine fosbergii* to adapt to changing environmental conditions over time and can be measured by having multiple resilient populations of a species occupying the full range of suitable habitat used by the species. Representation can be viewed as maintaining the breadth of genetic diversity within and among populations, in order to allow the species to adapt to changing environmental conditions over time. Unique traits likely exist in populations in different habitat types and by island; however, no information is available on unique traits of *M. fosbergii* by habitat type or island. We measure representation by the number of extant and resilient populations within each habitat type and island. We have no historical genetic information; however, we can assume that as populations decline and disappear, genetic diversity decreases. We have limited information on the connectivity of populations which would support genetic exchange and representation. However, connectivity decreases with habitat loss and fragmentation, thus we can assume that genetic diversity has likely decreased in the species over time. Representation is likely decreasing in the *M. fosbergii* species due to the limited number of individuals in decreasing populations. Little information is available, but we can assume that these existing populations do not represent the historic genetic diversity of *M. fosbergii* dispersed throughout its full range of habitat types on Kauaʻi and Oʻahu.

Table 1. Population units for *Myrsine fosbergii* with physical attributes.

Pop Unit Letter	Subpop Unit Names	Habitat Type	Elev ft (m)	Percent Slope	Soil Type	Avg Ann Temp °F (°C)	Avg Ann Precip in (mm)
Oʻahu Populations							
A	Kuliʻouʻou	Wet Forest	1,935–2,130 (590–649)	47–96	Rough mountainous land	66–68 (19–20)	72–74 (1,842–1,869)
	Waimānalo		1,893 (577)	40	Rock outcrop	68 (20)	63 (1,596)
	Kūpaua Valley		2,359 (719)	106	Rough mountainous land	66 (19)	77 (1,944)
B	Kapakahi	Wet Forest	2,386 (727)	109	Rough mountainous land	66 (19)	90 (2,266)
C	Nuʻuanu	Wet Forest	2,602 (793)	71	Rock land	64 (18)	106 (2,676)
D	Moanalua	Wet Forest	2,162–2,566 (659–782)	37–82	Rock land	66 (19)	110 (2,781)
E	Halawa Valley	Wet Forest	2,428 (740)	79	Rough mountainous land	64 (18)	107 (2,696)
F	Kaʻalaea	Wet Forest	2,556 (779)	87	Rock outcrop	64 (18)	139 (3,519)
G	Kaukonahua	Wet Forest	2,543 (775)	22	Rock land	62 (17)	249 (6,311)
H	Helemano	Wet Forest	2,336–2,405 (712–773)	32–75	Rough mountainous land	60–62 (16–17)	218–220 (5,531–5,566)
I	Punaluʻu	Wet Forest	2,641 (805)	45	Rock land	62 (17)	195 (4,933)
	ʻŌpaeʻula	Wet Forest	2,772–2,799 (845–853)	20–31	Rough mountainous land; Kapaʻa silt clay	60 (16)	214–215 (5,436–5,451)
	Kawaiiki	Wet Forest	2,733 (833)	11	Kapaʻa silt clay	60 (16)	221 (5,600)

	Kaluanui Gulch	Wet Forest	2,444–2,806 (745–855)	14–54	Kapa‘a silt clay	60–62 (16–17)	179–215 (4,558–5,451)
	Kaipāpa‘u Gulch	Wet Forest	2,408–2,760 (734–841)	28–94	Kapa‘a silt clay	60–62 (16–17)	205–217 (5,226–5,511)
	Kawainui Gulch	Wet Forest	2,526–2,546 (770–776)	13–29	Kapa‘a silt clay	62 (17)	202–206 (5,155–5,226)
	Kōloa Gulch	Wet Forest	2,168–2,363 (661–720)	16–32	Kapa‘a silt clay	62–64 (17–18)	184–191 (4,698–4,843)

Pop Unit Letter	**Subpop Unit Names**	**Habitat Type**	**Elev ft (m)**	**Percent Slope**	**Soil Type**	**Avg Ann Temp °F (°C)**	**Avg Ann Precip in (mm)**
Kaua‘i Populations							
J	Hulē‘ia	Mesic Forest	2,192 (668)	28	Rock outcrop	66 (19)	61 (1,552)
K	Hulē‘ia	Wet Forest	1,687 (514)	75	Rough mountainous land	68 (20)	105 (2,656)
L	Wahiawa	Wet Forest	2,084 (635)	40	Hulua gravelly silty clay loam	64 (18)	148 (3,757)
M	Wahiawa	Wet Forest	2,993 (912)	78	Rock outcrop	62 (17)	170 (4,297)
N	Iole-Waiahe	Wet Forest	3,143 (958)	57	Rock outcrop	59 (15)	234 (5,945)
O	Alakai-Wai‘ale‘ale	Wet Forest	4,767 (1,453)	2	Alakai mucky peat	54 (12)	329 (8,349)
P	Hanalei	Wet Forest	4,600 (1,402)	76	Rock outcrop	52 (11)	342 (8,670)
Q	Hanalei	Wet Forest	4,334 (1,321)	25	Wai‘ale‘ale mucky silty clay loam	57 (14)	185 (4,701)

R	Miloli‘i	Mesic Forest	2,399 (731)	64	Rough broken land	66 (19)	45 (1,136)
S	Kalalau	Mesic Forest	1,299–1,743 (396–531)	31–72	Rough mountainous land; Hīhīmanu silty clay loam	70 (21)	71–72 (1,804–1,820)
T	Hanakāpī‘ai	Mesic Forest	962 (293)	86	Rough mountainous land	72 (22)	118 (2,998)
U	Limahuli	Wet Forest	1,844 (562)	33	Rough mountainous land	68 (20)	120 (3,027)

Table 2. Population units for *Myrsine fosbergii* with physical attributes.

Island	Soil Type	Description
OA; KA	Rough mountainous land (p. 140)	This land occurs in mountainous areas where the land surface is dominated by deep, V-shaped valleys, extremely steep side slopes, narrow ridges between the valleys and numerous intermittent drainage channels. Soils are not stony but very thin, ranging from 1 to 10 in in thickness over sapprolite, which is occasionally soft, allowing roots and water to permeate. Elevation ranges from nearly sea level to over 6,000 ft.
OA	Rock land (p. 140)	This land is characterized by exposed rock (25–90 percent surface cover) and very shallow soils. Exposed rock is mainly basalt and andesite. The soil material can be very sticky, plastic, and have high shrink-swell potential. Elevations range from nearly sea level to over 6,000 ft.
OA; KA	Rock outcrop (p. 140)	This land is characterized by exposed bedrock of more than 90 percent surface cover. Exposed rock is mainly basalt and andesite. Elevations range from nearly sea level to 10,000 ft.
OA	Kapa‘a silty clay 40–100 percent slopes (p. 61–62)	This soil occurs in the uplands in narrow areas on ridgetops that have an ironsheet, 1/8 to ½ inch thick, about 10 to 18 inches below the surface. It is a mottled soil developed in material weathered from basic igneous rock. Runoff and erosion are very rapid and severe. Most of the surface layer has been removed by erosion. Elevations range from 200 to 800 ft.
KA	Hulua gravelly silty clay loam 25 to 70 percent slopes (p. 45)	This soil occurs in the uplands. It is a poorly drained soil developed in material weathered from basic igneous rock. The surface layer is about 10 inches thick and is a black gravelly silty clay loam. The next layer is about 6 inches thick and is a mottled, dark grayish-brown, massive silty clay. This soil is characterized by the next layer—an indurated ironstone that is ½ inch to 3 inches thick. Permeability is moderate above the ironstone layer. Below the ironstone, permeability is nearly impermeable. Runoff and erosion are very rapid and severe. Elevations range from 400 to 2,400 ft.

Island	Soil Type	Description
KA	Alakai mucky peat (p. 27)	This soil occurs on mountaintops and high ridges where the water table is at or near the surface. It is a poorly drained soil formed by the deposition and decomposition of organic matter over basalt, under wet conditions. The surface layer is about 8 inches thick and is a very dusky red mucky peat. The next layer is about 24 inches thick and is a dark reddish-brown, reddish-black dusky red muck. The texture of the substratum is clay. Permeability, runoff, and erosion are low. Elevations range from 3,000 to 5,000 ft. This soil is always wet.
KA	Wai‘ale‘ale mucky silty clay loam (p. 127)	This soil occurs on high upland slopes. It is a somewhat poorly drained soil developed in material weathered from basic igneous rock. The surface layer is about 3 inches thick and is a dark reddish-brown, massive mucky peat. The next layer is about 4 inches thick and is a dark-gray silty clay loam. In some areas, an ironstone sheet also characterizes this layer. The next layer is about 17 inches thick and is a strong-brown, gravelly silty clay loam. The substratum is hard and soft weathered rock. Permeability is moderate, runoff is rapid, and erosion is severe. Elevations range from 3,500 to 4,800 ft.
KA	Rough broken land (p. 140)	This land consists of very steep land with numerous intermittent drainage channels occurring in gulches and on mountainsides. Soils are depths vary from 20 to more than 60 in deep over soft weathered rock. Elevations range from nearly sea level to 8,000 ft.
KA	Hīhīmanu silty clay loam (p. 40)	This soil is very steep and occupies uplands. It is a well-drained soil developed in material weathered from basic igneous rock and colluvium at the base of slopes. The surface layer is about 15 inches thick and is a dark-brown silty clay loam. The next layer is about 24 to over 57 inches thick and is a brown, dark-brown, reddish-brown silty clay. The substratum is soft, weathered rock. Permeability, runoff, and erosion are moderate. Elevations range is from 100 to 2,000 ft.

Notes: O‘ahu abbreviated to OA; Kaua‘i abbreviated to KA. Source Foote et al. 1972.

FACTORS INFLUENCING VIABILITY

Threats and Conservation Actions

Hybridization

Threat – Hybridization is a threat to *Myrsine fosbergii*, as it hybridizes with other *Myrsine* broad-leaved species, for example, with *M. degeneri or M. lessertiana* (USFWS 2016 p. 67801; HBMP 2010). On O‘ahu, possible hybrids were identified at five population units (Figure 2). No hybrids were identified on Kaua‘i; however, identifying hybrids can be difficult at different life stages. Therefore, the number of hybrid individuals may actually be higher than estimated on O‘ahu and Kaua‘i (USFWS 2016 p. 67,801).

Conservation actions – There are currently no conservation actions in place to directly address hybridization of *Myrsine fosbergii*.

Limited numbers of individuals and populations

Threat – Impacts from limited numbers of individuals and populations are a serious and ongoing threat to *Myrsine fosbergii*. Low numbers and small occurrences of these plants result in greater vulnerability to stochastic events and can result in reduced levels of genetic variability. This may eventually lead to diminished capacity to adapt to environmental changes, which will decrease persistence and increase the likelihood of extirpation and extinction (USFWS 2016 p. 67,853).

Conservation actions – There have been very limited collection and propagation efforts for *Myrsince fosbergii*. There are seeds in storage at the NTBG from one individual from Upper Limahuli Preserve (U) as well as a single plant in the garden from this collection (NTBG 2019).

Climate change

Threat – Many population sites have a significant slope (Table 1). It is likely that *Myrsine fosbergii* is impacted from landslides and erosion. As environmental conditions are altered by climate change, *M. fosbergii* is unlikely to tolerate or adapt to projected changes in temperature, moisture, and storm frequency. Furthermore, *M. fosbergii* is unlikely to be able to move to areas with more suitable climatic conditions (USFWS 2016 p. 67,801). It is difficult to predict the timing, extent, and magnitude of specific impacts, but the effects of climate change are expected to exacerbate erosion and other threats to *M. fosbergii* (USFWS 2016 p. 67,801).

Conservation actions – Continued surveys and population monitoring by partners, such as the NTBG and O‘ahu DOFAW, will help better understand the microsite conditions necessary for the species to persist, and vulnerability studies, such as Fortini et. al. (2013), can use these data to get a better understanding of where those conditions exist now and in the future for *Myrsine forsbergii.* In addition to these efforts, continued collections and the propagation and secured maintenance of *ex situ* collections will also help to minimize the impact of this threat, by maintianing genetic representation of populations and providing time to identify how best to address the threat of climate change. There are seeds in storage at the NTBG of *M. fosbergii* from one individual from Upper Limahuli Preserve (Figure 3, population U) as well as a single plant in the garden from this collection (NTBG 2019). To better minimize this threat, more collections of individuals from different islands and habitat types should occur along with propagation and outplanting efforts.

Invasive plants

Threat – Nonnative plants are a threat to *Myrsine fosbergii* as they compete for the same resources (water, space, nutrients, and light) that individuals of *M. fosbergii* need to survive. Nonnative plants adversely affect microhabitat in the forest by modifying availability of light and nutrient cycling processes, and by altering soil-water regimes (Smith, 1985). Some of the major nonnative plant threats occurring within populations of *M. fosbergii* include *Axonopus fissifolius* (narrow-leaved carpetgrass), *Clidemia hirta* (Koster's curse), *Erigeron karvinskianus* (daisy fleabane), *Paspalum conjugatum* (Hilo grass), *Psidium cattleianum* (strawberry guava), *P. guajava* (common guava), *Pterolepis glomerata* (false meadowbeauty), *Rubus rosifolius* (thimbleberry), and *Sacciolepis indica* (cupscale grass) (USFWS 2016 p. 67,801; HBMP 2010). The degree of threat is proportional to active control of nonnative plants within population unit areas. As Hawai‘i has a year-round growing season, if nonnative plant control is not occurring, nonnative plants will likely outcompete *M. fosbergii* for resources and degrade habitat quality.

Conservation actions – Watershed partnerships are voluntary alliances of public and private landowners and water municipalities committed to protecting over 2.2 million acres (ac) (890,308 hectares [ha]) of the most important watersheds in the islands of Hawai‘i. Individual watershed partnerships have been established on five islands (Hawai‘i, Maui, Moloka‘i, O‘ahu, and Kaua‘i) to support statewide watershed protection needs. Typical management activities implemented by watershed partnerships which protect mesic and wet forests include landscape scale ungulate proof fencing, ungulate and invasive plant removal, rare species protection and fire protection. Several partnerships manage large scale active restoration projects which plant native plants back into degraded areas. In addition to on the ground work, watershed partnerships play an important role in community outreach, education, and engagement (Clark et al. 2019, p. 12; Lowe et al. 2019, p. 21). *Myrsine fosbergii* occurs on lands that are part of the Ko‘olau Mountains Watershed Partnership on the island of O‘ahu, and the Kaua‘i Watershed Alliance on the island of Kaua‘i.

Introduced Ungulates

Threat – Myrsine fosbergii is at risk from habitat modification and destruction by nonnative ungulates (hooved animals) which on O‘ahu include pigs (*Sus scrofa*) and goats (*Capra hircus)* and Kaua‘i has impacts from pigs, goats, as well as some populations may be impacted by the recent introduction and spread of black-tailed deer (*Odocoileus hemionus columbianus*) (Cuddihy and Stone 1990, pp. 63–64; Chapin et al. 2007). These animals degrade habitat, which reduces suitability and availability of habitat for *M. fosbergii.* The effects of ungulates include the destruction of vegetative cover; trampling of plants and seedlings; direct consumption of native vegetation and individuals of *M. fosbergii*; soil disturbance; dispersal of invasive plant seeds on hooves and coats, and through the spread of seeds in feces; and creation of open disturbed areas conducive to further invasion by invasive plant species. All of these impacts can lead to the subsequent conversion of a native plant community to one dominated by invasive species (USFWS 2016, p. 67,827).

Feral ungulates threaten *Myrsine fosbergii* throughout the species range. On O‘ahu, evidence of feral pig activity has been reported at all summit locations along the Ko‘olau Mountains (USFWS 2016 p. 67,800). On Kaua‘i, slight to moderate pig damage was reported in Wahiawa,

where majority of the remaining *M. fosbergii* individuals reside (HBMP 2010). Only populations within ungulate-excluding fences are considered to be protected.

Conservation actions – On Oʻahu, 14 individuals from populations H and I (Figure 2) in Helemano, ʻŌpaeʻula, Kaluanui, and Kōloa are within ungulate-exclusion fences. On Kauaʻi, only one individual from population R at Miloliʻi and one from population U (Figure 3) at Limahuli are within an enclosure.

Introduced Rats

Threat – Rats (*Rattus* spp.) are a threat to individuals of *Myrsine fosbergii* as they are known to impact population units F and G on Oʻahu (Kaʻalaea, Kaukonahua; Figure 1). They have the ability to affect recruitment by eating seeds, flowers, leaves, roots, and other plant parts (Atkinson and Atkinson 2000, p. 23). Rats are assumed to be widespread across these mesic and wet forest habitats and present at other populations, and would therefore have the same negative impact as at the Oʻahu populations where damage has been observed.

Conservation actions – NTBG is currently doing rat control in Limahuli for seabirds, which may also benefit individuals of *Myrsine fosbergii.* There are currently no other conservation actions in place to address the effects of rats on *M. fosbergii*.

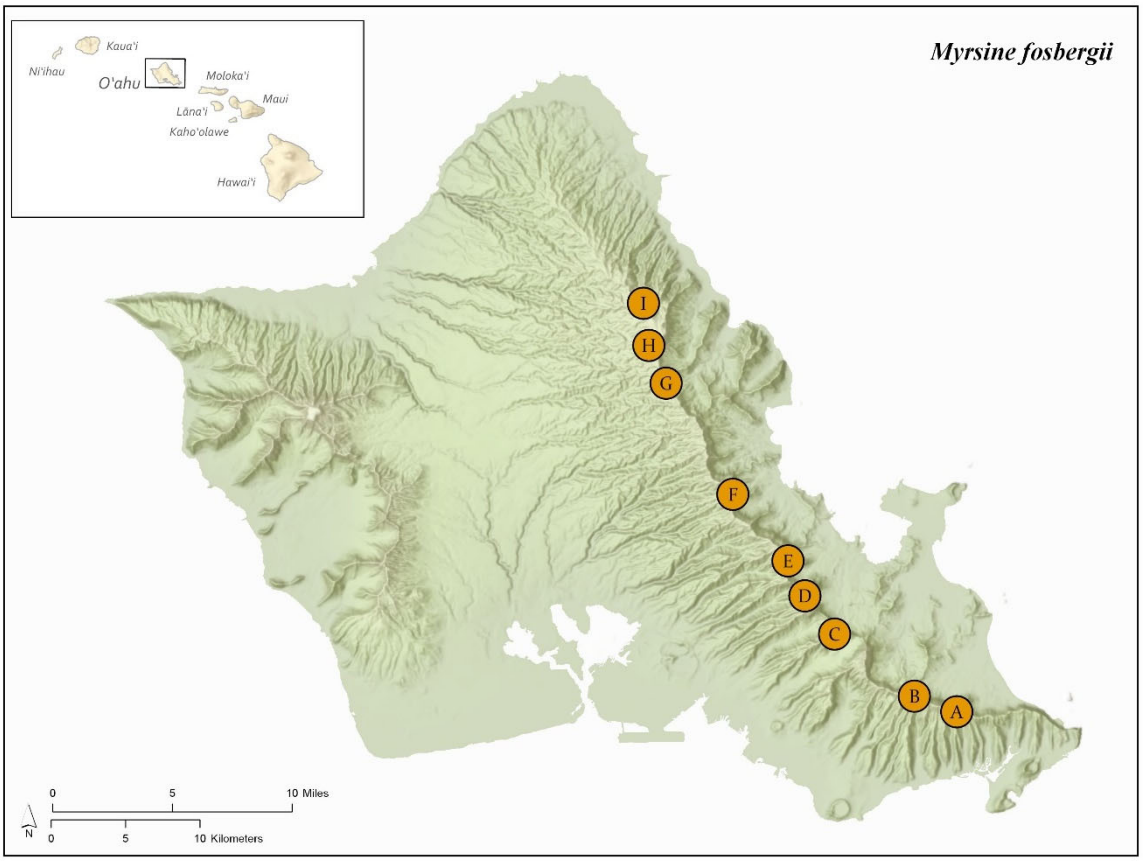

Figure 2. Distribution map of population units of *Myrsine fosbergii* on the island of O‘ahu.

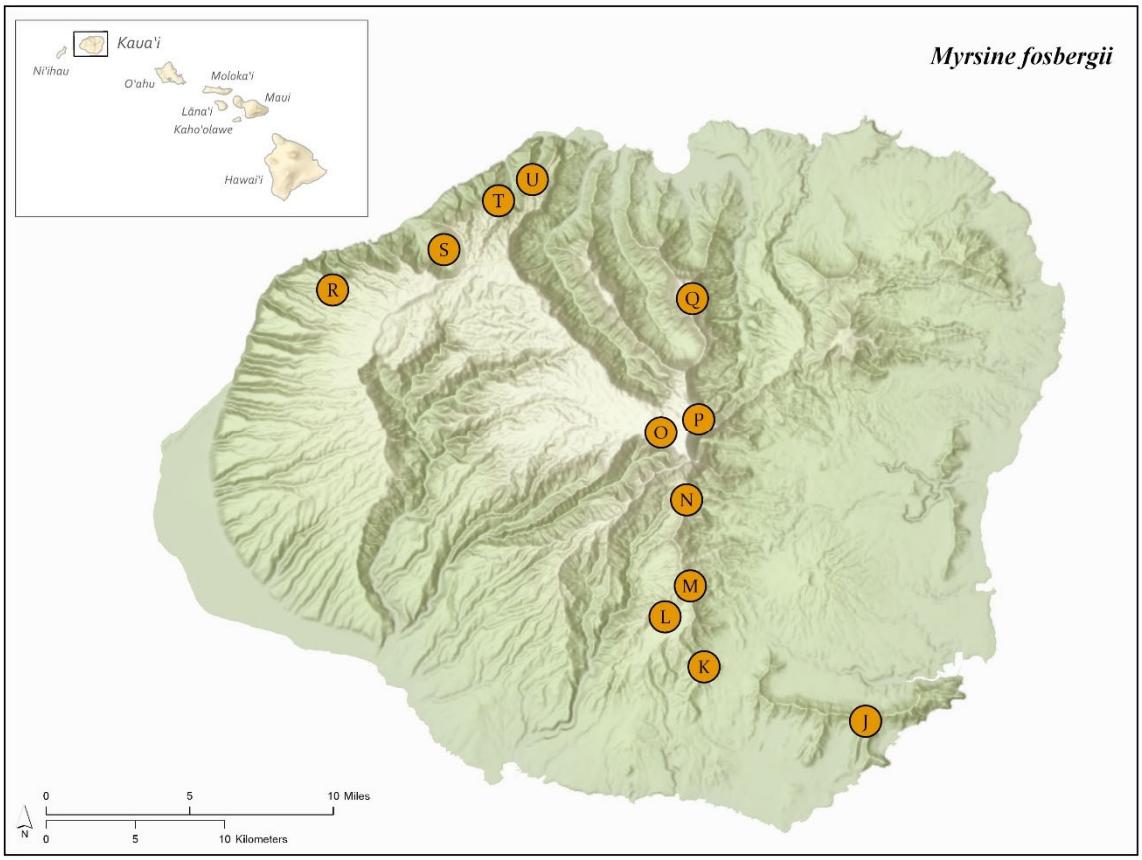

Figure 3. Distribution map of population units of *Myrsine fosbergii* on the island of Kauaʻi.

Additional Conservation Actions

The efforts in this section contribute to the conservation actions above. Conservation partnerships and alliances and the designation of protected areas (Reserves, Preserves) help to identify management actions (e.g. ungulate control – fence construction and maintenance, weed control, etc.) that also contribute to the protection of *Myrsine fosbergii* and protect and conserve the habitat where it occurs. The Department of Land and Natural Resources (DLNR) Division of Forestry and Wildlife (DOFAW) monitors and collects when they observe individuals. The DLNR Division of State Parks encourages visitors to view wildlife responsibly; however, they give no further guidance on how to protect and conserve native vegetation. The mission of the NTBG is to enrich life through discovery, scientific research, conservation, and education, by perpetuating the survival of plants, ecosystems, and cultural knowledge of tropical regions. Their collection includes the largest assemblages of native Hawaiian plant species in existence. They are actively working to restore habitats and protect plants from extinction (ntbg.org).

Regulatory Actions

Endangered Species Act: The USFWS in 2016 determined endangered status under the Act, as amended, for 49 plants and animals on September 30, 2016, including *Myrsine fosbergii* (USFWS 2016a p. 67,786). The primary purpose of the Act is the conservation of endangered and threatened species and the ecosystems upon which they depend. The ultimate goal of such

conservation efforts is the recovery of these listed species, so that they no longer need the protective measures of the Act. Conservation measures provided to species listed as endangered or threatened under the Act include recognition of threatened or endangered status, recovery planning, requirements for Federal protection, and prohibitions against certain activities. The Act encourages cooperation with the States and requires that recovery actions be carried out for all listed species. The Act and its implementing regulations in addition set forth a series of general prohibitions and exceptions that apply to all endangered wildlife and plants. For plants listed as endangered, the Act prohibits the malicious damage or destruction on areas under Federal jurisdiction and the removal, cutting, digging up, or damaging or destroying of such plants in knowing violation of any State law or regulation, including State criminal trespass law. Certain exceptions to the prohibitions apply to agents of the USFWS and State conservation agencies. The USFWS may issue permits to carry out otherwise prohibited activities involving endangered or threatened wildlife and plant species under certain circumstances. With regard to endangered plants, a permit must be issued for scientific purposes or for the enhancement of propagation or survival. For federally listed species unauthorized collecting, handling, possessing, selling, delivering, carrying, or transporting, including import or export across State lines and international boundaries, except for properly documented antique specimens of these taxa at least 100 years old, as defined by section 10(h)(1) of the Act, is prohibited.

Damaging or destroying any of the listed plants in addition is violation of the Hawai‘i State law prohibiting the take of listed species. The State of Hawai’i’s endangered species law (HRS, Section 195-D) is automatically invoked when a species is federally listed, and provides supplemental protection, including prohibiting take of listed species and encouraging conservation by State government agencies. *Myrsine fosbergii* occurs on both Federal and non-Federal lands.

CURRENT CONDITION

Historical Condition

Habitat Distribution and Description

Historically, *Myrsine fosbergii* occurred in wet forest habitats on the island of O‘ahu, and in wet forest and mesic forest habitats on the island of Kaua‘i (Table 1). The difference in age between O‘ahu and Kaua‘i influences differences in soil and habitat type. Table **2** describes the nine different soil types of the historic and current populations of *M. fosbergii*. In addition to the habitat type inferred by these soil types, we refer you to the Pre-Human Conditions sections of the Habitat Status Assessments for wet forest (Clark et al. 2019, p. 3) and mesic forest (Lowe et al. 2019, p. 3) for more information on the historic habitat distribution and description. See Table 3, below, for evaluation of historic habitat viability.

Table 3. Historic habitat viability evaluation

Habitat type	Resiliency	Redundancy	Representation
Wet forest	High. Large extent, high diversity of species, and ability of species to recolonize after stochastic events.	High. Distributed over broad geography and able to withstand catastrophic events.	High. Each subunit contained riparian areas, natural clearings, wetlands and bogs. These inclusions were common and they supported a variety of species. High biodiversity.
Mesic forest	High. Found in multiple areas containing high quality subunits with a wide range of species diversity that are able to recover after stochastic events.	High. Widely distributed across broad range of Hawaiian Islands. Less susceptible to catastrophic events.	High. On windward and leeward slopes as well as across a broad range of substrates. Speciation and high rate of endemism.

Historic Trends of *Myrsine fosbergii*

The earliest record of *Myrsine fosbergii* in the wild was in 1919 in wet forest habitat in Nuʻuanu (Population C, Table 4). The next record of this species occurred decades later in 1978 in wet forest habitat in Waimānalo (Population A, Table 4). Both of these populations have since become potentially extirpated. Historic information on this species is very limited. Three populations on Oʻahu that had been montiored between 1997 and 1999 and then revisited have all shown large declines in population size, from 10 to 1 individual in 22 years at Kuliʻouʻou, 21 to 2 individuals in 11 years at Moanalua, and 15 to 2 individuals in 7 years at Kaipāpaʻu. For the purposes of this Species Report, a population is considered potentially extirpated and its status unknown if it had not been onserved within the last 20 years, due to the presence of most if not all of the threats listed above, including hybridization, limited numbers, nonnative plants, introduced ungulates, and introduced rats, as well as documented population decline from three populations in Oʻahu. One population on Kauaʻi was last observed in 1987 but is not considered extirpated due to the presence of ungulate fencing to protect the habitat from more excelerated habitat decline due to the presence of ungulates. Table 4 further describes historic and current population units of *M. fosbergii* by habitat type and island, and it is also summarized below. Also refer to Figure 1 and Figure 2 for the distribution map of population units of *M. fosbergii* on Oʻahu and Kauaʻi, respectively.

O‘ahu

Myrsine fosbergii is historically known from wet forest summit ridges of the Ko‘olau Mountains (Figure 2) where the total number of individuals ever known was approximately 90–100, though some of these may be putative hybrids.

- Population A is the most southern poulation on O‘ahu and likely historically exceeded 30 individuals total within three subpopulations. However, several of these individuals were suspected of being hybrids. Only the Kuli‘ou‘ou subpopulation has been seen recently and only consists of a single individual. The remain subpopulations are presumed to be likely extirpated.
- Population B consisted of several individuals along the Ko‘olau summit at the back of Kapakahi gulch in 1987. It has not been observed since and is considered to be potentially extirpated.
- Population C, as mentioned above, was the first recorded population of *Myrsine fosbergii* in 1919. Other than the date, and location (Nu‘uanu), there were no other data provided from this observation. This population is considered to be potentially extirpated.
- Population D consisted of 21 individuals near the summit in the back of Moanalua in 1997, though some may have been hybrids. By 2008, when last oberved, this population declined to only two individuals.
- Populations E, F, G, and H consist of 15 individuals, including hybrids, along the summit ridge from Halawa to Helemano. These populations were last observed from 1995–2004. Population H consisted of two individuals that were protected within ungulate fencing in 2004, and the status of the other populations is unknown and consisted of a total of 13 individuals onbserved from 1995 to 1997.
- Population I is the most northern population on O‘ahu and consisted of about 30 individuals, including hybrids, across 15 sites from Punalu‘u to Kōloa. These populations were last observed from 2003–2013, and include 11 individuals within ungulate exclosures. The Kaipapa‘u site had 15 individuals, including hybrids, observed in 1999. In 2006, there were only two individuals remaining at this site. Kaipapa‘u is the only population with repeated observations that show a decline in total number of individuals within this population unit.

Kaua‘i

Myrsine fosbergii is historically known to be widely scattered throughout Kaua‘i (Figure 3), where the total number of individuals ever known was approximately 60, and no reports of putative hybrids have been reported on Kaua‘i. Currently there are five known individuals, and the status of the remaining individuals is unknown and possibly extirpated.

- Population J consists of one individual in mesic forest habitat near Hā‘upu Ridge on the south side of the island. This population was last observed in 2005.
- Population K consists of two individuals in wet forest habitat type at Hulē‘ia on the south side of the island. This population was last observed in 1988, and is considered potentially extirpated.
- Populations L, M, N, O, P, Q consisted of 52 individuals in wet forest habitat along mountain ridges that run through the center of the island, including Mt. Wai‘ale‘ale. The largest population of *Myrsine fosbergii* ever recorded was at Population M, in Wahiawa.

This population was last observed in 1991. Altogether, these populations were observed from 1991–2007, and only two individuals are known to be extant, one each in Alakai-Wai‘ale‘ale (O) and Hanalei (P), and the status of the remaining individuals is unknown.

- Population R consists of one individual in mesic forest habitat in Miloli‘i on the northwestern side of the island. It was last observed in 1987, but is not considered extirpated because is it within fencing.
- Population S consisted of two individuals in mesic forest habitat type in Kalalau on the northwestern side of the island. This population was last observed in 1990, when notes from the observation state that one of the trees was feeble. The status of this population unit is unknown.
- Population T consists of one individual in mesic forest in Hanakāpī‘ai on the northwestern side of the island. This individual was last observed in 1999 and its status is unknown.
- Population U consists of one individual in wet forest habitat in Limahuli on the northwestern side of the island. This individual was last observed in 1994 and is located within fencing.

Current Condition

Historically, there were 21 population units and 150–160 individuals of *Myrsine fosbergii* from two different habitat types on O‘ahu and Kaua‘i (Table 4). Only nine of these have been observed recently, and many are possibly extirpated (HBMP 2010, USFWS 2020, PEPP 2019). Currently, there are nine population units totaling 20 individuals, 15 individuals from four population units in wet forest on O‘ahu, three individuals in three population units in wet forest on Kaua‘i, and two individuals in two population units in mesic forests on Kaua‘i (Table 4). Refer to historic trends above for review of which populations were considered historic and potentially extirpated.

Table 4. Known Population Units of *Myrsine fosbergii* by habitat type and island.

Pop Unit Letter	Subpop Unit Names	Habitat Type	Last Observation Date	Last Observed No. Individuals	Hybrids Observed	Extant
Oʻahu Populations						
A	Kuliʻouʻou	Wet	2019	1 (10 in 1997)	Yes	Yes
	Waimānalo	Wet	1978	Unknown	Unk	Unk
	Kūpaua Valley	Wet	1987	20	Unk	Unk
B	Kapakahi	Wet	1987	Several	Unk	Unk
C	Nuʻuanu	Wet	1919	Unknown	Unk	No
D	Moanalua	Wet	2008	2 (21 in 1997)	Yes	Yes
E	Halawa Valley	Wet	1997	5	Yes	Unk
F	Kaʻalaea	Wet	1995	6	Unk	Unk
G	Kaukonahua	Wet	1995	2	Yes	Unk
H	Helemano	Wet	2004	2	Unk	Yes
I	Punaluʻu	Wet	Unknown	1	Unk	Unk
	ʻŌpaeʻula	Wet	2003	2	Unk	Yes
	Kawaiʻiki	Wet	2008	1	Unk	Yes
	Kaluanui Gulch	Wet	Unknown	3	Unk	Unk
	Kaipāpaʻu Gulch	Wet	2006	2 (15 in 1999)	Yes	Yes
	Kawainui Gulch	Wet	Unknown	2	Unk	Unk
	Kōloa Gulch	Wet	2013	5	Unk	Yes
Kauaʻi Populations						
J	Hulēʻia	Mesic	2005	1	Unk	Yes
K	Hulēʻia	Wet	1988	2	Unk	No
L	Wahiawa	Wet	1991	1	Unk	Unk
M	Wahiawa	Wet	1991	47	Unk	Unk
N	Iole-Waiahe	Wet	1999	1	Unk	Unk
O	Alakai-Waiʻaleʻale	Wet	2007	1	Unk	Yes
P	Hanalei	Wet	2007	1	Unk	Yes
Q	Hanalei	Wet	1991	1	Unk	Unk
R	Miloliʻi	Mesic	1987	1	Unk	Yes
S	Kalalau	Mesic	1990	2, 1 feeble	Unk	No
T	Hanakāpīʻai	Mesic	1999	1	Unk	Unk
U	Limahuli	Wet	1994	1	Unk	Yes

Notes: Wet forest abbreviated to Wet; mesic forest abbreviated to Mesic; unknown abbreviated to Unk.

SPECIES VIABILITY SUMMARY

Resiliency
For *Myrsine fosbergii* to maintain viability, the populations must be resilient, meaning they must have healthy, stable populations with enough individuals and adequate quality and quantity of habitat to withstand stochastic fluctuations. We determined resiliency for *M. fosbergii* based on the metrics of population size (number of individuals), population trends, and the quality of habitat factors that support the species. Populations are resilient if there are large numbers of individuals in all age classes; however, there is limited information on population structure for *M. fosbergii*. Therefore, we were unable to make the determination based on population structure.

Currently, there are nine extant wild populations (Table 5), totaling approximately 20 plants on the islands of O‘ahu (four populations, ~15 individuals) and Kaua‘i (five populations, ~five individuals). More surveys are needed to better understand the status of 12 population units that have not been recently observed, and to better understand the prevalence of hybrids in the populations. However, based on large declines in three populations on O‘ahu within the last 20 years, we can assume population sizes have decreased, to the extent that population units have been lost. We also assume that habitat extent and quality have also declined due to ongoing habtiat degradation and destruction by introduced ungulates and plants and other invasive species. By additionally considering the persistance of threats in the majority of the population units, there is reduced resiliency in the current condition.

Table 5. Resiliency of Known Populations of *Myrsine fosbergii.*

Population Unit Letter	Subpopulation Unit Names	Resiliency	Justification
Oʻahu Populations			
A	Kuliʻouʻou	Very Low	1 individual
B	Kapakahi	Very Low	Several in 1987 when last observed; not protected
C	Nuʻuanu	N/A	0 individuals
D	Moanalua	Very low	Population unit declined from 21 trees in 1991 to 2 in 2008. Nonnative plants present; not within an ungulate exclosure.
E	Halawa Valley	Very low	5 individuals last observed in 1997; hybrids present; nonnative plants present; no fencing.
F	Kaʻalaea	Very low	6 individuals last observed in 1995; nonnative plants present; damage from pigs and rats; no fencing.
G	Kaukonahua	Very low	2 individuals last observed in 1995; hybrids present; nonnative plants present; damage from pigs and rats; no fencing.
H	Helemano	Very low	2 individuals last observed in 2004; within fencing.
I	Punaluʻu	Very low	16 individuals total between 15 sites; last observed from 2003–2013; population size decline observed; some individuals within fencing (ʻŌpaeʻula, Kaluanui, and Kōloa).
	ʻŌpaeʻula		
	Kawaiiki		
	Kaluanui Gulch		
	Kaipapaʻu Gulch		
	Kawainui Gulch		
	Kōloa Gulch		

Population Unit Letter	Subpopulation Unit Names	Resiliency	Justification
Kaua‘i Populations			
J	Hulē‘ia	Very low	1 individual last observed in 2005; no fencing.
K	Hulē‘ia	Very Low	2 individuals last observed in 1988
L	Wahiawa	Very low	1 individual last observed in 1991; no fencing.
M	Wahiawa	Very Low	47 individuals last observed in 1991. Potential invasion by *Psidium cattleianum*, *Rhodomyrtus tomentosa*, and *Clidemia hirta*; damage from pigs; no fencing.
N	Iole-Waiahe	Very low	1 individual last observed in 1999; no fencing;
O	Alakai-Wai‘ale‘ale	Very low	1 individual last observed in 2007; no fencing.
P	Hanalei	Very low	1 individual last observed in 2007; no fencing.
Q	Hanalei	Very low	1 individual last observed in 1991; no fencing.
R	Miloli‘i	Very low	1 individual last observed in 1987; within fencing.
S	Kalalau	Very low	2 individuals, 1 poor, last observed in 1990; no fencing.
T	Hanakāpī‘ai	Very low	1 individual last observed in 1999; nonnative plants present; no fencing.
U	Limahuli	Very low	1 individual last observed in 1994; within ungulate-exclusion fencing.

Overall, the resiliency of *Myrsine fosbergii* is very low due to low numbers of individuals in the remaining populations, as well as the decreasing habitat quality. The degree of threats, particularly hybridization, and the presence of nonnative plants, pigs, and rats, further degrade the quality of habitat available for *M. fosbergii*. Therefore, the resiliency of *M. fosbergii* on the species level is very low.

Redundancy

We determined redundancy for *Myrsine fosbergii* based on the metric of the number of populations and their distribution across the known range of the species. Historically, the species was known from wet forests along the summit ridges of the Ko‘olau Mountains on the island of

Oʻahu, and from wet forest and mesic forest habitats throughout Kauaʻi. It has since been possibly extirpated from over half of these locations, and the resiliency of the extant populations is overall very low.

As monitoring efforts of *Myrsine fosbergii* have been minimal, we cannot be certain of the exact number of individuals; however, it is likely populations and individuals have been lost due to habitat loss and degradation which decreases redundancy. Currently only four populations are known on Oʻahu and five populations (all of which only contain one individual) on Kauaʻi, all with very low resiliency. The loss of populations reduces the species range and increases the risk of extirpation. Therefore, redundancy of *M. fosbergii* is very low due to loss of individuals and populations and species range constriction.

Representation

We determined representation for *Myrsine fosbergii* based on the number of populations occupying the different habitat types where *M. fosbergii* has been observed on each island. The distribution of historic and current populations occurs in two habitat types on two islands. All known populations on Oʻahu occur in wet forests, and representation has been reduced by the likely loss of the majority of individuals (~80 percent) and rouhgly have the populations, the majority of which are in the central and southern part of the Koʻolau summit. All 12 known populations on Kauaʻi occur in wet or mesic forests, and the species has only been documented in mesic forest at four of these locations. The current status of half of these locations is unknown, and only two individuals are currently known to represent any genetic diversity unique to this habitat type. The remaining three extant population units and five population units with unknown status are located in wet forests. The three extant populations have very low resiliency. The Wahiawa (M) unit had 47 individual in 1991 and while it has not been visited since, based on documented decline over the same time period of three other units also not protected from ungulates, we anticipate that the majority of individuals have been lost and the population also has very low resiliency.

In summary, seven population units are known to be extant and occur in wet forest, four on Oaʻhu and three on Kauaʻi, and two population units are known to be extant and occur in mesic forest on Kauaʻi. The resiliency of all populations is very low, and there are currently only two trees known to occur in mesic forest, and three trees in wet forest on Kauaʻi. In wet forest habitat, there are populations in the general vicinity of where *Myrsine fosbergii* occurred historically, but on a much smaller and more restricted scale. On Oʻahu, *M. fosbergii* likely occurred across the entire Koʻolau mountain summit. On Kauaʻi, most of the population units only contain one individual. This population is located in central Kauaʻi. Overall, the habitat types, which are analogous to the breadth of genetic diversity within the species, are not adequately represented. The unique traits which exist in the remaining populations are at risk of being lost due to very low resiliency, and there is very little *ex situ* propagation and storage to rely upon secured off-site facilities to maintain the genetic structure of the species. Ideally, several resilient populations would occur within each habitat type on both islands. Therefore, representation of *M. fosbergii* is very low.

Species Viability Summary

The current condition of *Myrsine fosbergii* is described as having nine populations on two islands. Overall, it is likely that individuals in populations have generally been decreasing due to existing threats such as hybridization, nonnative plants, pigs, and rats. *Ex situ* seed storage is minimal (one individual represented) and propagation has been lacking. At the species level, *M. fosbergii* has very low resiliency across all populations, very low redundancy, and very low representation. Therefore, the overall viability of this species is very low in the current condition (Table 6).

Table 6. Viability of Current Condition of *Myrsine fosbergii.*

Species Name	Overall Resiliency	Redundancy	Representation	Viability
Myrsine fosbergii	Very Low	Very Low	Very Low	Very Low

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