Calamagrostis expansa
(Maui reedgrass)

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: *Calamagrostis expansa* (Maui reedgrass)

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5-YEAR REVIEW
Calamagrostis expansa (Maui reedgrass)

1.0 GENERAL INFORMATION

1.1 Reviewers:

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Lauren Weisenberger, Plant Recovery Coordinator, 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 The review was based on the final rule listing this species; reviewed scientific publications; unpublished field observations and species status report by the Service, State of Hawai‘i, and other experienced biologists; unpublished survey reports; notes and communications from other qualified biologists; as well as a review of current, available information.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 Cheryl Phillipson, Biologist, was reviewed by Lauren Weisenberger, Plant Recovery Coordinator, and Megan Laut, Conservation and Restoration Team Manager.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 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; 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: *Calamagrostis expansa*
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 *Calamagrostis expansa*.

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: July 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**
__X_**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
__X_ 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.

Calamagrostis expansa is a short-lived perennial 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 should be documented on the islands of Maui and/or Hawai‘i where they now occur or occurred historically. Each of these populations must be naturally reproducing (i.e., viable seeds, seedlings, saplings) with a minimum of 50 mature individuals per population.

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

Interim Stage

To meet the interim stage of recovery of *Calamagrostis expansa*, 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:

Calamagrostis expansa, a member of the Poaceae (grass) family, is a short, rhizomatous (with horizontal underground stems) perennial grass. Culms (aerial stems) are erect or sometimes decumbent (close to the ground), 50 to 200 centimeters (cm) (1.6 to 6.6 feet (ft)) tall and 4 to 8 millimeters (mm) (0.2 to 0.3 inches (in)) in diameter. Sheaths surrounding the stems overlap closely along the middle of the culm; the ligule (ring at the junction of the blade and the sheath) is 3.5 to 4 mm (0.14 to 0.16 in) long and blades are flat to involute, 15 to 20 cm (5.9 to 7.9 in) long and 1 to 3 cm (0.4 to 1.2 in) wide. Densely scabrous (rough) inflorescences are 15 to 30 cm (6 to 12 in) long with no spikelets (ultimate flower cluster) on the lower half. The rachilla (spikelet axis) is 1.5 to 2 mm (0.06 to 0.08 in) long with whitish yellow silky hairs up to 1 cm (0.4 in) long. The pale brown ovoid caryopsis (fruit), up to 2.5 mm (0.1 in) long, is slightly grooved ventrally (O'Connor 1999, p. 1509).

The life history characteristics of *Calamagrostis expansa* have not been well studied. The pollination of *C. expansa* is unknown but wind is the presumed pollination mechanism for a related Hawaiian *Calamagrostis* species; therefore, wind is the presumed pollination mechanism for *C.*

expansa (Sakai et al. 1995, p. 2527). Herbarium collections from Maui and the island of Hawai‘i show flowering and fruiting nearly year-round (Ewart III 1928, in litt.; Forbes 1917, 1919, in litt.; Harrison 1973, in litt.; Herbst and Bishop 1968, in litt.; Higashino 1976, in litt.; Hobdy 1979, in litt.; Munro 1916, 1927, in litt.; NTBG 2020; Oppenheimer et al. 2010, in litt; St. John 1930, in litt; Wood and Perlman 1995, in litt.). The seeds of *C. expansa* are described as having slender teeth, which may aid in attachment to bird feathers for transport and dispersal (Sakai et al. 1995, p. 2524, 2527; O’Connor 1999, p. 1509). The results of a germination test indicated 26 percent viability initially and seeds germinated for a year after sowing (Lyon Arboretum 2020).

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, *Calamagrostis expansa* occurred in the west and east Maui mountains and on the island of Hawai‘i in the Kohala mountains. On east Maui, *C. expansa* was known from the wet upland areas of Haleakalā at Pi‘ina‘au-Ke‘anae-Honomanū (U.S. Exploration Expedition 1838–1842). On west Maui, occurrences were known at Pu‘u Kukui, Honokōhau, and ‘Eke Crater (Ewart 1928, in litt.; St. John 1930, in litt., Herbst 1968, in litt., Higashino 1976, in litt., Hobdy 1979, in litt.). Currently, on east Maui, there are occurrences at Kuiki, Kawakoe to Helele‘ike‘ōhā, Kawaipapa to Kawakoe, Pu‘u‘alea to Wai‘ānapanapa, and Pi‘ina‘au to Honomanū. These occurrences total from 35 to 60 individuals. No surveys for this species have been conducted on west Maui since 2016 when there were 23 to 25 individuals at Honokōwai Natural Area Reserve (NAR) (Bustamente and Oppenheimer 2020, pers. comm.). The status of populations on the island of Hawai‘i in the Kohala mountains (ca 750 individuals) and at Upper Waiākea (nine individuals) is unknown as the last recorded observations were in 1995 and 2004, respectively.

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:
Calamagrostis expansa was first described by Munro in 1862 and later by Hillebrand in 1888 under the name *Deyeuxia expansa* from a type specimen collected in the 1800s (during the Wilkes Expedition) from the northern slopes of Haleakalā Crater on east Maui (Munro 1862 *in* Hillebrand 1888, p. 519; U.S. Exploration Expedition 1883–1842, in litt.). The species was re-described by Hitchcock moving it from the genus *Deyeuxia* to *Calamagrostis* (Hitchcock 1926, p. 149). *Calamagrostis*

expansa is the currently recognized taxonomy (O'Connor 1999, p. 1509; Herbst and Clayton 1998 *in* Wagner et al. 2012, p. 90).

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):
Calamagrostis expansa occurs within four habitat types: wet forest, wet grassland and shrubland, and montane riparian and bog habitat at 1,217 to 2,032 meters (m) (3,993 to 6,668 feet (ft)). In general, the soil types where *C. expansa* occurs are well drained to poorly drained usually with a mid-soil layer of clay on top of lava flow, igneous rock or an "iron stone" substrate. The soils are usually acidic in nature. The presence of the clay layer and a solid substratum in a wet montane environment is indicative of bogs. *Calamagrostis expansa* populations on the island of Hawai‘i generally occur in 5 to 13 cm (2 to 5 in) soil depths with a pāhoehoe lava flow substratum or a clay type and ironstone layers. On east and west Maui, *C. expansa* generally occurs in very thin to well-developed soils of 3 to 25 cm (2 to 10 in) over a layer of clay and a cinder, stony and rock substratum that is indicative of the older age of the island (Harrington et al. 2019, pp. 8–9).

On the island of Hawai‘i, *Calamagrostis expansa* occurs in *Metrosideros polymorpha* (‘ōhi‘a)–*Machaerina angustifolia* (‘uki) montane bogs, *Metrosideros polymorpha* mixed shrub montane bogs bordered by *Metrosideros polymorpha–Cheirodendron trigynum* (‘ōlapalapa) wet forest. Associated native plant species include *Carex alligata*, *Cheirodendron trigynum* (‘ōlapa), *Dichanthelium cynodon*, *Dryopteris wallichiana* (laukahi), *Leptecophylla tameiameiae* (pūkiawe), *Myrsine* spp. (kōlea), *Oreobolus furcatus*, *Rhynchospora chinensis* (beak-rush, kuolohia), *Rubus hawaiensis* (‘ākala), *Stenogyne cranwelliae*, *Vaccinium* spp. (‘ōhelo), and *Viola maviensis* (Hawai‘i Biodiversity and Mapping Program (HBMP) 2010; Bernice Pauahi Bishop Museum (BPBM) 2020).

On Maui, *Calamagrostis expansa* occurs in *Machaerina–Rhynchospora–Racomitrium lanuginosum* (wooly fringemoss) montane bogs, montane bog-wet forest margins, wet forests, and along a stream. Associated native plant species include *Anthoxanthum odoratum* (vernal grass), *Carex montis-eeka*, *C. uncinata*, *Cheirodendron trigynum* (‘ōlapa), *Coprosma granadensis* (mākole), *Deschampsia nubigena*, *Dicranopteris linearis* (uluhe), *Dryopteris glabra*, *Dubautia* spp. (na‘ena‘e), *Elaphoglossum wawrae* (laukahi), *Hydrangea arguta* (kanawao), *Ilex anomala* (kāwa‘u),

Labordia hedyosmifolia (kāmakahala), *Leptecophylla tameiameiae* (pūkiawe), *Luzula hawaiiensis* (wood rush), *Lysimachia remyi*, *Metrosideros polymorpha*, *Oreobolus furcatus*, *Palhinea cernua* (wāwaeʻiole), *Peperomia kipahuluensis* (ʻala ʻala wai nui), *Rubus hawaiensis* (ʻākala), *Sadleria* spp. (ʻamaʻu), *Smilax melastomifolia* (hoi kuahiwi), *Sticherus owhyhensis* (uluhe), *Trematolobelia macrostachys* (koliʻi), *Vaccinium dentatum* (ʻōhelo), and *Viola maviensis* (HBMP 2010; BPBM 2020).

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 pigs (*Sus scrofa*) have been documented to impact individuals of *Calamagrostis expansa* (Perlman and Wood 1996, p. 144; 81 FR 17790, March 30, 2016; HBMP 2010). Ungulates consume and trample plants, roots, and seedlings, destroy vegetation cover throughout large areas, create trails and open disturbed areas which promote erosion by destabilizing substrate and creating gullies that convey water, and dislodge stones from ledges that can cause rockfalls, landslides, and damage vegetation below (Cuddihy and Stone 1990, pp. 64–65; 81 FR 17790, March 30, 2016). Feral ungulates aid in the dispersal of seeds of invasive nonnative plants in native forests on their hooves, coats, and through their feces. This promotes the invasion of nonnative plants that outcompete native species for space, water, light, and nutrients.

Established ecosystem-altering invasive plant modification and degradation of habitat—Invasive plants affect individuals of *Calamagrostis expansa* as they have the ability to outcompete the species for water, space, nutrients and light (Perlman and Wood 1996, p. 129; 81 FR 17790, March 30, 2016). Invasive nonnative plant species modify the availability of light; alter soil-water regimes; modify nutrient cycling; alter the fire regime affecting native plant communities; and ultimately, convert native-dominated plant communities to nonnative plant communities (Smith 1985, pp. 180–181; Cuddihy and Stone 1990, p. 74; D'Antonio and Vitousek 1992, p. 73; Vitousek et al. 1997, p. 6). The nonnative invasive plants documented to affect *C. expansa* and its habitat include *Argeratina adenophora* (Maui pamakani), *Holcus lanatus* (common velvet grass), *Hypochoeris radicata* (hairy cat's ear), *Juncus ensifolius* (swordleaf rush), *Persicaria punctata* (water smartweed), *Sacciolepis indica* (glenwood grass), and *Tibouchina herbacea* (cane tibouchina) (HBMP 2010; BPBM 2020).

Landslides, erosion, and flooding destruction and degradation of habitat—*Calamagrostis expansa* occurs in drainages and gulches and is impacted by landslides, erosion, and flooding (HBMP 2010). These hazards can have a significant effect on small populations by destabilizing substrate, altering hydrological patterns, and by damaging and destroying individual plants (Stearns 1985, Pp. 99–107, 291–305).

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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 rats—Herbivory by rats is noted to be a threat to *Calamagrostis expansa* and its habitat (Perlman and Wood 1996, p. 151; HBMP 2010). Rats eat virtually every part of plants and at every stage: fleshy fruits, seeds, flowers, stems, leaves, shoot, seedlings, and roots (Russell 1980, pp. 269–272; Cuddihy and Stone 1990, pp. 34, 67). The effects on plants range from reduced vigor and decreased reproduction to mortality of individuals and complete lack of recruitment.

2.3.2.4 Inadequacy of existing regulatory mechanisms (Factor D):
The only known occurrences of *Calamagrostis expansa* are adjacent to State hunting areas (Department of Land and Natural Resources (DLNR) 2010). Nonnative feral ungulates are an ongoing threat to this species through destruction and degradation of habitat and herbivory. The State of Hawai‘i provides game mammal (feral pigs and goats, deer, sheep and mouflon) hunting opportunities on Maui and the island of Hawai‘i. The State’s management objectives for game animals range from maximizing public hunting opportunities (e.g., “sustained yield”) in some areas to removal by State staff, or their designees, in other areas (State of Hawai‘i 2010 H.A.R. 13-123). Public hunting areas are not fenced and game mammals have unrestricted access for most areas across the landscape, regardless of underlying land use designation; therefore, any unfenced populations of *C. expansa* are at risk (DLNR 2010). Exclosures in the Kohala mountains may provide protection from feral ungulates if any individuals of *C. expansa* remain there. The occurrence at Upper Waiākea on the island of Hawai‘i is not fenced. Populations of *C. expansa* that occur within Haleakalā National Park (NP), Hanawī Natural Area Reserve (NAR), and Waikamoi Preserve (PR) on east Maui may be provided protection by fencing and ungulate control, and fences must be maintained and monitored for ungulate ingress (The Nature Conservancy (TNC) 2014, pp. 16–18; State of Hawai‘i 1989, pp. 26–28; Haleakalā NP 2018, 7 pp.). The west Maui occurrence is within a remote, managed area and protected by ungulate control.

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

Reduced viability due to low numbers—There are fewer than 100 individuals of *Calamagrostis expansa* remaining in the wild on both Maui and the island of Hawai‘i. Small, isolated populations often exhibit reduced levels of genetic variability, which diminishes the species' capacity to adapt and respond to environmental changes, thereby lessening the probability of long-term persistence (Barrett and Kohn 1991, pp. 3, 7; Newman and Pilson 1997, pp. 354–355). The problems associated with small population size and vulnerability to random demographic fluctuations or natural catastrophes are further magnified by synergistic interactions with other threats, such as anthropogenic impacts like habitat loss from human development or predation by nonnative species. Very small plant populations may experience reduced reproductive vigor due to ineffective pollination or inbreeding depression.

Climate change loss or degradation of habitat, including hurricanes—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 *Calamagrostis expansa* is vulnerable to the impacts of climate change with a vulnerability score of 0.239 (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.

Tropical cyclone frequency and intensity are projected to change as a result of climate change over the next 100 to 200 years (Vecchi and Soden 2007, p. 4317; Emanuel et al. 2008, p. 348; Yu et al. 2010, pp. 1369–1372). In the central Pacific, modeling projects an increase of up to two additional tropical cyclones per year in the main Hawaiian Islands by 2100 (Murakami et al. 2013, pp. 1–6). In 2014, category 4 Hurricane Iselle was downgraded to a tropical storm as it neared the southeast coast of the island of Hawai‘i. Maximum sustained winds were 60 knots (69 miles per hour) and the storm caused significant damage, toppling large numbers of very tall, brittle, nonnative albizia trees within the Puna district (Kimberlain et al. 2018, p. 6). Hurricanes pose an ongoing and ever-present threat because they can happen at any time. A destructive hurricane holds the potential of driving a localized endemic species to extinction in a single event.

Current Management Actions:

- Surveys and monitoring—No surveys have been conducted for this species since 2016 (Bustamente and Oppenheimer 2020, pers. comm.).
- Ungulate control—Occurrences of *Calamagrostis expansa* within the Kahakuloa section of the West Maui NAR, Waikamoi PR, Hanawī NAR, and Haleakalā NP are provided protection by ungulate exclosures; however, the occurrence at Upper Waiākea on the island of Hawai‘i is not fenced.
- Ecosystem-altering invasive nonnative plant control—Nonnative plant control efforts at Waikamoi PR, Hanawī NAR, and Haleakalā NP may benefit occurrences of *C. expansa* (TNC 2014, pp. 16–18; State of Hawai‘i 1989, pp. 26–28; Haleakalā NP 2018, 7 pp.).
- Captive propagation for genetic storage and reintroduction—
    - Lyon Arboretum Seed Conservation Laboratory reported one seed accession in 2013 (87 seeds) representing an individual from Kawaipapa, and two seed accessions in 2013 (14,138 seeds) and in 2017 (968 seeds) representing individuals from Honokōhau in the Honokōwai section of the West Maui NAR-Pu‘u Kukui population (Lyon Arboretum 2020).
    - The Olinda Rare Plant Facility (ORPF) reported three plants in storage representing one founder from Honokōhau in the Honokōwai section of the West Maui NAR-Pu‘u Kukui population (ORPF 2019).
    - Haleakalā NP reported 800 seeds in storage from the Kūhiwa population (Haleakalā NP 2019).
- Population biology research—The results of a germination test indicated 26 percent viability initially with seeds germinating for a year after sowing (Lyon Arboretum 2020).

Table 1. Status and trends of *Calamagrostis expansa* from listing through 5-year review.

Date	No. wild individuals	No. outplanted	Preventing Extinction Criteria identified by HPPRCC	Preventing Extinction Criteria Completed?
2016 (listing)	300 (Maui) >200 (Hawai‘i)	0	All threats managed in all 3 populations	Partially, most individuals within exclosures
			Complete genetic storage	No
			3 populations with 50 mature individuals each	Yes
2021 (5-year review)	58–85 (Maui) Unknown (Hawai‘i)	0	All threats managed in all 3 populations	Partially, most individuals within exclosures

			Complete genetic storage	Partially, 2 Maui populations represented in seed storage
			3 populations with 50 mature individuals each	Partially, 1 population > 50
			Each population naturally reproducing	None reported

Table 2. Threats to *Calamagrostis expansa* and ongoing conservation efforts.

Threat	Listing Factor	Current Status	Conservation/Management Efforts
Destruction and degradation of habitat by ungulates	A	Ongoing	Partial, ungulate exclosures for most populations
Destruction and degradation of habitat by established ecosystem-altering invasive plants	A	Ongoing	Partial, nonnative plant control in managed areas
Rat herbivory	C	Ongoing	None
Inadequacy of regulatory mechanisms	D	Ongoing	Partial, ungulate exclosures and nonnative plant control
Climate change destruction and degradation of habitat, including hurricanes	E	Ongoing	None
Reduced viability due to low numbers	E	Ongoing	Partial, at least 3 founders from Maui are represented in seed collections

2.4 Synthesis

There are fewer than 100 known individuals of *Calamagrostis expansa* on the islands of Maui and 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 *C. expansa* is vulnerable to the effects of climate change. There are seeds representing at least three founders from the Maui populations in storage. Most populations are within fencing for ungulates and are managed areas.

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 that is well managed. In addition, a minimum of three populations total should be documented on Maui and/or Hawai‘i where they now occur or occurred historically and each of these populations must be naturally reproducing (i.e., viable seeds, seedlings, or saplings) with a minimum of 50 mature, reproducing individuals per population.

The preventing extinction goals for this species have not been met. There is only one known population of more than 50 mature individuals, only partial genetic representation (Table 1) and all threats are not being sufficiently managed throughout the range of the species (Table 2). Therefore, *Calamagrostis expansa* 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*
__X__**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 *Calamagrostis expansa* in historical locations and potentially suitable habitat.
- Ungulate monitoring and control—Continue to maintain fenced exclosures 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

C. expansa at all 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—Begin propagation and reintroduction efforts to increase numbers of populations and individuals in suitable habitat to build resiliency and redundancy and reduce the impacts of landslides, flooding, erosion, and climate change.
- Population biology research—Continue to research the biological needs of the species to determine best management practices.
- Alliance and partnership development—Continue to work with State and private land managers and partners 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 *Calamagrostis expansa*
(Maui reedgrass)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

____Downlist to Threatened
____Uplist to Endangered
____Delist
_X__No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: _____

Review Conducted By:
Cheryl Phillipson, Fish and Wildlife Biologist, PIFWO
Lauren Weisenberger, Plant Recovery Coordinator, PIFWO
Megan Laut, Conservation and Restoration Team Manager, PIFWO

FIELD OFFICE APPROVAL:

for MEGAN LAUT Digitally signed by MEGAN LAUT Date: 2021.08.31 14:39:38 -10'00'

Field Supervisor, Pacific Islands Fish and Wildlife Office