

Geranium hillebrandii
(nohoanu)

**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: *Geranium hillebrandii* (nohoanu)

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5-YEAR REVIEW

***Geranium hillebrandii* (nohoanu)**

1.0 GENERAL INFORMATION

1.1 Reviewers:

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Lauren Weisenberger, Plant Recovery Coordinator, PIFWO
Megan Laut, Conservation and Restoration Team Manager, PIFWO

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 2019. The review was based on the final rule listing this species; the final critical habitat designation; peer reviewed scientific publications; unpublished field observations by the Service, State of Hawai‘i, and other experienced biologists; unpublished survey reports; notes and communications from other qualified biologists; as well as a review of current, available information.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 of 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. 2018. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 156 species in Oregon, Washington, Hawaii, Palau, Guam, and the Northern Mariana Islands. Federal Register 88(83): 20088–20092, May 7, 2018.

1.3.2 Listing history:

Original Listing

FR notice: [USFWS] U.S. Fish and Wildlife Service. 2013. Endangered and threatened wildlife and plants; determination of endangered status for 38 species

on Molokai, Lanai, and Maui; final rule. Department of the Interior, Federal Register 78 (102): 32014–32065, May 28, 2013.

Date listed: May 28, 2013
Entity listed: *Geranium hillebrandii*
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:

[USFWS] U.S. Fish and Wildlife Service. 2016. Endangered and threatened wildlife and plants; designation and nondesignation of critical habitat on Molokai, Lanai, Maui, and Kahoolawe; final rule. Department of the Interior, Federal Register 81 (61): 17790–18110, March 30, 2016.

Critical habitat was designated on Maui for *Geranium hillebrandii* totaling six units in the montane wet and montane mesic ecosystems (816 ha; 2,019 ac) (81 FR 17790).

1.3.4 Review History:

This is the first 5-year review for *Geranium hillebrandii*.

1.3.5 Species' Recovery Priority Number at start of this 5-year review:
2

1.3.6 Current Recovery Plan or Outline:

Name of plan or outline: Recovery Outline for the islands of Maui, Moloka'i, Kaho'olawe, and Lāna'i (Maui Nui)
Date issued: October 2019
Dates of previous revisions, if applicable: N/A

2.0 REVIEW ANALYSIS

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

2.1.1 Is the species under review a vertebrate?

Yes
 No

2.1.2 Is the species under review listed as a DPS?

Yes
 No

2.1.3 Was the DPS listed prior to 1996?

Yes

No

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

Yes

No

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

Yes

No

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

Yes

No

2.2 Recovery Criteria

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

Yes

No

2.2.2 Adequacy of recovery criteria.

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

Yes

No

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

Yes

No

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

A synthesis of the threats (Listing Factors A, C, D, and E) affecting this species is presented in section 2.3.2 and Table 2. Listing Factor B (overutilization for

commercial, recreational, scientific, or educational purposes) is not known to be a threat to this species.

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

Current information is lacking for many Hawaiian plant species on the status of the species and their habitats, breeding systems, genetics, and propagule storage options. The following downlisting and delisting criteria for plants have therefore been adopted from the revised recovery objective guidelines developed by the HPPRCC (2011). Many of the Hawaiian plant species are at very low numbers, so the 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.

Geranium hillebrandii is a short-lived perennial decumbent subshrub. 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 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, reproducing individuals per population.

Although there are five populations totaling an estimated 2,000 to 10,000 individuals, there is no genetic representation in storage or in propagation. Four of the five populations are fenced; however, this fencing must be monitored for ingress by ungulates. The threat of predation by rats and slugs is also not being addressed. Therefore, this recovery objective has not been met (see Table 1).

Interim Stage

To meet the interim stage of recovery of *Geranium hillebrandii*, 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. 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) that is secured and well-maintained. 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 five 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. 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 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. 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:

Geranium hillebrandii is a mat-forming subshrub with dark reddish to nearly black stems, often rooting at the nodes (where leaf joins the stem), and 5 to 10 decimeters (1.6 to 3.3 feet (ft)) long. The leaves are alternate, elliptic to elliptic-cuneate (triangular), 1.5 to 2.6 centimeters (cm) (0.6 to 1.0 inches (in)) long, 0.9 to 1.5 cm (0.4 to 0.6 in) wide, with the upper surface pubescent (hairy) on veins, the lower surface densely grayish silky strigose (straight hairs, often pointing in a similar direction), and the margins entire except at the apex (the base) which is 5- to 7-toothed. The flowers are usually three to four in terminal cymes (characterized by having the terminal flowers bloom first) that project beyond the leaves. The petals are white with purple veins, 10 to 15 millimeters (mm) (0.4 to 0.6 in) long. The carpel (ovule-bearing structure) is 3 mm (0.12 in) long and densely pubescent. The seeds are one per cell with dark reddish brown, oblong-obovoid (egg-shaped), 2.5 mm (0.1 in) long, with a reticulate (netted) surface (Wagner *et al.* 1999, pp. 732–733).

Little is known about the life history of *Geranium hillebrandii*. It has been observed flowering nearly year-round, in February, April, July, August, and November (NTBG 2019). Its seed dispersal agents, specific environmental requirements, and limiting factors are unknown.

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:

Little information is known about the historical locations of *Geranium hillebrandii* on west Maui; the only definitive record is of a collection made in the 1800s at ‘Eke Crater (Hillebrand 1888, p. 56). In 1999, the populations were estimated to total 2,000 plants (HBMP 2010). At the time of listing in 2013, there were estimated to be more than 10,000 plants from ‘Eke Crater to Lihau. Currently, there are three populations of *G. hillebrandii* within the Pu‘u Kukui montane bogs. A fourth population is within bogs at ‘Eke Crater and a fifth population occurs at Lihau in montane mesic shrubland and cliff habitat (Oppenheimer 2019, pers. comm.). All five populations are estimated to total between 2,000 to 10,000 individuals.

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

A study was conducted to better determine phylogeny, radiation pathways, and origin of Hawaiian *Geranium* species (Kidd 2005). This study showed that the Hawaiian *Geraniums* are strongly affiliated with species found in North America. There is no geological evidence for any now-extinct islands which could have served as stepping-stones to the Hawaiian Islands therefore the original colonization was likely on one of the younger Hawaiian Islands (the *Geranium* species on Kaua‘i are a back radiation). The analysis showed there was convergent evolution of traits (node rooting) for bog species. In addition, results indicated that a more diverse sampling of outgroups, specifically those from South America, may provide evidence for a South American origin for the Hawaiian *Geraniums*. Further genetic studies are needed.

2.3.1.4 Taxonomic classification or changes in nomenclature:

Geranium hillebrandii was first described as *G. humile* by Hillebrand from a collection at ‘Eke on west Maui (Hillebrand 1888, p. 56). Fosberg (1936) and Rock (1911) recognized varieties of *G. humile* on Maui and Kaua‘i. In 1997, Aedo and Muñoz recognized new names for 12 species of *Geranium* in Hawai‘i, and assigned *G. hillebrandii* for the endemic species on west Maui, and *G. kauaiense* for *G. humile* var. *kauaiense* as the endemic species on Kaua‘i. This species is recognized as a distinct taxon in Wagner *et al.* (1999) and Wagner and Herbst (2003), the most recently accepted Hawaiian plant taxonomy.

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

See section 2.3.1.2 above for spatial distribution of the species.

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

Geranium hillebrandii occurs in montane wet bogs as well as within the montane mesic shrubland and cliffs on the west Maui (Oppenheimer 2019, pers. comm.). Dominant native plants are *Metrosideros polymorpha* ('ōhi'a)-*Dicranopteris linearis* (uluhe) with the associated native plant species *Argyroxiphium caliginis* ('Eke silversword), *Carex montis-eeka* (no common name), *Dodonaea viscosa* ('a'ali'i), *Dubautia laxa* (na'ena'e pua melemele), *Keysseria maviensis* (hōwaiaulu), *Leptecophylla tameiameia* (pūkiawe), *Palhinea cernua* (wāwae'iole), *Machaerina angustifolia* ('uki), *Oreobolus furcatus* (no common name), *Pittosporum* sp. (hō'awa), *Plantago pachyphylla* (laukahi kuahiwi), *Rhynchospora chinensis* subsp. *spiciformis* (kuolohia), *Sanicula purpurea* (snakeroot), *Vaccinium* sp. ('ōhelo), and *Viola mauiensis* (pāmakani) (HBMP 2010).

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

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

Ungulate destruction and degradation of habitat—Destruction and degradation of habitat by feral ungulates such as pigs are a potential threat to *Geranium hillebrandii*. Feral ungulates modify and degrade habitat by disturbing and destroying vegetative cover, trampling plants and seedlings, reducing or eliminating plant regeneration by damaging seeds and seedlings, and increasing erosion by creating large areas of bare soil (Loope 1998, pp. 747–774; van Riper and van Riper 1982, pp. 34–35; Oppenheimer 2019, pers. comm.). Individuals of *G. hillebrandii* within exclosures are provided some protection from the effects of feral pigs; however, these exclosures must be monitored for ingress (Oppenheimer 2019, pers. comm.; Mauna Kahālāwai Watershed Partnership (MKWP) 2019).

Established ecosystem-altering invasive plant modification and degradation of habitat—Invasive introduced plants modify habitats occupied by native plant species by changing the availability of light, altering soil-water regimes, changing nutrient cycling and the fire characteristics of the native plant community (Cuddihy and Stone 1990, p. 74). Habitat modification and destruction by invasive nonnative plants

negatively affects the only known populations of *Geranium hillebrandii* (HBMP 2010). Nonnative plants with the greatest impacts on *G. hillebrandii* include *Ageratina adenophora* (Maui pāmakani), *Tibouchina herbacea* (cane tibouchina), and several *Juncus* (bog rush) species. (HBMP 2010; MKWP 2019).

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 *Geranium hillebrandii* is highly vulnerable to the impacts of climate change with a vulnerability score of 0.795 (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). Modeling for the Central Pacific projects an increase of up to two additional tropical cyclones per year in the main Hawaiian Islands by 2100 (Murakami *et al.* 2013). 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 such as *Geranium hillebrandii* to extinction with a single event.

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

Not a threat.

2.3.2.3 Disease or predation (Factor C):

Not a threat.

2.3.2.4 Inadequacy of existing regulatory mechanisms (Factor D):

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). 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). The Service inspects arriving wildlife products, enforces the injurious 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. Many invasive plants established in 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 nonnative 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. The introduction of new invasive plant species to the State of Hawaii is a significant risk to *Geranium hillebrandii* and other federally listed species.

Nonnative feral ungulates are an ongoing threat to *Geranium hillebrandii* through destruction and modification of habitat and by direct predation. The State of Hawai‘i provides game mammal (feral pigs and goats, axis deer) hunting opportunities (e.g., “sustained yield”) in public hunting areas on Maui (DLNR 2012). Four of the five populations of *G. hillebrandii* are fenced; however, the exclosures must be monitored for ingress by feral pigs, goats, and deer. 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 *G. hillebrandii* are at risk (DLNR 2010).

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

Not a threat.

Current Management Actions:

- Surveys and monitoring—PEPP monitors individuals of *Geranium hillebrandii* on west Maui (Oppenheimer 2019, pers. comm.). In addition, rappelling has occurred on the steep slopes of Lihau, where a population of *G. hillebrandii* has been confirmed (Oppenheimer 2019, pers. comm.).
- Ungulate control—The Mauna Kahālāwai Watershed Partnership (MKWP; formerly known as the west Maui Mountains Watershed Partnership (WMMWP)) works in coordination with landowners to reverse the negative impacts of forest degradation by addressing the numerous threats to the native ecosystems of west Maui (WMMWP

2019). The partnership has constructed 22 miles of enclosure fencing (WMMWP 2019) and removed pigs from the upper summits of the west Maui Mountains. Four of the five known populations of *G. hillebrandii* are fenced.

- Nonnative plant control—The MKWP has also initiated nonnative plant control planning and implementation in areas where *G. hillebrandii* occurs (WMMWP 2013). The partnership manages 47,321 ac (19,150 ha) of watershed that includes the populations of *G. hillebrandii* at Pu‘u Kukui, ‘Eke, and Lihau on west Maui.

Table 1. Status and trends of *Geranium hillebrandii* from listing through 5-year review.

Date	No. wild individuals	No. outplanted	Preventing Extinction Criteria identified by HPPRCC	Preventing Extinction Criteria Completed?
2013 (listing)	>10,000	0	All threats managed in all 3 populations	Partially, ungulate and nonnative plant control ongoing
			Complete genetic storage	No
			3 populations with 50 mature individuals each	Yes
2016 (critical habitat)	>10,000	0	All threats managed in all 3 populations	Partially, ungulate and nonnative plant control ongoing
			Complete genetic storage	No
			3 populations with 50 mature individuals each	Yes
2020 (5-year review)	ca 2,000–10,000	0	All threats managed in all 3 populations	Partially, ungulate and nonnative plant control ongoing
			Complete genetic storage	No
			3 populations with 50 mature individuals each	Yes

Table 2. Threats to *Geranium hillebrandii* and ongoing conservation efforts.

Threat	Listing Factor	Current Status	Conservation/Management Efforts
Ungulate degradation of habitat	A	Ongoing	Partial, 4 populations fenced
Established ecosystem-altering invasive plant	A	Ongoing	Partial, nonnative plant control within enclosures

modification and degradation of habitat			
Climate change degradation or loss of habitat, including hurricanes	A	Ongoing	None
Inadequacy of existing regulatory mechanisms	D	Ongoing	Partial, 4 of 5 populations are in exclosures

2.4 Synthesis

There are five populations of *Geranium hillebrandii* totaling an estimated 2,000 to 10,000 individuals. Landscape and plant form prevent surveys to obtain more precise estimates. 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 *G. hillebrandii* is highly vulnerable to the effects of climate change. Four of the five populations are provided some protection from ungulates within exclosures. Monitoring is minimal because of the sensitivity of the montane bog habitat and cliffs. There are no collections stored or in propagation, and no reintroductions at this time.

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 Maui 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. Although there are five populations totaling between an estimated 2,000 to 10,000 individuals, there is no genetic representation (Table 1), and all threats are not being sufficiently managed throughout the range of the species (Table 2). Therefore, *Geranium hillebrandii* 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 monitor known populations and conduct surveys for *Geranium hillebrandii* in historical locations and potentially suitable habitat. Develop survey methodology for assessing populations within sensitive bog habitat.
- Ungulate monitoring and control—Continue to construct and maintain fenced enclosures to protect wild and reintroduced 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 *G. hillebrandii* at all populations.
- Predation and herbivory by slugs—Implement effective control measures for slugs at all populations.
- Captive propagation for genetic storage and reintroduction—Collect seeds and other propagative materials for storage and begin propagation efforts for maintenance of genetic stock.
- Reintroduction and translocation—If necessary, augment populations and increase numbers of populations and individuals in suitable habitat to reduce the impacts of predation and climate change.
- Climate change adaptation strategy—Research suitability of habitat in the future due to the impacts of climate change.
- 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 *Geranium hillebrandii*
(nohoanu)

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:

Cheryl Phillipson, Fish and Wildlife Biologist, PIFWO
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Megan Laut, Conservation and Restoration Team Manager, PIFWO

FIELD OFFICE APPROVAL:

for

Field Supervisor, Pacific Islands Fish and Wildlife Office