

Plantago princeps
(laukahi kuahiwi)

**5-Year Review
Summary and Evaluation**

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

5-YEAR REVIEW

Species reviewed: *Plantago princeps* (laukahi kuahiwi)

TABLE OF CONTENTS

1.0	GENERAL INFORMATION	1
1.1	Reviewers	1
1.2	Methodology used to complete the review:.....	1
1.3	Background:	1
2.0	REVIEW ANALYSIS.....	3
2.1	Application of the 1996 Distinct Population Segment (DPS) policy	3
2.2	Recovery Criteria	4
2.3	Updated Information and Current Species Status	5
2.4	Synthesis.....	7
3.0	RESULTS	15
3.3	Recommended Classification:	15
3.2	New Recovery Priority Number:	15
3.3	Listing and Reclassification Priority Number:	15
4.0	RECOMMENDATIONS FOR FUTURE ACTIONS.....	15
5.0	REFERENCES.....	15
	Signature Page.....	19

5-YEAR REVIEW
***Plantago princeps* / laukahi kuahiwi**

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office:

Region 1, Endangered Species Program, Division of Recovery, Jesse D'Elia,
(503) 231-2071

Lead Field Office:

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor, (808)
792-9400

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 (USFWS), beginning on April 29, 2008. The review was based on the final critical habitat designation for *Plantago princeps* and other species from the islands of Kauai, Molokai, Maui and Oahu as well as a review of current, available information (USFWS 2003a-d). The National Tropical Botanical Garden provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The evaluation of Tamara Sherrill, biological consultant, was reviewed by the Plant Recovery Coordinator. The document was then reviewed by the Assistant Field Supervisor for Endangered Species and Acting Deputy Field Supervisor before submission to the Field Supervisor for approval.

1.3 Background:

1.3.1 Federal Register (FR) Notice citation announcing initiation of this review:

USFWS. 2008. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 70 species in Idaho, Montana, Oregon, Washington, and the Pacific Islands. Federal Register 73(83): 23264-23266.

1.3.2 Listing history

Original Listing

FR notice: USFWS. 1994. Endangered and threatened wildlife and plants; endangered status for 12 plants from the Hawaiian Islands; final rule. Federal Register 59(217):56333-56351.

Date listed: November 10, 1994

Entity listed: Species

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 rule makings :

USFWS. 2003a. Endangered and threatened wildlife and plants; final designation or nondesignation of critical habitat for 95 plant species from the islands of Kauai and Niihau, Hawaii; final rule. Federal Register 68(39):9116-9479.

USFWS. 2003b. Endangered and threatened wildlife and plants; final designations and nondesignations of critical habitat for 42 plant species from the island of Molokai, Hawaii; final rule. Federal Register 68(52):12982-13141.

USFWS. 2003c. Endangered and threatened wildlife and plants; designation of critical habitat for 60 plant species from the Islands of Maui and Kahoolawe, Hawaii; final rule. Federal Register 68(93):25934-26165.

USFWS. 2003d. Endangered and threatened wildlife and plants; final designation or nondesignation of critical habitat for 101 plant species from the island of Oahu, Hawaii; final rule. Federal Register 68(116):35949-35998.

USFWS. 2003e. Endangered and threatened wildlife and plants; final designation or nondesignation of critical habitat for 46 plant species from the island of Hawaii, Hawaii; final rule. Federal Register 68(116):39623-39722.

Critical habitat was designated for *Plantago princeps* in four units totaling 724 hectares (1,787 acres) on Kauai (USFWS 2003a), one unit totaling 52 hectares (129 acres) on Molokai (USFWS 2003b), two units totaling 491 hectares (1,213 acres) on Maui (USFWS 2003c), and five units totaling 1,419 hectares (3,504

acres) on Oahu (USFWS 2003d). These designations include habitat on State, Federal, and private lands (USFWS 2003a-d). Critical habitat was not proposed for the island of Hawaii because the species no longer occurs on that island and habitat essential to its conservation was not possible to identify (USFWS 2003e).

1.3.4 Review History:

Species status review [FY 2009 Recovery Data Call (August 2009)]:
Stable

Recovery achieved:

1 (0-25%) (FY 2007 Recovery Data Call – this is the last year this was reported)

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 plan for multi-island plants. U.S. Fish and Wildlife Service, Portland, Oregon. 206 pages plus appendices.

Date issued: July 10, 1999.

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 criteria?

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 (Factors A, C, D, and E) affecting this species is presented in section 2.4. Factor B (overutilization for commercial, recreational, scientific, or educational purposes) is not known to be a threat to this species.

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for the multi-island plants (USFWS 1999), based on whether the species is an annual, a short-lived perennial (fewer than 10 years), or a long-lived perennial. *Plantago princeps* is a short-lived perennial, and to be considered stabilized, which is the first step in recovering the species, the taxon must be managed to control threats (*e.g.*, fenced, weeding, etc.) and be represented in an *ex situ* (at other than its original site, *e.g.*, a nursery or arboretum) collection. In addition, a minimum of three populations should be documented on islands where they now occur or occurred historically. Each of these populations must be naturally reproducing and increasing in number, with a minimum of 50 mature individuals per population.

This recovery objective has not been met.

For downlisting, a total of five to seven populations of *Plantago princeps* should be documented on islands where they now occur or occurred historically. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with a minimum of 300 mature individuals per population. Each population should persist at this level for a minimum of five consecutive years before downlisting is considered.

This recovery objective has not been met.

For delisting, a total of eight to ten populations of *Plantago princeps* should be documented on islands where they now occur or occurred historically. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with 300 mature individuals per population for short-lived perennials. Each population should persist at this level for a minimum of five consecutive years before delisting is considered.

This recovery objective has not been met.

2.3 Updated Information and Current Species Status

In addition to the status summary table below, information on the species' status and threats was included in the final critical habitat rule referenced above in section 1.3.3 ("Associated Rulemakings") and in section 2.4 ("Synthesis") below, which also includes any new information about the status and threats of the species.

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

Date	No. wild individuals	No. outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization Criteria Completed?
1994 (listing)	300-1,200	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	Unknown
1999 (recovery plan)	640-1,750	0	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Unknown
2003 (critical habitat)	795-973	0	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Unknown
2009 (5-year review)	several thousand		All threats managed	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

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:

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

2.3.1.4 Taxonomic classification or changes in nomenclature :

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.):

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

2.3.1.7 Other:

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:

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

2.3.2.3 Disease or predation:

2.3.2.4 Inadequacy of existing regulatory mechanisms:

2.3.2.5 Other natural or manmade factors affecting its continued existence:

2.4 Synthesis

Significant new information is available on the genetic relationships and evolution of Hawaiian *Plantago* species. Dunbar-Co *et al.* (2008) presented the theory that a single Kauai ancestor, most likely a herbaceous *Plantago pachyphylla* (manene) type, arrived from either North America or Rapa, and following establishment on Kauai, dispersed several million years ago, to the next oldest volcanoes such as Waianae on western Oahu and Koolau on eastern Oahu where it then diversified. From Koolau, *Plantago* would have dispersed to Molokai or Maui and, finally to the island of Hawaii, since all of the volcanoes comprising the Maui Nui complex were at one time connected by land bridges (Dunbar-Co *et al.* 2008).

Wagner recognized three species and four varieties of *Plantago*: *P. pachyphylla*, *P. hawaiiensis* (laukahi kuahiwi), and *P. princeps* var. *anomala*, *P. princeps* var. *laxifolia*, *P. princeps* var. *longibracteata*, and *P. princeps* var. *princeps* (Wagner *et al.* 1999). There is disagreement, however, regarding their relationships and the number of taxa that should be recognized. Apparently frequent hybridization occurs in areas where different species are found in close proximity of each other, causing

morphological differences within and between them to be confusing. By using habitat, growth form, leaf arrangement, attachment, pubescence, and the position of the flower relative to the spike, Dunbar-Co differentiated 13 distinct morphotypes. Greenhouse experiments carried out in conjunction with her study indicated that these differences are genetically based and not simply as a result of phenotypic plasticity. Additionally, Dunbar-Co found that within Hawaiian *Plantago* species, growth form appears to be correlated with habitat; woody forms being found mostly in forest and shrubland habitats and herbaceous forms found in open bogs or on wet ridge tops (Dunbar-Co *et al.* 2008).

One result of this work may be a taxonomic realignment of *Plantago* subsp. *longibracteata*. Dunbar-Co *et al.* (2008) suggests that this subspecies should be considered a distinct species because of its unique woody, prostrate form, its fully fertile pollination system, and its probable hybrid origin. The putative parents are the shrubby *P. princeps* var. *anomala* and a herbaceous *P. pachyphylla* form, both of which occur in the Alakai area. In the Alakai area, gene flow may have been considerable, with close proximity of woodland, riparian, and bog habitats.

Other findings in the same study suggest that *Plantago princeps* var. *laxifolia* from Iao (West Maui) and Kipahulu (East Maui) hybridizes with nearby *P. pachyphylla*. Populations of *P. princeps* var. *laxifolia* occur in valleys directly below the mountain summits where *P. pachyphylla* populations are found and gene flow between them may have been frequent when *P. princeps* var. *laxifolia* was more common. The study also suggests that *P. princeps* var. *laxifolia* evolved from *P. princeps* var. *princeps* following dispersal from Koolau to Maui Nui. Genetic differences between Waianae and Koolau populations of *P. princeps* var. *princeps* also suggest the possibility that they are diverging into separate species (Dunbar-Co *et al.* 2008).

When the species was listed in 1994, all four varieties totaled 300 to 1,200 individuals State-wide in 18 populations (USFWS 1994).

Plantago princeps var. *anomala* was known historically from a ridge west of the Hanapepe River on Kauai and in upper Pohakuao. Currently, it is known on Kauai from one population of 30 to 40 individuals on Mt. Kahili, on cliffs above Kahili Ridge Trail, observed in February 2005 (Perlman 2008a). It is also known from scattered locations on the rim of Kalalau Valley, where 15 individuals were seen on the south side of the valley in 2000 (Perlman 2008a), and several clumps were seen on steep slopes of the east side of the valley between the two Kalalau lookouts, next to the Kalalau Rim rare plant sanctuary, in May 2006 (National Tropical Botanical Garden 2009a).

Historically, *Plantago princeps* var. *laxifolia* was known from East Molokai in Waikolu, Olokui, Kamakou, and Pelekunu. One hundred individuals were last seen on Molokai, East Kawela Valley at 841 meters (2,759 feet) elevation in 1994. Only 20 individuals were observed at that location in 2001. None were seen there in 2007 (Perlman 2008b).

Plantago princeps var. *laxifolia* was known historically from West Maui. In 2001, about 20 or more individuals were seen in Iao Valley, in a gulch to the north of Iao Needle, at 411 meters (1,350 feet) elevation (Perlman 2008b), and at Nakalaloa Stream in 1991 (Hawaii Biodiversity and Mapping Program 2009). In 2008, seven individuals were observed in Kauaula Valley at 1,163 to 1,167 meters (3,816 to 3,830 feet) elevation by the waterfall (H. Oppenheimer, Plant Extinction Prevention Program, pers. comm. 2008; Perlman 2008b).

On East Maui, *Plantago princeps* var. *laxifolia* is known from as many as five populations in Haleakala National Park between 914 and 2,134 meters (3,000 and 7,000 feet) elevation. These include: Kipahulu Valley at 960 meters (3,150 feet) in 1988 (Hawaii Biodiversity and Mapping Program 2009), Kipahulu, Palikea Gulch at 939 meters (3,080 feet) in 1994 (Perlman 2008b); the west side of Kaupo Gap at 2,073 meters (6,802 feet) in 1991 (Perlman 2008b); Koolau Gap south of Waikau at 2,042 meters (6,700 feet) in the 1980s (Hawaii Biodiversity and Mapping Program 2009); and Waikau, near Koolau gap in Haleakala crater at 2,225 meters (7,300 feet) elevation in 1991. There may have been an additional East Koolau population near the old Waikau cabin (A. Medeiros, U.S. Geological Survey, pers. comm. 2008). None of these locations have reported occurrences since the 1990s.

Plantago princeps var. *laxifolia* was also known historically on the island of Hawaii in Kohala and Hamakua, but has not been seen since the 1800s (USFWS 1999).

Plantago princeps var. *longibracteata* was known historically from Hanalei, the Wahiawa Mountains, and Hanapepe Falls on Kauai. In 1999, there were six populations on Kauai at Namolokama, Iliiliula drainage, Wainiha Valley, Waioli Valley, and Waialeale with an estimated 400 to 1,400 individuals (USFWS 1999). Currently, most of these locations still contain *P. princeps* var. *longibracteata*, except possibly the bogs of Namolokama, where Ken Wood of the National Tropical Botanical Garden only mentions observing *Plantago pachyphylla*, (Wood 2000; National Tropical Botanical Garden 2009b). Several thousand individuals were observed at Waialeale Summit Bogs in 2006 and 2007 (Perlman 2008c; National Tropical Botanical Garden 2009b). In the very back of Wainiha Valley below Hinalele falls, about 100 individuals were observed in 2004 (Perlman 2008c; National Tropical Botanical Garden 2009b; Wood and Perlman 1993). Plants were also seen in Hanakapiai Valley, in a big bowl to the east of the falls, on a back wall of the seeping cliff in 1999 (Perlman 2008c). Steve Perlman found several hundred individuals at Iliiliula's south waterfall in 1994. In 2004, Ken Wood of National Tropical Botanical Garden found only approximately 50 individuals in Iliiliula (Perlman 2008c; Hawaii Biodiversity and Mapping Program 2009).

Four historical locations of *Plantago princeps* var. *longibracteata* on Kauai, with no recent observations, include Blue Hole, at the base of Mt. Waialeale, on the north fork of the Wailua river, where 100 scattered individuals were seen in December 1998 (Perlman 2008c); the back of Waioli Valley, at the base of the waterfalls and wet

cliffs, where 20 to 30 individuals were seen in November 1992 (Lorence and Flynn 1993); and the Upper Hanalei Valley, below Pohakupele, where 40 to 50 individuals were seen in 1993 (Perlman 2008c).

Plantago princeps var. *longibracteata* occurred historically on Oahu in the Koolau Mountains on Oahu, it was last observed in 1976 (USFWS 1999).

Historically, *Plantago princeps* var. *princeps* was known from locations in both the Koolau and Waianae Mountains of Oahu. The most recent observations in the Koolau Mountains are at the Manana summit area, in a stream area below the peaks, to north of the Manana Trail, at 629 meters (2,060 feet) elevation where two individuals were seen in 2000 (Perlman 2008d); Nuuanu Valley, on cliffs below the Manoa Cliff Trail, where one individual was seen in 2008 (Perlman 2008d; U.S. Army Garrison 2006); and in Waiawa where 16 mature individuals, 17 immature individuals, and 50 seedlings were observed (U.S. Army Garrison 2006).

In the Waianae Mountains of Oahu, *Plantago princeps* var. *princeps* occurred in at least nine locations: North Mohiakea, on the Army's Schofield Barracks Military Reservation, West Range, containing ten mature individuals, two immature individuals, and 11 seedlings (U.S. Army Garrison 2006); North Palawai Gulch (previously referred to erroneously as Napepeiauolelo) (Hawaii Biodiversity and Mapping Program 2009) at about 792 meters (2,600 feet) elevation, containing two individuals in 2000 (Perlman 2008d); Palikea on a ridge above Lualualei where 30 individuals were seen in 1997 (Perlman 2008d), and one mature individual and one seedling in 2006 (U.S. Army Garrison 2006); Makua Valley, on the cliffs of Ohikilolo, at 783 meters (2,570 feet) elevation where eight individuals were seen in 1993 (Perlman 2008d), and 12 mature and 14 immature individuals were seen in 2006 (U.S. Army Garrison 2006). At Ekahanui Gulch, one mature individual and two seedlings were seen in 2001 (Perlman 2008d), but the Army Environmental staff reported 34 mature individuals, 50 immature individuals, and 36 seedlings there in 2006 (U.S. Army Garrison 2006). Army Environmental staff on Oahu also reported two mature individuals, ten immature individuals, and four seedlings at Pahole; 40 mature and five immature individuals at Konahuanui; and ten mature individuals, 17 immature individuals, and 11 seedlings at Halona (U.S. Army Garrison 2006).

Currently, *Plantago princeps* var. *princeps* is found in the following locations in the Waianae Mountains: North Mokiakea (10 mature, 16 immature, 2 seedlings); Ohikilolo (11 mature); Pahole (2 mature, 6 immature, 6 seedlings); Ekahanui (29 mature, 37 immature, 7 seedlings); Halona (29 mature, 43 immature); North Palawai (1 mature, 2 immature); and Waieli (8 mature, 17 immature reintroduced) (U.S. Army Garrison 2008).

In summary, *Plantago princeps* is currently known from several thousand individuals in 22 populations on the islands of Kauai, Oahu, Maui, and Hawaii. Only two of these populations have more than 50 individuals, and both of these populations are of *P. princeps* var. *longibracteata*, including the only significant population of several

thousand at Waialeale. According to the most recent observations, *P. princeps* var. *anomala* has at least two populations with at least 45 to 55 individuals on Kauai; *P. princeps* var. *laxifolia* has two populations with 27 individuals on West Maui; *P. princeps* var. *longibracteata* has at least four populations with several thousand individuals on Kauai; and *P. princeps* var. *princeps* has approximately 14 populations with 130 mature individuals on Oahu. Surveys are needed to determine whether *P. princeps* var. *laxifolia* has been extirpated on Molokai.

Plantago princeps subsp. *anomala* on Kauai grows in *Metrosideros polymorpha* (ohia) montane wet forest with associated plant species including *Artemisia kauaiensis* (ahinahina), *Boehmeria grandis* (akolea), *Broussaisia arguta* (kanawao), *Chamaesyce eleanoriae*, *C. remyi* (akoko), *Cheirodendron trigynum* (olapa), *Cibotium* sp. (hapuu), *Cryptocarya mannii* (holio), *Cyanea* spp. (haha), *Dicranopteris linearis* (uluhe), *Diplazium sandwicense* (hoio), *Dodonaea viscosa* (aalii), *Dubautia laevigata*, *D. plantaginea* (naenae), *Exocarpos luteolus* (heau), *Ilex anomala* (kawau), *Kadua affinis* (manono), *Leptecophylla tameiameiae* (pukiawe), *Lobelia yuccoides* (panaunau), *Lysimachia kalalauensis* (no common name [NCN]), *Melicope* spp. (alani), *Myrsine linearifolia* (kolea), *Nestegis sandwicensis* (olopua), *Nothoestrum peltatum* (aiea), *Perrottetia sandwicensis* (olomea), *Pleomele aurea* (hala pepe), *Poa siphonoglossa* (NCN), *Pouteria sandwicensis* (alaa), *Pritchardia minor* (loulu), *Psychotria greenwelliae*, *P. mariniana* (kopiko), *Remya montgomeryi* (NCN), *Sadleria cyatheoides* (amau), *Scaevola procera* (naupaka kuahiwi), *Stenogyne campanulata* (NCN), *Syzygium sandwicense* (ohia ha), *Tetraplasandra flynnii* (NCN), *Wilkesia gymnoxiphium* (iliau), and *Xylosma hawaiiense* (ae) (National Tropical Botanical Garden 2009a; Perlman 2008a). In the Mt. Kahili area, the habitat is *Metrosideros polymorpha* lowland wet forest and cliff with *Bidens forbesii* (kookoolau), *Carex wahuensis* (NCN), *Eragrostis variabilis* (kawelu), *Hibiscus kokio* subsp. *kokio* (aloalo), *Kadua affinis*, *Machaerina angustifolia* (uki), *Pipturus* sp. (mamake), *Scaevola procera*, *Tetraplasandra bisattenuata* (NCN), and *T. flynnii* (National Tropical Botanical Garden 2009a; Perlman 2008a).

The habitat for *Plantago princeps* var. *laxifolia* on West Maui's Iao Valley and gulch to the north of Iao Needle is *Metrosideros polymorpha* wet shrubland and cliff with *Bidens micrantha* (kookoolau), *Dubautia plantaginea* ssp. *humilis* (naenae), *Kadua formosa* (NCN), *Lysimachia remyi* (NCN), *Pisonia* sp. (papala kepau), *Pittosporum* sp. (hoawa), *Pritchardia glabrata* (loulu), and *Psychotria mauiensis* (kopiko). In Nakalaloa, it occurs on the back wall of Iao Valley, where the habitat is *Metrosideros polymorpha* wet forest with *Boehmeria grandis*, *Cheirodendron* sp., *Cyrtandra* sp. (haiwale), *Perrottetia sandwicensis* (olomea), *Psychotria* sp. (kopiko), and *Touchardia latifolia* (olona). In Waikau, near Koolau gap in Haleakala Crater, *Plantago princeps* var. *laxifolia* occurs at 2,225 meters (7,300 feet) elevation on wet cliffs where the associated species include *Artemisia mauiensis* (ahinahina), *Coprosma montana* (pilo), *Dubautia menziesii* (naenae), *Leptecophylla tameiameiae*, *Lobelia grayana* (NCN), *Metrosideros polymorpha*, *Sophora chrysophylla* (mamane), and *Vaccinium* sp. (ohelo) (Perlman 2008b).

In the Kaua'ula Valley, the habitat is *Metrosideros polymorpha* wet forest with *Broussaisia arguta*, *Cheirodendron* sp., *Pipturus* sp., and *Sadleria cyatheoides* (Perlman 2008b). At Iliili'ula, *Plantago princeps* var. *laxifolia* occurs in its lowland wet mixed forest habitat with riparian vegetation, on vertical walls of waterfall region with *Antidesma platyphylla* (hame), *Bobea brevipes* (ahakea lau lili), *Boehmeria grandis*, *Cheirodendron fauriei* (olapa), *Cyrtandra confertiflora* (haiwale), *Metrosideros polymorpha* var. *glaberrima* (ohia), *Perrottetia sandwicensis*, *Pipturus albidus*, *P. ruber*, and *Syzygium sandwicensis* (Hawaii Biodiversity and Mapping Program 2009).

Plantago princeps var. *longibracteata* occurs on Kauai in Wainiha Valley, in *Metrosideros polymorpha* wet forest and shrubland habitat with *Athyrium* sp. (akolea), *Boehmeria grandis*, *Carex alligata* (NCN), *Cyrtandra paludosa* (moa), *Isachne pallens* (NCN), *Kadua centranthoides* (NCN), *Lipochaeta connata* var. *acris* (nehe), *Machaerina angustifolia*, *Perrottetia sandwicensis*, *Peperomia* sp. (ala ala wai nui), and *Pipturus albidus* (Perlman 2008c).

On Oahu, *Plantago princeps* var. *princeps* occurs in two different habitat types. In the Waianae Mountains it is found on cliff faces and ledges with mostly native mesic vegetation consisting predominantly of grasses, sedges, herbs, and shrubs. Associated native plant species include *Artemisia australis*, *Bidens* sp., *Chamaesyce* sp., *Dubautia plantaginea*, *Eragrostis* sp., *Lysimachia* sp., *Pilea peploides* (NCN), and *Viola chamissoniana* subsp. *chamissoniana* (pamakani). Historical occurrences in the southeastern Koolau Mountains were also found in mesic cliff habitats. The cliffs of Ohikilolo in the Makua Valley are degraded *Metrosideros polymorpha* forest and shrubland with *Artemisia* sp., *Bidens torta*, *Carex* sp., *Chamaesyce multiformis* (akoko), *Diospyros* sp. (lama), *Dubautia plantaginea*, *Eragrostis variabilis*, *Kadua cordata* subsp. *remyi* (kopa), *Lysimachia hillebrandii* (kolokolo kuahiwi), *Pipturus* sp., *Perrottetia sandwicensis*, *Rumex albescens* (huahuako), *Sophora chrysophylla*, and *Stenogyne kaalae* (NCN) (Perlman 2008d). Ekahanui gulch habitat includes *Bidens torta* (kookoolau), *Dianella sandwicensis* (uki uki), *Dubautia plantaginea*, *Lysimachia* sp., *Metrosideros polymorpha*, *Myrsine lessertiana* (kolea lau nui), and *Viola chamissoniana* subsp. *trachelifolia* (olopu) (Perlman 2008d). Palikea Gulch is degraded *Acacia koa* - *Metrosideros polymorpha* cliff with *Alyxia* sp., *Carex wahuensis*, *Coprosma longifolia* (pilo), *Kadua parvula* (NCN), *Labordia kaalae* (kamakahala), *Lysimachia lydgatei* (NCN), *Nestegis sandwicensis*, *Panicum beecheyi* (NCN), *Psychotria* sp., *Schiedea ligustrina* (NCN), *Silene perlmanii* (NCN), and *Zanthoxylum kauaense* (ae) (Perlman 2008d).

In contrast to the mesic habitat, the Waiawa population on Oahu occurs on a streamside embankment in wet, rainforest habitat close to the Koolau summit ridge, an area with the highest precipitation on Oahu (USFWS 2003c), including sides of waterfalls or wet rock faces. The associated native plant species include *Bidens* spp., *Nertera granadensis* (makole), *Eugenia* sp. (nioi), *Lobelia gaudichaudii* (NCN), *Metrosideros rugosa* (lehua papa), and *Scaevola glabra* (ohe naupaka) (USFWS 2007).

Goats (*Capra hircus*) (Factor A) and landslides (Factor E) threaten this species on Kauai. Invasive introduced plant species (Factor E) including *Blechnum appendiculatum* (NCN), *Erigeron karvinskianus* (daisy fleabane), *Rubus argutus* (prickly Florida blackberry), *Passiflora tarminiana* (banana poka), and *Fragaria vesca* (strawberry) compete with *Plantago princeps* var. *anomala* around the Kalalau rim and Wainiha valley areas. On Mt. Kahili, invasive introduced plant species (Factor E) include *Schinus terebinthifolius* (Christmas berry), *Lantana camara* (lantana), and *Setaria parviflora* (NCN) (National Tropical Botanical Garden 2006; Perlman 2008a).

In West Maui, invasive introduced plant species that threaten *Plantago princeps* (Factor E) include *Tibouchina herbacea* (glorybush), *Ageratina adenophora* (sticky snakeroot) and *Casuarina equisetifolia* (ironwood) (Perlman 2008b).

Plantago princeps var. *princeps* is present in both the Makua and Schofield Barracks military action areas in Ohikilolo, Pahole, and North Mokiikea that are at risk from training-related wildfires (Factor E) (USFWS 2003c). Many areas are vulnerable to non-military related fires as well (Factor E). Fire burned native vegetation in parts of Ekahanui near the Halona population during the summer of 2005 (U.S. Army Garrison 2005). In addition, *P. princeps* var. *princeps* is vulnerable to natural events such as rockslides and hurricanes (Factor E) (USFWS 2007). Invasive alien plant species (Factor E) in the Palikea and north Palawai areas include *Schinus terebinthifolius* and *Ageratina adenophora*; at Palikea *Morella faya* (firetree) and *Passiflora suberosa* (corky stem passion flower); and at Palawai with *Erigeron karvinskianus* covering almost the whole cliff. Invasive plants (Factor E) at Ekahanui include *Schinus terebinthifolius* and *Psidium cattleianum* (strawberry guava) (Perlman 2008d).

On Oahu, rat (*Rattus rattus*) predation on fleshy stems and leaves (Factor C) is a problem in Honouliuli Preserve, and may have caused the near disappearance of the North Palawai population. The Army also lists various species of introduced slugs and snails, Chinese rose beetle (*Adoretus sinicus*), and black twig borer (*Xylosandrus compactus*) as pests of this species on military lands (Factor C) (U.S. Army Garrison 2005, USFWS 2007).

Reduced reproductive vigor due to small population size and limited distribution (Factor E) create a high background risk of species extinction for *Plantago princeps* var. *princeps*, and any additional threats could reduce expectation of its long-term persistence (USFWS 2007). Climate change may also pose a threat to all varieties of *P. princeps* (Factors A and E). However, current climate change models do not allow us to predict specifically what those effects, and their extent, would be for this species.

The U.S. Army is expending considerable efforts and resources to protect, preserve, and enhance the natural populations of endangered species, including *Plantago*

princeps, on military lands on Oahu. Army Environmental staff plans to manage four populations at Ohikilolo, Kalena, Ekahanui (within the Nature Conservancy's Honouliuli Preserve), and Halona (on State land in Nanakuli) for stability, and two populations, Palawai (within Honouliuli Preserve) and Pahole (within Pahole NAR) for genetic storage collections (U.S. Army Garrison 2007).

Ongoing conservation actions include fencing to control ungulates in Ohikilolo and Pahole, starting in 2007, to be completed by 2015. A major part of the Ohikilolo management unit is protected by a boundary ridgeline fence, and feral goats (*Capra hircus*) have been virtually eradicated from Makua (U.S. Army Garrison 2005). Invasive introduced plant species control is ongoing. Genetic storage of seeds is being done, with 41 individuals from all nine populations represented to meet goals outlined in the Makua Implementation Plan. Ten plants were growing in the Army nursery (U.S. Army Garrison 2005; USFWS 2007).

Haleakala National Park reintroduced into the park 22 *Plantago princeps* var. *laxifolia* individuals from five wild plants in 2007 and 40 individuals from four wild plants in 2008, and has more seed and plants in their nursery (Haleakala National Park 2007, 2008).

In the early 1990s seed from all four varieties was collected from populations on three islands and put into long term storage at the National Tropical Botanical Garden on Kauai, and in 2006 more seed of *Plantago princeps* var. *laxifolia* from Maui was stored at Harold L. Lyon Arboretum on Oahu (Center for Conservation Research and Training Seed Storage Facility 2008; National Tropical Botanical Garden 2009c, d). At the National Tropical Botanical Garden, there are around 5,000 seeds of *P. princeps* var. *anomala* from Kalalau and Pohaku on Kauai, 1,500 seeds of *P. princeps* var. *laxifolia* from Iao Valley, Haleakala, and Kipahulu on Maui, 200 seeds of *P. princeps* var. *longibracteata* from Blue Hole, Kauai, and 1,400 seeds of *P. princeps* var. *princeps* from North Palawai Ditch, the Waianae Mountains, Lualualei, and Pahole Gulch on Oahu (National Tropical Botanical Garden 2009c,d). It is unknown whether these seeds are still viable. There are additionally 40 seeds in storage of *P. princeps* var. *laxifolia* collected in 2006 from Iao Valley, Maui on Oahu at the Harold L. Lyon Arboretum (Center for Conservation Research and Training Seed Storage Facility 2008).

The Olinda Rare Plant Facility has three plants of *Plantago princeps* var. *laxifolia* from Iao Valley, Maui in its nursery (Olinda Rare Plant Facility 2009). On Oahu, *P. princeps* var. *princeps* has been successfully cloned from seed and seedlings from Pahole (Harold L. Lyon Arboretum 2009).

The interim stabilization goals for this species have not been met as only two populations are documented to contain more than 50 individuals and not all threats are being managed (see Table 1). Therefore, *Plantago princeps* meets the definition of endangered as it remains in danger of extinction throughout its range.

3.0 RESULTS

3.3 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

- Continue collection of fruit and plant material for future reintroductions.
- Establish new populations within protected habitats.
- Reassess the taxonomic status of all varieties of *Plantago princeps*. If taxonomy changes are needed, update the listed entity on 50 CFR 17 to match the currently recognized taxonomy.
- Survey historical locations on East Maui and Molokai for *Plantago princeps* var. *laxifolia*.
- Survey historical locations on Oahu for *Plantago princeps* var. *longibracteata*.
- Work with the U.S. Army Garrison, the Hawaii Division of Forestry and Wildlife, and other landowners to continue implementation of ecosystem-level restoration and management to benefit this species.

5.0 REFERENCES

Center for Conservation Research and Training Seed Storage Facility. 2008. Seed conservation lab database report for *Plantago princeps*. University of Hawaii at Manoa, Honolulu, Hawaii. Unpublished.

- Dunbar-Co, S., Wieczorek, A.M. and Morden, C.W. 2008. Molecular phylogeny and adaptive radiation of the endemic Hawaiian *Plantago* species (Plantaginaceae). *American Journal of Botany* 95(9):1177-1188.
- Haleakala National Park. 2007. Controlled propagation report to the U.S. Fish and Wildlife Service. Haleakala National Park, Kipahulu, Hawaii. 2 pages. Unpublished.
- Haleakala National Park. 2008. Controlled propagation report to the U.S. Fish and Wildlife Service. Haleakala National Park, Kipahulu, Hawaii. 15 pages. Unpublished.
- Harold L. Lyon Arboretum Micropropagation Laboratory. 2009. Micropropagation database. University of Hawaii at Manoa, Honolulu, Hawaii. Unpublished.
- Hawaii Biodiversity and Mapping Program. 2009. Program database. University of Hawaii, Center for Conservation, Research and Training, Honolulu, Hawaii. Unpublished.
- Lorence, D.H., and T. Flynn. 1993. Botanical survey of upper Waioli Valley, Kauai, submitted to the State of Hawaii, Department of Land and Natural Resources. National Tropical Botanical Garden, Lihue, Hawaii. 38 pages. Unpublished.
- National Tropical Botanical Garden. 2006. Living collections catabase. National Tropical Botanical Garden, Unpublished.
- National Tropical Botanical Garden. 2009a. Provenance report 060490 for *Plantago princeps* and accession records for all *Plantago princeps*, Kalaheo, Hawaii. Unpublished.
- National Tropical Botanical Garden. 2009b. Herbarium database report for *Plantago princeps* var. *longibracteata*. National Tropical Botanical Garden, Kalaheo, Hawaii. Available online at <<http://ntbg.org/herbarium/>>. Accessed 4 December 2009.
- National Tropical Botanical Garden. 2009c. Native seed inventory. National Tropical Botanical Garden, Kalaheo, Hawaii. Unpublished.
- National Tropical Botanical Garden. 2009d. Controlled propagation report to U.S. Fish and Wildlife Service. National Tropical Botanical Garden, Kalaheo, Hawaii. 48 pages. Unpublished.
- Olinda Rare Plant Facility. 2009. Controlled propagation report to U.S. Fish and Wildlife Service. Department of Land and Natural Resources, Division of Forestry and Wildlife, Olinda, Hawaii. 1 page. Unpublished.
- Perlman, S. 2008a. Field notes on *Plantago princeps* var. *anomala*. National Tropical Botanical Garden, Kalaheo, Hawaii. 3 pages. Unpublished.

- Perlman, S. 2008b. Field notes for *Plantago princeps* var. *laxifolia*. National Tropical Botanical Garden, Kalaheo, Hawaii. 3 pages. Unpublished.
- Perlman, S. 2008c. *Plantago princeps* var. *longibracteata* field notes summary. National Tropical Botanical Garden, Kalaheo, Hawaii. 3 pages. Unpublished.
- Perlman, S. 2008d. *Plantago princeps* var. *princeps*. National Tropical Botanical Garden, Kalaheo, Hawaii. 2 pages. Unpublished.
- U.S. Army Garrison. 2005. 2005 Status report for the Makua implementation plan, island of Oahu. U.S. Army Garrison, Directorate of Public Works, Environmental Division, Schofield Barracks, Hawaii. 334 pages.
- U.S. Army Garrison. 2006. 2006 Status reports for the Makua implementation plan and the draft Oahu implementation plan. U.S. Army Garrison, Directorate of Public Works Environmental Division, Schofield Barracks, Hawaii. 534 pages.
- U.S. Army Garrison. 2007. 2007 Status reports for the Makua implementation plan and the draft Oahu implementation plan. United States Army Garrison, Directorate of Public Works, Environmental Division, Schofield Barracks, Hawaii. 611 pages.
- U.S. Army Garrison. 2009. 2009 Status Reports for the Makua and Oahu Implementation Plans. United States Army Garrison, Directorate of Public Works, Environmental Division, Schofield Barracks, Hawaii. 711 pages.
- [USFWS] U. S. Fish and Wildlife Service. 1994. Endangered and threatened wildlife and plants; endangered status for 12 plants from the Hawaiian islands. Federal Register 59(217):58333-56351.
- [USFWS] U.S. Fish and Wildlife Service. 1999. Recovery plan for the multi-island plants. U.S. Fish and Wildlife Service. Portland, Oregon. 206 pages + appendices.
- [USFWS] U.S. Fish and Wildlife Service. 2002. Endangered and threatened wildlife and plants; designations of critical habitat for plant species from the island of Hawaii, Hawaii; proposed rule. Federal Register 67(102):36968-37106.
- [USFWS] U.S. Fish and Wildlife Service. 2003a. Endangered and threatened wildlife and plants; designation of critical habitat for 60 plant species from the islands of Maui and Kahoolawe, Hawaii; final rule. Federal Register 68(93):25934-26165.
- [USFWS] U.S. Fish and Wildlife Service. 2003b. Endangered and threatened wildlife and plants; final designation or nondesignation of critical habitat for 95 plant species from the islands of Kauai and Niihau, Hawaii; final rule. Federal Register 68(39):9116-9479.

- [USFWS] U.S. Fish and Wildlife Service. 2003c. Endangered and threatened wildlife and plants; final designation or nondesignation of critical habitat for 101 plant species from the island of Oahu, Hawaii; final rule. Federal Register 68(116):35949-35998.
- [USFWS] U.S. Fish and Wildlife Service. 2003d. Endangered and threatened wildlife and plants; final designations and nondesignations of critical habitat for 42 plant species from the island of Molokai, Hawaii; final rule. Federal Register 68(52):12982-13141.
- [USFWS] U.S. Fish and Wildlife Service. 2003e. Endangered and threatened wildlife and plants; final designation or nondesignation of critical habitat for 46 plant species from the island of Hawaii, Hawaii; final rule. Federal Register 68(116):39623- 39722.
- [USFWS] U.S. Fish and Wildlife Service. 2007. Reinitiation of the 1999 biological opinion of the U.S. Fish and Wildlife Service for U.S. Army military training at Makua Military Reservation, island of Oahu, Honolulu, Hawaii. 639 + appendices. Unpublished.
- Wagner, W.L., D.R. Herbst and S.H. Sohmer. 1999. Plantaginaceae. Pages 1,048-1,055 in Manual of the flowering plants of Hawaii; revised edition. University of Hawaii Press, Honolulu, Hawaii.
- Wood, K.R. 2000. Lumahai, Namolokama, and Laau Ridge, Kauai, Hawaii; personal observations and checklist of vascular plants with topographical mapping. National Tropical Botanical Garden, Kalaheo, Hawaii. 37 pages. Unpublished.
- Wood, K.R. and S. Perlman. 1993. Rare and endangered flora of Wainiha. National Tropical Botanical Garden technical report, sierra club legal defense fund under pew charitable trusts biodiversity grant, Kalaheo, Hawaii. Unpublished.

Personal Communications

- Oppenheimer, Hank. 2008. Plant Extinction Prevention Program, Maui Nui Coordinator, Lahaina, Hawaii. E-mail to Margaret Clark, National Tropical Botanical Garden, dated January 2, 2009. Subject: *Plantago princeps* var. *laxifolia*.
- Medeiros, Art C. 2008. Botanist, U.S. Geological Survey, Makawao, Hawaii. E-mail to Margaret Clark, National Tropical Botanical Garden, dated October 20, 2008. Subject: *Plantago princeps* var. *laxifolia*.

Signature Page
U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Plantago princeps*/ (laukahi kuahiwi)

Current Classification: _____ E _____

Recommendation resulting from the 5-Year Review:

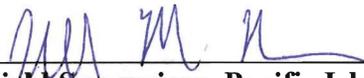
- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: _____

Review Conducted By:

Marie Bruegmann, Plant Recovery Coordinator
Marilet A. Zablan, Assistant Field Supervisor for Endangered Species
Jeff Newman, Acting Deputy Field Supervisor

Approved _____

Jul 

Field Supervisor, Pacific Islands Fish and Wildlife Office

Date **AUG 27 2010**