

5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Plantago princeps* (laukahi kuahiwi, ale)

Current Classification: Endangered

Federal Register Notice 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.

Lead Region/Field Office:

Interior Region 12/Pacific Islands Fish and Wildlife Office (PIFWO), Honolulu, Hawai‘i

Name of Reviewer:

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Methodology used to complete this 5-year review:

This review was conducted by staff of the Pacific Islands Fish and Wildlife Office (PIFWO) of the U.S. Fish and Wildlife Service (Service) beginning in October 2020. The review was based on a review of current, available information since the last 5-year review for *Plantago princeps* (USFWS 2013). The evaluation by Cheryl Phillipson, Biologist, was reviewed by Lauren Weisenberger, Plant Recovery Coordinator, and Megan Laut, Conservation and Restoration Team Manager.

Background:

For information regarding the species' listing history and other facts, please refer to the Fish and Wildlife Service's Environmental Conservation On-line System (ECOS) database for threatened and endangered species (http://ecos.fws.gov/tess_public).

Review Analysis:

Please refer to the previous 5-year reviews for *Plantago princeps* in the Federal Register on August 27, 2010 and August 12, 2013 (available at https://ecos.fws.gov/docs/tess/species_nonpublish/1616.pdf and https://ecos.fws.gov/docs/tess/species_nonpublish/2093.pdf) for a complete review of the species' status, threats, management efforts, and references cited. We are not aware of any significant new information regarding the species' biological status since listing to warrant a change in the Federal listing status of *P. princeps*.

This short-lived perennial herb or shrub in the Plantaginaceae (plantain) family is endangered and is known from the islands of Kaua‘i, O‘ahu, Moloka‘i, Maui, and Hawai‘i. Currently, four varieties are recognized: *P. princeps* var. *anomala* (Kaua‘i and O‘ahu), *P. princeps* var. *laxifolia* (Moloka‘i, Maui, and Hawai‘i), *P. princeps* var. *longibracteata* (Kaua‘i and O‘ahu), and *P. princeps* var. *princeps* (O‘ahu). The variety

anomala is extirpated from O‘ahu, and *longibracteata* was also believed to be extirpated from O‘ahu until rediscovered in December 2020 (Togikawa et al., 2020). The variety *laxifolia* is extirpated from Moloka‘i and Hawai‘i. The status and trends for *P. princeps* are provided in the tables below.

New Status Information:

- *Plantago princeps* var. *anomala*: In 2013, there were six wild individuals at Kalalau rim and five individuals at Kahili, Kaua‘i, with a new population of three individuals found at Kalalau in 2014 (PEPP 2013, 2014). In 2014, there were approximately six individuals at Hulē‘ia (Perlman and Kishida 2014). In 2015, the population at Kāhili declined from about 40 plants down to only five plants (PEPP 2015). In 2016, there were five individuals at Kalalau (PEPP 2016). In 2018, at Kahuama‘a Flats, there were four mature and two immature plants (Kishida and Perlman 2018), at Kālepa ridge, there was one mature and three immature plants (Kishida and Perlman 2018), and at Limahuli, there are approximately 10 individuals observed by drone (Perlman 2018). In 2019 on Kaua‘i, one population of three individuals was monitored at Kalalau (Department of Land and Natural Resources-Division of Forestry and Wildlife [DLNR-DOFAW] 2019).
- *Plantago princeps* var. *longibracteata*: In 2013 on Kaua‘i, there were approximately 10 individuals along a ridge at Kawaikini-‘Ili‘ili‘ula and 50 individuals along a drainage below the northern falls of ‘Ili‘ili‘ula (Wood 2014, pp. 136–137). One individual was observed during a survey of ‘Ili‘ili‘ula in 2014 (Wood 2014, p. 7). In 2015, there were 30 individuals observed at Wainiha, Kaua‘i (PEPP 2015). In 2016, 20 individuals were reported at Hanalei (PEPP 2016). In 2020, a population of five individuals was discovered along a waterfall in Kaluanui Natural Area Reserve (NAR) in the Ko‘olau mountains on O‘ahu
- *Plantago princeps* var. *princeps*: The Army Natural Resources Program (ANRP) monitors populations in the Wai‘anae and Ko‘olau mountains of O‘ahu and reported 28 mature and 43 immature plants at North Mohiākea in 2018, two mature and seven immature plants at Pahole in 2018, one mature and 42 immature plants at ‘Ēkahanui in 2019, 32 mature and 10 immature plants at Nu‘uanu in 2017, one mature plant at North Pālāwai in 2018, and the extirpation of the wild population at ‘Ōhikilolo in 2020 (ANRP 2020).
- *Plantago princeps* var. *laxifolia*: On east Maui, one wild individual in the Ko‘olau Gap was last observed in 2009 (Oppenheimer and Welton 2009) and one wild individual at Haleakalā-Kahikinui was last observed in 2011 (Bustamente et al. 2011). In 2016, there were more than 66 plants on the cliffs at ‘Īao and five individuals at Kaua‘ula (PEPP 2016). By 2017, there were only 43 plants counted at ‘Īao, and by 2021, only nine plants were accessible (PEPP 2017, PEPP 2021). In 2017, the plants at ‘Ohe‘o (‘Ōpae and Palikea streams) could not be relocated (Oppenheimer and Torigoe 2017, PEPP 2017).
- In 2012, critical habitat was designated on O‘ahu for *Plantago princeps* var. *princeps* in 34 units in the lowland mesic, lowland wet, dry cliff, and wet cliff ecosystems (16,186 hectares [ha], 40,026 acres [ac]) and for *P. princeps* var. *longibracteata* in 11 units in the lowland wet ecosystem (10,162 ha, 25,114 ac)

(77 FR 57648, September 18, 2012). In 2016, critical habitat was designated for *P. princeps* var. *laxifolia* on Moloka‘i in four units in the lowland wet and montane mesic ecosystems (3,615 ha, 8,934 ac) and for *P. princeps* var. *laxifolia* on Maui in 11 units in the dry cliff and wet cliff ecosystems (2,946 ha, 7,282 ac) (81 FR 17790, March 30, 2016). Critical habitat as designated for *Plantago princeps* on Kaua‘i in 2003 remains the same.

New Threats:

- 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 *Plantago princeps* is vulnerable to the impacts of climate change with a vulnerability score of 0.28 (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.

New Management Actions:

- Monitoring and surveys—The Plant Extinction Prevention Program (PEPP) monitors reintroduced populations of *Plantago princeps* on Kaua‘i, Maui and O‘ahu and searched for suitable reintroduction sites at Ukumehame and Pōhākea, west Maui and at Poamoho, O‘ahu (PEPP 2017, 2018).
- Ungulate monitoring and management—The ANRP manages ungulates in some areas where variety *princeps* occurs on O‘ahu at North Mohiākea, ‘Ōhikilolo, Pahole, ‘Ēkahanui, Wai‘eli, and Kōnāhuanui (ANRP 2020). Occurrences at Pana‘ewa, Kaua‘ula, Haleakalā National Park, Ko‘olau Gap-Waikamoi of variety *laxifolia* are fenced.
- Nonnative plant management—Nonnative plants are managed by the ANRP at Pahole, ‘Ēkahanui, and Wai‘eli (ANRP 2020).
- Control of predation by rats—The ANRP reported that the population at ‘Ēkahanui is protected by ongoing rat control (ANRP 2020).
- Collection and propagation for genetic storage and reintroduction—
 - The Lyon Seed Conservation Laboratory reported a total of 268 seeds of variety *anomala* representing three founders on Kaua‘i; more than 42,000 seeds representing more than 16 founders of variety *laxifolia* at ‘Īao and Kaua‘ula on Maui; and 955 seeds representing two founders at Nu‘uanu on O‘ahu (Lyon Arboretum 2020).
 - The ANRP stores plants in refugia at the rare plant nursery and in 2019 reported one individual of variety *princeps* representing one founder from Pahole and seven plants in refugia representing one founder from Mohiākea (ANRP 2019). In 2020, there were four plants in propagation representing one founder from Mohiākea, four plants representing one founder from ‘Ēkahanui, and 16 plants representing one founder from Pahole (ANRP 2020).

- In 2019, for the variety *princeps* on O‘ahu, the seedbank facility for ANRP reported 80 seeds in storage representing 11 founders from Waiawa, 7,360 seeds representing 68 founders from ‘Ēkahanui, 4,510 seeds representing 24 founders from Hālonā, 2,194 seeds representing 20 founders from ‘Ōhikilolo, 166 seeds representing 10 founders from Nu‘uanu, 641 seeds representing six founders from Pahole, 656 seeds representing three founders from Pālāwai, and 5,090 seeds representing 22 founders from Mohiākea (ANRP 2019). In 2020, the seedbank inventory for variety *princeps* on O‘ahu totaled 34 seeds representing two founders from ‘Ēkahanui, 1,496 seeds representing four founders from Pahole, 382 seeds representing three founders from ‘Ōhikilolo, 135 seeds representing five founders from Nu‘uanu, and 2,613 seeds representing one founder from Mohiākea. This may best be summarized by the genetic storage goals the ANRP has set for this variety, and currently, the representation is 44 percent complete (16 founders) for the population at North Mohiākea, 82 percent complete (14 founders) for ‘Ōhikilolo, 83 percent complete (five founders) for Pahole, 78 percent complete (39 founders) for ‘Ēkahanui, and 67 percent complete (two founders) for North Pālāwai (ANRP 2020).
- In 2016, Haleakalā National Park (Hale NP) reported nine individuals of variety *laxifolia* and 100 seeds in storage representing three founders at Haleakalā Crater, Kīpahulu, and Waikamoi. In 2019, Hale NP reported 36 plants propagated, with 2,050 seeds collected and stored representing three founders at Haleakalā-Kahikinui and 1,000 seeds stored representing 10 founders at Ko‘olau Gap, Maui (Hale NP 2019).
- The National Tropical Botanical Garden (NTBG) reported, for variety *anomala* from Kaua‘i, one plant in the nursery representing one wild individual at Kalalau rim and one individual outplanted as a living collection in the Southshore Gardens. For variety *longibracteata* there are 50 seeds in storage representing one wild individual at Blue Hole (Kaua‘i) (NTBG 2020).
- The Olinda Rare Plant Facility (ORPF) reported storage of 10 plants representing one individual of variety *laxifolia* from Kaua‘ula, and 17 individuals in storage of variety *laxifolia* representing four founders from ‘Īao (Maui) (ORPF 2020).
- Pahole nursery reported propagation of 15 individuals of variety *princeps* for reintroduction on O‘ahu (Pahole 2019).
- In 2015, one individual of variety *princeps* was relocated to a more suitable location at Mānoa cliffs (O‘ahu) (PEPP 2015, 2016).
- Reintroduction and translocation—
 - In 2019, almost 100 individuals of variety *princeps* were reintroduced at ‘Ēkahanui (O‘ahu), but none were successful (ANRP 2019). Of the 71 plants reintroduced at Kalena, only 10 survived, and of the 54 reintroduced at ‘Ōhikilolo, only 12 survived (ANRP 2019). From 2019 to 2020, the ANRP monitored reintroduction sites for variety *princeps* in the Wai‘anae mountains of O‘ahu and reported one mature individual at ‘Ōhikilolo and five mature and three immature individuals at Wai‘eli (Hāpapa) (ANRP 2020). In 2012, PEPP reported reintroduction of five individuals of variety *laxifolia* at Waihe‘e,

Maui (PEPP 2013). In 2017, a reintroduction site at Kahuama‘a Flats (Kaua‘i) for variety *anomala* was monitored and there were two mature and 60 immature plants remaining, and 59 had died (Kishida et al. 2017). Of the six individuals of variety *anomala* outplanted within an enclosure at Kalalau, Kaua‘i, only four remained in 2013 (PEPP 2013). In 2013, three individuals of variety *laxifolia* were reintroduced at Honokōhau, and 14 individuals were reintroduced at Waihe‘e (Maui) (PEPP 2014). By 2016, the reintroduced individuals at Honokōhau could not be relocated (PEPP 2016). On Maui in 2018, variety *laxifolia* was reintroduced at Honokōhau Falls (four seedlings) and six seedlings were reintroduced at Hana‘ula Springs, Ukumehame (Oppenheimer 2018). In 2013 on O‘ahu, five individuals of variety *princeps* were reintroduced to Mānoa, but by 2015, only one remained (Ching-Harbin et al. 2015; PEPP 2014). In 2018 on O‘ahu, 17 reintroduced individuals of variety *princeps* were monitored at Poamoho (Togikawa et al. 2018).

- In 2016 on Maui, Hale NP reported reintroduction of six individuals of variety *laxifolia* to Kaupō (Hale NP 2020).

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

Date	No. wild individuals	No. outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization Criteria Completed?
1994 (listing)	var. <i>anomala</i> : 45 (Kaua‘i) 0 (O‘ahu) var. <i>laxifolia</i> : ca 100 (Maui) 5 (Moloka‘i) 0 (Hawai‘i) var. <i>longibracteata</i> : 130–1,000 (Kaua‘i) unknown (O‘ahu) var. <i>princeps</i> : 16–20 inds (O‘ahu)	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	Unknown

1999 (recovery plan)	var. <i>anomala</i> : 97 (Kaua'i) 0 (O'ahu) var. <i>laxifolia</i> : 78–88 (Maui) 5 (Moloka'i) 0 (Hawai'i) var. <i>longibracteata</i> : 400–1,400 (Kaua'i) unknown (O'ahu) var. <i>princeps</i> : 50–150 inds (O'ahu)	0	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Unknown
2003 (critical habitat)	var. <i>anomala</i> : unknown (Kaua'i) var. <i>laxifolia</i> : 5 (Moloka'i) 118 (Maui) var. <i>longibracteata</i> : unknown # (Kaua'i) 0 (O'ahu) var. <i>princeps</i> : 130–180 (O'ahu)	0	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Unknown

2010 (5-year review)	var. <i>anomala</i> : 45–55 (Kaua‘i) var. <i>laxifolia</i> : 27 (Maui) var. <i>longibracteata</i> : sev 1,000 (Kaua‘i) var. <i>princeps</i> : 130 (O‘ahu)	Unknown	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2012 (critical habitat, O‘ahu)	var. <i>princeps</i> : 159–232 (O‘ahu)	Unknown	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2013 (5-year review)	var. <i>anomala</i> : 5–10 (Kaua‘i) var. <i>laxifolia</i> : 29+ (Maui) var. <i>longibracteata</i> : sev 1,000 (Kaua‘i) var. <i>princeps</i> : 206 mature 193 immature (O‘ahu)	var. <i>laxifolia</i> : total 494 since 2010 (Maui)	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Partially, 2 populations >50
2016 (critical habitat, Maui Nui)	var. <i>laxifolia</i> : ca 70 (Maui)	var. <i>laxifolia</i> : ca 500 (Maui)	All threats managed in all 3 populations	Partially

			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Partially, not for Maui
Date	No. wild individuals	No. outplanted	*Preventing Extinction Criteria identified by HPPRCC	*Preventing Extinction Criteria Completed?
2021 (5-year review)	var. <i>anomala</i> : ca 25 mature 3 immature (Kaua'i) var. <i>laxifolia</i> : 16 (Maui) var. <i>longibracteata</i> : ca 110 (Kaua'i) 5 (O'ahu) var. <i>princeps</i> : 64 mature 102 immature (O'ahu)	var. <i>anomala</i> : 8 mature 60 immature 61 died (Kaua'i) var. <i>laxifolia</i> : 33, 3 died (Maui) var. <i>princeps</i> : 252, 34 remain (O'ahu)	All threats managed in all 3 populations	Partially, ungulate exclosures at Pahole, Kalena, Wai'eli, 'Ēkahanui, and Poamoho (O'ahu), Wainiha (Kaua'i), Pana'ewa, Kaua'ula, Hale NP, Ko'olau Gap-Waikamoi (Maui); nonnative plant control at Pahole, 'Ēkahanui, Wai'eli, Mānoa (O'ahu) Honokōhau, Ukumehame, Kaua'ula, 'Īao, Pōhākea (Maui)
			Complete genetic storage	Partial, nearly complete for var. <i>princeps</i> (O'ahu)
			Natural reproduction at all 3 populations	Partial, recruitment var. <i>anomala</i> observed Kahuama'a Flats (Kaua'i)

			3 populations with 50 mature individuals each	No, possibly 1 population var. <i>longibracteata</i> (Kaua'i), reproduction unknown
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* The Preventing Extinction Stage was established in 2011. Prior to 2011, the Interim Stabilization Stage was the first stage towards recovery (now it is the second stage after Preventing Extinction).

Table 2. Threats to *Plantago princeps* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Degradation and destruction of habitat by feral ungulates	A	Ongoing	Partial, exclosures at Pahole, Kalena, Wai'eli, 'Ēkahanui, and Poamoho (O'ahu), Wainiha (Kaua'i), Pana'ewa, Kaua'ula, Hale NP, Ko'olau Gap-Waikamoi (Maui)
Established ecosystem altering invasive plant species degradation of habitat	A	Ongoing	Partial, nonnative plants controlled at Pahole, 'Ēkahanui, Wai'eli, Mānoa (O'ahu) Honokōhau, Ukumehame, Kaua'ula, 'Īao, Pōhākea (Maui)
Degradation and destruction by fire	A	Ongoing	Partial, fire management plan for military training area on O'ahu
Degradation and destruction by landslides	A	Ongoing	None
Predation and herbivory by rats	C	Ongoing	Partial, rat control at 'Ēkahanui (O'ahu)
Predation and herbivory by invertebrates—slugs, snails, Chinese rose beetle, black twig borer	C	Ongoing	None
Reduced viability due to low numbers	E	Ongoing	Partial, seed collection, propagation, reintroduction and translocation for vars. <i>anomala</i> , <i>laxifolia</i> , and <i>princeps</i>
Climate change	E	Ongoing	Partial, reintroductions

Synthesis:

Currently, there are 25 mature and 3 immature wild *Plantago princeps* var. *anomala* (Kaua'i), 16 mature wild *P. princeps* var. *laxifolia* (Maui), 115 wild *P. princeps* var. *longibracteata* (Kaua'i, O'ahu), and 64 mature and 102 immature wild *P. princeps* var. *princeps* (O'ahu). Seed collections from all varieties of wild and reintroduced plants are ongoing, with propagation and some reintroductions on Kaua'i, O'ahu, and Maui. Five areas on O'ahu, four areas on Maui, and one area on Kaua'i are protected by ungulate exclosures with some nonnative plant control. Rats are controlled at one area on O'ahu.

Stabilizing (interim), downlisting, and delisting objectives were provided in the Recovery Plan for the Multi-Island Plants (USFWS 1999) and have been updated according to the draft revised recovery objective guidelines developed by the Hawai'i and Pacific Plants Recovery Coordinating Committee a (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.

Plantago princeps is a short-lived perennial herb or shrub. 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 a total of three populations should be documented on one or more islands 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. There are 25 wild mature individuals remaining of the variety *anomala* on Kaua'i, 16 wild mature individuals of variety *laxifolia* on Maui, 110 wild mature individuals of variety *longibracteata* on Kaua'i and 5 on O'ahu, and 64 wild mature individuals of variety *princeps* on O'ahu; however, variety *laxifolia* extirpated from Moloka'i and Hawai'i and populations continue to decline. Although hundreds of individuals of all varieties except for var. *longibracteata* have been reintroduced, survival is poor, and only one individual of var. *anomala* was observed as a natural recruit. There is almost complete genetic representation for variety *princeps*, but representation is incomplete for the other varieties (Table 1). There are some exclosures for ungulate control on O'ahu, Maui, and Kaua'i; however, not all threats are being addressed (Table 2). Therefore, *Plantago princeps* meets the definition of Endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

No significant new information regarding the species' biological status has been reported since the last 5-year review in 2013. Thus, the following recommendations for future actions are reiterated for the 5-year review for 2021.

- Surveys and inventories—Continue surveys of geographical and historical range for a current assessment of the species' status.
- Ungulate control—Continue to construct and maintain existing exclosures at all populations and monitor for incursions.
- Invasive nonnative plant monitoring and control—Continue to control invasive introduced plants within exclosures and at all wild and reintroduced populations.
- Predator and herbivore monitoring and control—Implement effective measures to control rats and slugs and determine and implement effective control methods for nonnative insects.
- Fire prevention and control—Implement existing fire management plan for O'ahu and develop and implement fire management plans for occurrences on Maui and Kaua'i.
- Captive propagation for genetic storage and reintroduction—Continue collection of genetic resources of all varieties for storage, propagation, and reintroduction.
- Reintroduction and translocation—
 - Continue reintroductions and augmentations into suitable habitat in areas that are managed for known threats.
 - Increase numbers of populations and individuals within suitable habitat to reduce impacts from landslides, small populations, and climate change.
- Climate change adaptation strategy—Research suitability of habitat for reintroduction of this species in the future due to impacts of climate change, including landslides.
- Taxonomic and genetic research—Continue to assess genetic and morphological variability within extant populations of all varieties to better inform recovery efforts.
- Alliance and partnership development—Continue to work with partners and other land managers in planning and implementation of ecosystem-level restoration and management to benefit this taxon.

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U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of *Plantago princeps*
(laukahi kuahiwi, ale)

Pre-1996 DPS listing still considered a listable entity? N/A

Recommendation resulting from the 5-year review:

- Delisting
- Reclassify from Endangered to Threatened status
- Reclassify from Threatened to Endangered status
- X No Change in listing status

For Field Supervisor, Pacific Islands Fish and Wildlife Office

Date _____