

Festuca hawaiiensis
(no common name)

**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: *Festuca hawaiiensis* (no common name)

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5-YEAR REVIEW
***Festuca hawaiiensis* (no common name)**

1.0 GENERAL INFORMATION

1.1 Reviewers:

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Chelsie Javar-Salas, Plant Biologist, PIFWO
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Lead Regional Office:

Interior Region 12, Portland Regional Office

Lead Field Office:

Pacific Islands Fish and Wildlife Office

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 (Service), beginning in October 2020. The review was based on the final rule listing this species; peer reviewed scientific publications; unpublished field observations and species status report by the Service, State of Hawai‘i, and other experienced biologists; unpublished survey reports; notes and communications from other qualified biologists; as well as a review of current, available information.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 by Christina Richards, Biologist, was reviewed by Chelsie Javar-Salas, Plant Biologist, 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. 2019. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 91 species in Oregon, Washington, Hawaii, and American Samoa. Federal Register 84 (112): 27152–27154, June 11, 2019.

1.3.2 Listing history:

Original Listing

FR notice: [USFWS] U.S. Fish and Wildlife Service. 2016. Endangered and threatened wildlife and plants; determination of endangered status for 49 species from the Hawaiian Islands; final rule. Department of the Interior, Federal Register 81 (190): 67786–67860, September 30, 2016.

Date listed: September 30, 2016

Entity listed: *Festuca hawaiiensis*

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 *Festuca hawaiiensis*.

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 Hawaiian Multi-Island Species

Date issued: August 2020

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, B, C, D, and E) affecting this species is presented in section 2.3.2 and Table 2.

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 Service 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 Service 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.

Festuca hawaiiensis is a short-lived annual grass. To prevent extinction, which is the first milestone 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 that are well managed. In addition, a minimum of three populations total should be documented on the islands of Hawai‘i and/or Maui where they now occur or occurred historically. Each of these populations must be naturally reproducing (i.e., viable seeds, seedlings) with a minimum of 50 mature individuals per population.

This recovery objective has been met (see Table 1).

Interim Stage

To meet the interim stage of recovery of *Festuca hawaiiensis*, 300 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. Multi-island species should be represented by at least one population on each of the islands from which they were known historically as long as suitable habitat exists. 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, entire) that is secure and well managed. 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 500 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. Multi-island species should be represented by at least three populations on each of the islands from which they were known historically as long as suitable habitat exists. 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 500 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. Multi-island species should be represented by at least three populations on each of the islands from which they were known historically as long as suitable habitat exists. 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:

Festuca hawaiiensis, a member of the Poaceae (grass) family, is a caespitose (growing in tufts or clumps) annual grass. Culms (stems or stalks) are erect 0.5 to 1.5 meters (m) (1.6 to 5 feet [ft]) tall. The culms branch above the base and are glabrous (smooth) to slightly hairy with open sheaths and flat, smooth blades. Blades are 0.3 to 1 centimeter (cm) (0.1 to 0.5 inches [in]) wide and 25 to 40 cm (10 to 16 in) long. The inflorescences are branched and composed of six to eight alternate racemes (many flowers on one branch). The fruits are ellipsoid, dorsally compressed, and approximately 1.5 to 5 millimeters (mm) (0.06 to 0.2 in) long (O'Connor 1999, p. 1547).

The specific life history characteristics of *Festuca hawaiiensis* have not been studied and little is known about the phenology and reproduction of this species. However, an examination of the specific characteristics of the plant can provide clues to reproduction. The high, pendulous inflorescence that are held away from the vegetation and long ellipsoid and dorsally compressed fruits are all indicative of species that are associated with wind pollination. These characteristics along with a habitat that has low

humidity, infrequent precipitation, and open surrounding vegetation may indicate that wind pollination plays a role in reproduction. Dry open areas with moderate wind regimes are also preferred for species specialized in wind pollination (Culley et al. 2002, p. 362).

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:

Historically, *Festuca hawaiiensis* occurred on east Maui and on the island of Hawai‘i in the Hualālai area. On east Maui, *F. hawaiiensis* possibly occurred at ‘Ulupalakua; however, it is no longer found at this site. On the island of Hawai‘i, occurrences were known at Hualālai and Pu‘u Huluhulu (O’Connor 1999, p. 1547). In the early 1990s, *F. hawaiiensis* was documented within the Kīpuka ‘Alalā area at the Pōhaku Training Area (PTA) on the island of Hawai‘i, but as exceedingly rare, which was assumed to be due to ungulates (CSU 2015, p. 34). Population numbers started to increase due to the implementation of conservation actions to control threats including the construction of ungulate fencing, the removal of ungulates within the fences, and management of invasive grasses to reduce fire fuels (CSU 2015, pp. 34–36).

When *Festuca hawaiiensis* was listed it occurred only within the PTA. Surveys for this species were conducted at PTA in 2010 through 2015 and 683 sites containing at least 1,083 individuals were observed (CSU 2017, p. 10). The species has been documented within four populations on the island of Hawai‘i including ‘Āinahou, Nā‘ōhule‘elua, Kīpuka Kalawamauna East, and Kīpuka ‘Alalā to Kīpuka Kalawamauna (CSU 2019a). Currently there are approximately 1,083 individuals in three populations (Nā‘ōhule‘elua, Kīpuka Kalawamauna East, and Kīpuka ‘Alalā to Kīpuka Kalawamauna). The total estimated number of individuals is combined for all three populations. We do not have an estimate for each population separately. Although two of the populations appear to be outliers of the same large metapopulation at Kīpuka ‘Alalā to Kīpuka Kalawamauna and may have been more contiguous historically, there is no data available to support that. The ‘Āinahou population has not been observed since 1916 (USFWS 2020). The Kīpuka ‘Alalā to Kīpuka Kalawamauna population is the only population where natural recruitment has occurred (CSU 2015, p. 187).

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:

Festuca hawaiiensis was first described by Hillebrand in 1888 under the name *Festuca drymeja* from an unlabeled specimen possibly collected from “Maui et Hawaii” and assumed to be from ‘Ulupalakua on Maui. Hillebrand considered *F. drymeja* as an introduced species from southeastern Europe (Hillebrand 1888, pp. 534–535), but that was misapplied. The type specimen collected from Maui was presumed destroyed (O’Conner 1999, p. 1547). The species was later re-described by A.S. Hitchcock to *F. hawaiiensis* in 1922 from a type specimen he collected in 1916 from Pu‘u Huluhulu near Mauna Kea on the island of Hawai‘i (Hitchcock 1922, p. 17). *Festuca hawaiiensis* is the currently recognized taxonomy (O’Conner 1999, p. 1547).

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 and 2.3.1.4 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):

Festuca hawaiiensis occurs within the dry grassland and shrubland habitat type, more specifically in the dry montane grassland at 1,615 to 2,300 m (5,300 to 7,500 ft) in elevation (Pe‘a et al. 2020, p. 4). In general, the annual precipitation where *F. hawaiiensis* is located ranges from 400 to 500 mm (15 to 20 in) (Gagné and Cuddihy 1999, p. 94; LANDFIRE 2016, p. 1205). The soil types where *F. hawaiiensis* usually occurs are sandy-loamy soils derived from volcanic ash, weathered lava, and sand (Gagné and Cuddihy 1999, p. 94).

On the island of Hawai‘i, *Festuca hawaiiensis* occurs in the dry montane grasslands. Associated native species include *Alyxia stellata* (maile), *Chenopodium oahuense* (‘āweoweo), *Coprosma montana* (pilo), *Leptecophylla tameiameia* (pūkiawe), *Osteomeles anthyllidifolia* (‘ūlei), *Myrsine lanaiensis* (kōlea), *Santalum paniculatum* (‘iliahi), and *Sida fallax* (‘ilima) (CSU 2015, p. 219).

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 destruction and degradation of habitat—Introduced ungulates such as feral goats (*Capra hircus*), sheep (*Ovis aries*), and mouflon (*Ovis gmelini musimon*) have been documented to impact individuals of *Festuca hawaiiensis* (USFWS 2016, p. 67796; CSU 2015, p. 219). Feral ungulates

modify and degrade habitat by disturbing and destroying vegetative cover, consuming and trampling plants, 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). Feral ungulates aid in the dispersal of seeds of invasive plants in native forests on their hooves, coats, and through their feces. Surveys at PTA in the 1990s showed that *F. hawaiiensis* was rare and usually occurred within the protection of other plants, such as *Leptecophylla tameiameia*.

Established ecosystem-altering invasive plant modification and degradation of habitat—Invasive plants modify habitats occupied by native plant species by changing the availability of light, altering soil-water regimes, modifying nutrient cycling, and changing the fire characteristics of the native plant community (Cuddihy and Stone 1990). Habitat modification and destruction by invasive plants negatively affects all occurrences of *Festuca hawaiiensis* (USFWS 2016, p. 67796; CSU 2015, pp. 84–86). Nonnative plants with the greatest impacts on *F. hawaiiensis* include *Cenchrus setaceus* (fountain grass) and *Senecio madagascariensis* (fireweed) (USFWS 2016, p. 67796; Lowe et al. 2020, pp. 14–15).

Fire destruction and degradation of habitat—*Festuca hawaiiensis* is at risk of the negative impacts by fire because it occurs in or near areas that were burned in previous fires (USFWS 2016, p. 67796). Fire damages and destroys native vegetation, including dormant seeds, seedlings, juvenile and adult plants. Many invasive plants, particularly fire-tolerant grasses, outcompete native plants and inhibit their regeneration (D’Antonio and Vitousek 1992, pp. 70, 73–74; Tunison et al. 2002, p. 122). Successive fires burn farther into native habitat and alter microclimatic conditions creating conditions favorable to nonnative plants. The threat from fire is unpredictable but is increasing in frequency in ecosystems that have been invaded by nonnative plants and fire-tolerant nonnative grasses.

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 *Festuca hawaiiensis* is vulnerable to the impacts of climate change with a vulnerability score of 0.470 (on a scale of 0 being not vulnerable to 1 being extremely vulnerable to climate change). Therefore, additional management actions may be needed to conserve this taxon into the future, such as locating key microsites that overlap with current and future climate envelopes for outplanting efforts.

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):

Herbivory and predation by feral goats and sheep—Research and field observations indicate that herbivory by feral goats and sheep is a threat to *Festuca hawaiiensis* in the wild (USFWS 2016, p. 67836). Feral goats are able to forage in extremely rugged terrain and are instrumental in the decline of native vegetation in many areas of the Hawaiian Islands (Cuddihy and Stone 1990, p. 64). Both feral goats and sheep have been observed browsing on individuals of *F. hawaiiensis* within the Pōhakuloa Training Area (USFWS 2016, pp. 67796, 67837–67838; CSU 2015, p. 219).

2.3.2.4 Inadequacy of existing regulatory mechanisms (Factor D):

Lack of adequate hunting regulations—Nonnative feral ungulates are an ongoing threat to *Festuca hawaiiensis* through destruction and degradation of habitat and herbivory. The State of Hawai‘i provides game mammal (feral pigs [*Sus scrofa*] and goats) hunting opportunities within State-designated public hunting areas on the island of Hawai‘i (DLNR 2010) including areas necessary for the recovery of *Festuca hawaiiensis*. Management of game animals by the State ranges from providing maximal sustained public hunting opportunities and benefits (e.g., sustained yield) in some areas, with one animal allowed per day; to other areas with as little as one animal allowed per year (DLNR 2010). Public hunting areas are not fenced and game mammals have unrestricted access to most areas across the landscape, regardless of underlying land use designation; therefore, any unfenced populations of *F. hawaiiensis* are at risk (DLNR 2010). Populations of *F. hawaiiensis* that occur within PTA may be provided protection by fencing and ungulate control; however, fences must be maintained and monitored for ungulate ingress (Fleishman 2019, entire; CSU 2015, p. 34; PTANRO 2020, entire).

Lack of adequate biosecurity regulations—Currently, four agencies are responsible for inspection of goods arriving in Hawai‘i (CGAPS 2009). The Hawai‘i Department of Agriculture (HDOA) inspects domestic cargo and vessels and focuses on pests of concern to Hawai‘i, especially insects or plant diseases. The U.S. Department of Homeland Security-Customs and Border Protection (CBP) is responsible for inspecting commercial, private, and military vessels and aircraft and related cargo and passengers arriving from foreign locations, focusing on non-propagative plant materials, and internationally regulated commercial species under the Convention in International Trade in Endangered Species (CITES) (U.S. CBP 2020, cbp.gov/about). Also included are federally listed noxious

seeds and plants, soil, and pests of concern for forests and agriculture. The U.S. Department of Agriculture-Animal and Plant Health Inspection Service-Plant Protection and Quarantine (USDA-APHIS-PPQ) inspects propagative plant material, provides identification services for arriving plants and pests, and conducts pest risk assessments among other activities. (HDOA 2009, p. 1). The Service inspects arriving wildlife provisions of the Lacey Act (18 U.S.C. 42; 16 U.S.C. 3371 et seq.), and prosecutes CITES violations. The State of Hawai‘i allows the importation of most plant taxa, with limited exceptions (Hawaii Legislative Reference Bureau (HLRB) 2002; USDA-APHIS-PPQ 2010; CGAPS 2009). Many invasive plants established on Hawai‘i have expanding ranges. Resources available to reduce the spread of these species and counter their negative ecological effects are limited. Control of established invasive plants is largely focused on a few invasive species that cause significant economic or environmental damage to public and private lands, and comprehensive control of an array of invasive plants remains limited in scope (CGAPS 2009). Adequate staffing, facilities, and equipment for Federal and State pest inspectors and identifiers in Hawaii devoted to invasive species interdiction are critical biosecurity gaps (HLRB 2002; USDA-APHIS-PPQ 2010; CGAPS 2009). The introduction of new invasive plant and invertebrate species to the State of Hawai‘i is a significant risk to federally listed species including any remaining wild or translocated individuals of *Festuca hawaiiensis*.

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

Reduced viability due to low numbers—The number and size of *Festuca hawaiiensis* populations have been declining for decades, with the possible exception of the population at Kīpuka ‘Alalā to Kīpuka Kalawamauna. Having a low number of individuals reduces reproductive vigor and subsequently diminishes the capacity of a species to adapt to environmental changes and disease, thereby lessening the probability of long-term persistence (Barrett and Kohn 1991, pp. 3,7; Newman and Pilson 1997, pp. 354–355). The remaining populations of *F. hawaiiensis* are at risk from stochastic events due to their low number of individuals.

Current Management Actions:

- Surveys and monitoring—The PTA Natural Resource Office staff surveys for and monitors populations of *Festuca hawaiiensis* (CSU 2015, 2017, 2019a).
- Ungulate control—In 2013, 14 conservation fenced units were installed in PTA encompassing 15,300 hectares (37,807 acres) of dryland habitat. Ungulate eradication efforts were initiated, and by 2017 all conservation fenced units were considered free of ungulates (Fleishman 2019, entire). Today, fences are maintained through the Fence Maintenance Project run by the PTA Natural Resources Office

(CSU 2015, p. 34; PTANRO 2020). All occurrences of *Festuca hawaiiensis* are fenced (CSU 2015, p. 34). The PTA has established a Wildlife Program for the training area to control invasive animal species including ungulates, including regular inspection and maintenance of ungulate exclusion fencing (CEMML 2021, p. 5).

- Ecosystem-altering invasive nonnative plant control—The PTA Natural Resource Office has established an invasive plants program for the training area to control target nonnative plant species at select plant populations, including around all occurrences of *Festuca hawaiiensis* (CSU 2015, pp. 84-86; PTANRO 2020).
- Fire management—The PTA invasive plants program not only controls invasive plants, but also reduces the fire fuel load created by invasive plants. More specifically, these management actions include mechanical removal, herbicide application, and hand clearing of invasive plants within 3.3 ft (1 m) of federally listed species. Additional actions include the implementation and maintenance of firebreak, fuel-breaks, and fuel monitoring corridors (PTANRO 2020).
- Captive propagation for genetic storage and reintroduction—The PTA Natural Resources Office collects seeds and cuttings, propagates seedlings, and outplants individuals into suitable habitat within the PTA conservation areas as well as suitable habitat outside of PTA on State of Hawai‘i protected lands. In 2019, PTA reported storage of approximately 303 seeds of *F. hawaiiensis* representing three founders (CSU 2019b, entire).
- Reintroduction and translocation—The PTA Natural Resources Office translocated *Festuca hawaiiensis* in 2004, 2012, 2013, and 2015 with minimal success. Translocations occurred at PTA and outside of PTA at Pu‘u Huluhulu. The site within PTA has had some success. In a 2014 survey, three mature translocated individuals had survived out of the seven individuals translocated. An additional 15 mature and 40 immature individuals were observed, for a total of 58 individuals. In 2019, 24 mature and 62 immature individuals were observed, for a total of 86 individuals. However, of the four plants that were translocated to Pu‘u Huluhulu, none were found in 2014 and the site was not accessible for the 2019 survey (CSU 2015, p. 35; CSU 2019a, p. 48).

Table 1. Status and trends of *Festuca hawaiiensis* from listing through 5-year review.

Date	No. wild individuals	No. outplanted	Preventing Extinction Criteria identified by HPPRCC	Preventing Extinction Criteria Completed?
2016 (listing)	ca 1,500	7	All threats managed in all 3 populations	Partially, exclusion fencing at PTA, also weed and fire control
			Complete genetic storage	Partially, at least 3 founders from PTA represented
			3 populations with 50 mature individuals each	Partially, one population > 50 (Kīpuka ‘Alalā to Kīpuka Kalawamauna)
2021 (5-year review)	1,083	0	All threats managed in all 3 populations	Partially, exclusion fencing at PTA, also weed and fire control
			Complete genetic storage	Partially, at least 3 founders from PTA represented
			3 populations with 50 mature individuals each	Partially, one population > 50 (Kīpuka ‘Alalā to Kīpuka Kalawamauna)
			Each population naturally reproducing	Partially, one population at Kīpuka ‘Alalā to Kīpuka Kalawamauna

Table 2. Threats to *Festuca hawaiiensis* and ongoing conservation efforts.

Threat	Listing Factor	Current Status	Conservation/Management Efforts
Destruction and degradation of habitat by ungulates	A	Ongoing	Partial, ungulate exclosures at PTA
Destruction and degradation of habitat by established ecosystem-altering invasive plants	A	Ongoing	Partial, some invasive plant control within ungulate exclosures
Fire destruction and degradation of habitat	A	Ongoing	Partial, fire management plan for PTA
Climate change degradation or loss of habitat	A	Ongoing	None
Herbivory and predation by feral ungulates	C	Ongoing	Partial, ungulate exclosures at PTA
Inadequacy of regulatory mechanisms	D	Ongoing	None
Reduced viability and low numbers	E	Ongoing	Partial, seed collection, propagation, and reintroduction efforts

2.4 Synthesis

There are approximately 1,083 wild individuals of *Festuca hawaiiensis* on the island of Hawai‘i. 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 *F. hawaiiensis* is vulnerable to the effects of climate change. All individuals are within exclosures for protection from ungulates, and the fencing is monitored and maintained to limit incursion. There are seeds and propagules in collections representing three founders. Outplanting efforts are ongoing, and recruitment and regeneration have been observed at one site.

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 the island of Hawai‘i 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 50 mature, reproducing individuals per population.

The preventing extinction goals for this species have not been met as, although the number of wild individuals is 1,083 there are only three populations on the island of Hawai‘i and there are no plants on Maui. Only one known population contains more than 50 mature individuals and is naturally reproducing. There is only partial genetic representation (three founders) (Table 1) and all threats are not being sufficiently managed throughout the range of the species (Table 2). Therefore, *Festuca hawaiiensis* 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—Continue to conduct surveys for *Festuca hawaiiensis* in historical locations and potentially suitable habitat.
- Ungulate monitoring and control—Continue to construct and maintain fenced enclosures to protect individuals from the negative impacts of feral ungulates.
- Invasive plant monitoring and control—Continue to control established ecosystem-altering nonnative invasive plant species and those that compete with *F. hawaiiensis*.
- Fire management—Continue to implement a fire management plan for all wild and reintroduced populations.
- Climate change adaptation strategy—Research suitability of habitat in the future due to the impacts of climate change.

- Captive propagation for genetic storage and reintroduction—Continue to collect seeds for storage and propagation efforts for maintenance of genetic stock.
- Reintroduction and translocation—Increase numbers of populations and individuals in suitable habitat to build resiliency and redundancy and reduce the impacts of low population numbers.
- Alliance and partnership development—Continue to contribute to planning and implementation of ecosystem-level restoration and management to benefit this taxon.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Festuca hawaiiensis*
(no common name)

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

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