Haplostachys haplostachya
(Honohono)

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: *Haplostachys haplostachya* (Honohono)

TABLE OF CONTENTS

5-YEAR REVIEW
Haplostachys haplostachya (Honohono)

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 8, 2010. The review was based on final critical habitat designation for *Haplostachys haplostachya* and other species from the island of Hawaii (USFWS 2003a), as well as a review of current, available information. The Bernice Pauahi Bishop Museum 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 Samuel Aruch, biological consultant, was reviewed by a recovery biologist and the Plant Recovery Coordinator. The document was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species 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] U.S. Fish and Wildlife Service. 2010. Endangered and threatened wildlife and plants; 5-year review status of 69 species in Idaho, Washington, Hawaii, Guam, and the Commonwealth of the Northern Mariana Islands. Federal Register 75(67):17947-17950.

1.3.2 Listing history

Original Listing
FR notice: USFWS. 1979. Endangered and threatened wildlife and plants; determination that three Hawaiian plants are endangered; final rule. Federal Register 44(211):62468-62470.
Date listed: October 30, 1979
Entity listed: Variety
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:

No critical habitat has been designated for *Haplostachys haplostachya*.

1.3.4 Review History:

Species status review [FY 2010 Recovery Data Call (August 2010)]: Increasing

Recovery achieved:
1 (0-25%) (FY 2007 Recovery Data Call)

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

The Recovery Priority number for *Haplostachys haplostachya* is currently 2 (based on the USFWS scale of 1 to 18); however, since this is the only extant species within this endemic Hawaiian genus, in this 5-year review we are elevating the Recovery Priority number to 1, as this is effectively a monotypic species.

1.3.6 Current Recovery Plan or Outline

Name of plan or outline: USFWS. 1993. Draft recovery plan for *Haplostachys haplostachya* and *Stenogyne angustifolia*. U.S. Fish and Wildlife Service, Portland, Oregon. 55 pages. Available online at <http://www.fws.gov/pacificislands/recoveryplans.html>.
Date issued: September 20, 1993
Dates of previous revisions, if applicable: N/A

2.0 REVIEW ANALYSIS

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

2.1.1 Is the species under review a vertebrate?

_____***Yes***
__X__ ***No***

2.1.2 Is the species under review listed as a DPS?

____ ***Yes***
__X_ ***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***
__X_ ***No***

2.2 Recovery Criteria

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

____ ***Yes***
__X_ ***No***

2.2.2 Adequacy of recovery criteria.

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

____ ***Yes***
__X_ ***No***

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

__X_ ***Yes***
____ ***No***

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

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

Stabilization, downlisting, and delisting objectives are provided in the draft recovery plan for *Haplostachys haplostachya* and *Stenogyne angustifolia* (USFWS 1993). The stabilization objectives, which are the first step in recovering the species, are to increase and stabilize population sizes and numbers.

This recovery objective has been partially met.

For the taxon to be downlisted from endangered to threatened status, existing habitat on the Island of Hawaii must be secured and managed to perpetuate the species at those locations and three additional populations of *Haplostachys haplostachya* must be reestablished in secure, managed habitat on Maui and Kauai.

This recovery objective has not been met.

For delisting, the downlisting targets must be met. In addition, threats must be reduced or eliminated to allow 17 populations of *Haplostachys haplostachya* to reproduce naturally on Hawaii, Maui and Kauai. The 17 populations must be stable or increasing and they should be comprised of an adequate number of reproductive, self-regenerating adults to produce a mixture of reproductive stages (i.e., seedlings, juveniles, and adults) adequate to ensure the self-perpetuation of the populations.

This recovery objective has not been met.

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:

Pollination vectors, longevity, seed viability, and dispersal mechanisms are unknown (USFWS 1993; CEMML 2003, USFWS 2010b). Although it was unknown whether the species was self-compatible or required cross fertilization, it was observed that fruit set was between 70 and 95 percent,

and seed crops range from 30 to 536 seeds per square meter, with 51 to 655 seeds per plant (USFWS 1993). The woody nutlet coat suggests that the fruit persists intact for long periods in the soil (USFWS 1993). *Haplostachys haplostachya* is able to both re-sprout and regenerate from seed after low and moderate intensity fires (Beavers and Burgan 2002), suggesting some fire resistance (CEMML 2003; USFWS 2010b). The species is probably aided by its preference for rocky slopes, where fires are less intense due to low fuel loads (Arnett 2002; CEMML 2003; USFWS 2010b). However, fire coupled with drought appears to affect the species' ability to maintain population numbers (CEMML 2003; USFWS 2010b).

In some cases, genetic material is maintained vegetatively when seed germination is poor (U.S. Army 2009). Poor germination had been reported in the draft recovery plan (USFWS 1993), where 500 seeds, half scarified and half unscarified, were planted, and only three of the scarified seeds and none of the unscarified seeds germinated. The problem apparently is one of seed dormancy, and the physiological requirements to break it are not yet understood (CEMML 2006).

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:

Haplostachys haplostachya was previously recorded on Kauai, Maui (sandy isthmus and Kula), and Hawaii Island (Nohonaohae, Cinder Cone, Puukapele, and Waikii) (Wagner *et al*. 1999). Currently it is only known to occur on Hawaii Island (USFWS 2010a).

Since its rediscovery at Pohakuloa Training Area on Hawaii Island in 1977 (USFWS 1993), *Haplostachys haplostachya* was federally listed as endangered in 1979 (under the name *H. haplostachya* var. *angustifolia*) (USFWS 1979); no population numbers or individual counts were included in the listing. The draft recovery plan (USFWS 1993) reported 14 populations restricted to a 2,000 hectare (5,000 acre) area in Pohakuloa Training Area; again, there were no individual counts, but two of the populations were said to number more than 100 individuals, and all populations appeared to be healthy.

Shaw (1997) estimated over 20,000 individuals at Pohakuloa Training Area, while Evans *et al*. (2002) estimated numbers to be between 25,000 and 30,000 in four to five populations. Significant new populations of *Haplostachys haplostachya* were located during a rare plant survey of the Keamuku Parcel; approximately 8,822 individuals were located in the southeast corner of the parcel in very rugged terrain unsuited for military

exercises, and another 10 individuals were found on Puu Nohonaohae, representing a significant range extension (Arnett 2002). Overall, there were 274 locations totaling an estimated 8,832 individuals (Arnett 2002). In 2003, another population (from an undisclosed location) was found at Pohakuloa Training Area, consisting of 71 adults and 322 juveniles (Anonymous 2003). An estimate of 25,150 to 30,200 individuals at Pohakuloa Training Area was provided in 2003 by the Center for Environmental Management of Military Lands, compared to a USFWS estimate of 34,000 to 39,000 individuals, in five to six populations (CEMML 2003). At that time it appeared that four populations at Pohakuloa Training Area might be qualified as stabilized, at least from a population size standpoint (a minimum of 50 mature individuals per population): Keamuku Parcel (over 8,000 individuals); northwest of Puu Ahi in Training Area 13 (over 5,000 individuals); Puu Ka Pele (over 250 individuals); and Kipuka Kalawamauna (over 50 individuals) (CEMML 2003). At the end of 2007, the Pohakuloa Training Area census was 21,815 to 24,094 plants, in 12 Areas of Species Recovery units (CEMML 2008), and in 2009 there were 12 populations reported totaling approximately 17,000 individuals (USFWS 2010b). As of 2010, the listed census for *H. haplostachya* is two populations at Puu Nohonaohae and Keamuku, containing over 10,000 individuals (USFWS 2010a).

Several factors make point-in-time population estimates of *Haplostachys haplostachya* somewhat unreliable in determining current and future population health and demographics, including annual rainfall patterns and management activities (CEMML 2008). The species may be sensitive to drought (CEMML 2003; USFWS 2010b); individuals probably die back to the roots during the dry season, and plants that appear dead may actually persist for several years (USFWS 1993). On the other hand, following significant rainfall in late November and early December 2007, the resulting prolific flush of seedlings and juvenile plants precluded counts of all individuals (CEMML 2008). Ungulate browse can be heavy, leaving few or no adults to be counted at monitoring locations in unfenced units; likewise, there is lower mortality and greater vigor of individuals of *H. haplostachya* in weed-controlled, fenced areas as compared to unfenced monitoring sites (CEMML 2008). New monitoring methods implemented in 2007 were to provide better data for charting the overall health of the population and its long-term viability (CEMML 2008).

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

Using phylogenetic analyses of DNA sequence data, Lindqvist and Albert (2002) evaluated the hypothesized origin of the three endemic genera of Hawaiian mints (*Haplostachys*, *Phyllostegia*, *Stenogyne*) from its supposedly closely related East Asian relatives. Surprisingly, Lindqvist

and Albert discovered that the Hawaiian mints were most closely related to a group of temperate North American *Stachys* from the Pacific coast, suggesting that they were derived from a single colonization event from western North America to the Hawaiian Islands. Furthermore, the Hawaiian genera were found to be monophyletic but deeply nested inside the genus *Stachys*, and Lindqvist and Albert suggested that it would be biologically logical to transfer *Haplostachys*, *Phyllostegia*, and *Stenogyne* into the genus *Stachys*, in the strict sense defined in their paper. They point out that it would be a nomenclaturally daunting task, as 26 of the 60 specific epithets of recognized Hawaiian mints already exist in *Stachys* and new epithets would have to be provided for them. A potential alternative would be to retain the three genera of Hawaiian mints (whose common ancestor was of hybrid origin), but to describe new genera for other recognized lineages of hybrid origin within *Stachys* (Lindqvist and Albert 2002). As of 2012, no nomenclatural changes have been published.

Noting that *Haplostachys haplostachya* was once thought to be contiguous in its xerophytic shrubland habitat in the saddle between Mauna Loa and Mauna Kea, but now is fragmented into isolated subpopulations by virtue of grazing pressure by feral ungulates, habitat destruction due to military activities, and conversion of forest to pasturelands, Morden and Loeffler (1999) investigated whether these subpopulations were becoming genetically different by virtue of their isolation, and whether smaller subpopulations were becoming genetically less fit by virtue of a smaller gene pool. Using random amplified polymorphic DNA (RAPD) markers, plants were sampled from two large (containing more than 1,000 individuals) subpopulations at Puu Ka Pele and Kipuka Kalawamauna (both fenced habitats), and at Puu Leilani, an unfenced cinder cone with (at the time) contained only 14 individuals of *H. haplostachya*. Results showed that the Puu Leilani subpopulation had a lower level of genetic variation, as expected, likely as the consequence of genetic and demographic factors following human-caused environmental perturbations. Such genetic depauperization is linked to inbreeding depression, a precursor to extirpation or extinction. The authors strongly recommended the genetic evaluation of potential sources of rare plant germplasm to ensure that sources with the highest levels of genetic variation are used in conservation efforts (Morden and Loeffler 1999).

2.3.1.4 Taxonomic classification or changes in nomenclature:

Haplostachys haplostachya was originally collected from Maui during the U.S. Exploring Expedition in 1840. The species was described by Asa Gray in 1862 as *Phyllostegia haplostachya* (USFWS 1993; CEMML 2003). Gray also described a variety from Kauai, *P. haplostachya* var. *leptostachya*. Hillebrand (1888) erected a new genus, *Haplostachys*, and synonymized Gray's *P. haplostachya* under a new name, *Haplostachys*

grayana. Hillebrand also accepted Gray's *P. haplostachya* var. *leptostachya* under *H. grayana*. Sherff (1934) described a third variety, *H. grayana* var. *angustifolia*, from Hawaii Island. St. John (1973, as cited in USFWS 1993), recognizing that Hillebrand had created an illegitimate name when he synonymized *P. haplostachya* and created the new epithet *grayana* rather than using the available *haplostachya*, published new combinations for all three varieties: *H. haplostachya* var. *haplostachya*, *H. haplostachya* var. *angustifolia*, and *H. haplostachya* var. *leptostachya*. The varieties are distinguishable by leaf morphology (CEMML 2003), but Wagner *et al*. (1999) did not accept any of them, and all variants are currently known as *Haplostachys haplostachya*.

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.):

No new information.

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

Haplostachys haplostachya is typically found in dry exposed areas on ash-veneered lava, very stony, shallow soils, and lava outcrops. It often establishes in large cracks on rocky ridges and on cinder cones on Hawaii Island. It is found in *Euphorbia* sp. (akoko) forest, open *Metrosideros polymorpha* (ohia) forest with dense shrub understory, open *Dodonaea viscosa* (aalii) shrubland, *Dodonaea viscosa* mixed shrubland, *Myoporum sandwicense* (naio) shrubland, and *Myoporum sandwicense—Dodonaea viscosa* shrubland vegetation types. The taxon occurs almost exclusively on old Mauna Kea flows, with a single population on Mauna Loa pahoehoe lava (USFWS 2010b; Shaw 1997; Arnett 2002; CEMML 2003). Associated native species at Pohakuloa Training Area include *Chenopodium oahuense* (aweoweo), *Bidens menziesii* (kookoolau), *Dodonea viscosa*, *Dubautia menziesii* (naenae), *D. linearis* (naenae), *Eragrostis atropioides* (kawelu), *Euphorbia olowaluana* (akoko), *Hesperocnide sandwicnesis* (No common name [NCN]), *Leptecophylla tameiameiae* (pukiawe), *Melanthera venosa* (nehe), *Metrosideros polymorpha*, *Myoporum sandwicense*, *Osteomeles anthyllidifolia* (ulei), *Pseudognaphalium sandwicensium* (enaena), *Sicyos* sp. (anunu), *Sida fallax* (ilima), *Silene lanceolata* (catchfly), *Sophora chrysophylla* (mamane), *Stenogyne angustifolia* (NCN), *S. microphylla* (NCN), *Tetramalopium arenarium* (NCN), *T. consanquineum* (NCN), *Vaccinium reticulatum* (ohelo), and *Zanthoxylum hawaiiense* (ae) (USFWS 1993; National Tropical Botanical Garden 2011a, b).

2.3.1.7 Other:

No new information.

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:

Threats:

- Ungulate degradation of habitat (Arnett 2002; CEMML 2003; USFWS 2010b)
  - Feral sheep (*Ovis aries*)
  - Goats (*Capis hirca*)
  - Rooting by feral pigs (*Sus scrofa*)
- Established ecosystem-altering invasive plant species degradation of habitat (Arnett 2002; CEMML 2003; USFWS 2010b)
  - *Pennisetum setaceum* (fountain grass)
- Agricultural and urban development (Morden and Loeffler 1999)

Current conservation efforts:

- Ungulate exclosures:
  - As of 2009, approximately 97 percent of known *H. haplostachya* individuals are located within ungulate-free fenced units that were constructed and maintained by the U.S. Army (USFWS 2010b). Existing fenced units include the following: Kipuka Kalawamauna Fence Unit (754 hectares [1,863 acres]); Puu Ka Pele Fence Unit (45 hectares [111 acres]), *Haplostachys haplostachya* Fence Unit; Puu Nohonaohae Fence Unit (127 hectares [314 acres]) (CEMML 2003; U.S. Army 2009).
  - Additionally, an effort is underway to complete large fence units around the concentration of federally listed plant species on the west and southwest side of Pohakuloa Training Area, as instructed in the 2003 USFWS Biological Opinion (USFWS 2003b). These contiguous fence units will enclose approximately 7,921 hectares (19,572 acres) and consist of 101 kilometers (63 miles) of fencing (U.S. Army 2009). Approximately 18 kilometers (11 miles) of fencing was completed by the end of 2007 (approximately 17.1 percent of

the planned total) (CEMML 2008), and fencing is scheduled for completion in 2011 or 2012 (CEMML 2008).

  - A number of emergency fences were erected in 2007 in Areas of Species Recovery 5, 8, and 10 following heavy rains in late November and early December 2007, when a flush of healthy, vigorous *H. haplostachya* seedlings emerged in the unfenced habitats. These temporary fences are designed to minimize or eliminate browse and potentially preserve a fraction of the seed set and overall genetic variation of the *H. haplostachya* population (CEMML 2008).

- Ungulate control – At Pohakuloa Training Area surveys for feral ungulates occurred within the fenced units (CEMML 2008). Fewer than 12 feral pigs were estimated in the Kipuka Alala Fence Units, and 4 feral goats were detected during aerial hunts. A single goat was observed and removed from the *Haplostachys haplostachya* Fence Unit, making it ungulate-free. Another goat was observed in the Kipuka Kalawamauna East Fence Unit. Until recently, ungulates were not a concern in the Puu Ka Pele Fence Unit, but in 2007 seven goats were detected and removed from the unit, whose fence is only 1.2-meters (4.0-feet) high. The latest survey detected no animals in Puu Ka Pele. *Haplostachys haplostachya* populations occur in all of these fenced units except for Kipuka Alala. The expectation was for the fence units to be ungulate-free in 2008 (CEMML 2008; USFWS 2003a; U.S. Army 2009).

- Ecosystem-altering invasive plant species control – At Pohakuloa Training Area invasive species are controlled; they are developing a weed management plan and establishment of procedures to control and monitor invasive and noxious species; and education of troops entering the training area about invasive introduced species (CEMML 2003).

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

This is not a threat.

2.3.2.3 Disease or predation:

Threats:

- Ungulate predation or herbivory – Shaw (1997) and Arnett (2002) have noted that ungulates browse primarily on floral parts, and that the foliage does not appear to be palatable, with the exception of re-sprouting vegetative parts following fire.

- Invertebrate predation or herbivory – Aphids has been noted on individuals located in the Keamuku Parcel and under greenhouse conditions (Arnett 2002; CEMML 2003; USFWS 2010b).
- Disease – A mildew problem has been noted on individuals located in the Keamuku Parcel and under greenhouse conditions (Arnett 2002; CEMML 2003; USFWS 2010b).

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Threats:

- Lack of adequate hunting regulation in areas with ungulates – The lack of adequate ungulate control and the existence of established hunting programs in areas where *Haplostachys haplostachya* occurs outside of the National Park Service continue to threaten this species.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Threats:

- Hiking and trail maintenance – Monitoring of *Haplostachys haplostachya* within Area of Species Recovery 6 on Puu Ka Pele, located on loose ash substrate on steep slopes, was suspended due to substantial erosion problems caused by the monitoring activities; weed control activities were likely causing similar damage (CEMML 2008).
- Fire – Fuel load provided by *Pennisetum setaceum*, coupled with military activity increases the threat of fire to the species (Arnett 2002; CEMML 2003; USFWS 2010b). A wildfire starting on private land spread south to the U.S. Army's Keamuku Parcel in June 2007, burning approximately 100 hectares (250 acres) of the latter and threatening the fenced Puu Nohonaohae rare plant exclosure, including a small population of *Haplostachys haplostachya* (CEMML 2008).
- Drought (CEMML 2003; USFWS 2010b).
- Military activities – Some populations at Pohakuloa Training Area are impacted by Army training activities (Arnett 2002; CEMML 2003; USFWS 2010b).
- Climate change may pose a threat to this species. However, current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these

spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Current conservation efforts:

- Surveys / inventories – Field surveys to identify new populations of threatened and endangered plant species in previously unsurveyed areas and areas of suitable habitat were conducted on Hawaii Island (USFWS 2003a; U.S. Army 2009).
- Compliance and enforcement – Stewardship of *Haplostachys haplostachya* and other endangered plants at Pohakuloa Training Area was mandated in the USFWS's 2003 Biological Opinion for Routine Military Training and Transformation of the 2nd Brigade 25th Infantry Division (Light), and the U.S. Army's Integrated Natural Resources Management Plan (USFWS 2003b). *Haplostachys haplostachya* is protected from military activities on Pohakuloa Training Area by a 100 meter (328 feet) buffer; soldiers are provided with maps indicating sensitive areas and sites restricted to off-road vehicle maneuvers, and provided with field cards explaining not to cut, remove, or damage vegetation; and fencing is in place or planned for some locations (CEMML 2003).
- Captive propagation for genetic storage and reintroduction:
    - Seeds are collected for storage at the National Seed Storage Laboratory at Colorado State University, and occasionally used for seed germination tests.
    - National Tropical Botanical Garden (2011c) reported hundreds of seeds in storage.
    - Pohakuloa Training Area (2011) reported 90 individuals in controlled propagation from Pohakuloa Training Area, representing 90 wild individuals.
    - Volcano Rare Plant Facility (2011, 2010) reported two individuals in controlled propagation [in previous years, Volcano Rare Plant Facility (2008, 2009) totals were: 2009, 500 seeds in refugia from a single wild individual; 2008, 4,483 seeds from 3 wild individuals from Puu Ka Pele (Pohakuloa Training Area), and 146 seeds from a single wild individual from Puu Anahulu].
    - Hawaii Volcanoes National Park (2011) reported 214 seeds and 33 individuals in controlled propagation from Pohakuloa Training.
    - The Center for Conservation Research and Training (2010) reported 40 seeds sown, with 2 seeds remaining in storage, but no current micropropagation efforts are underway for this species at the Harold L. Lyon Arboretum (2010).

- Reintroduction / translocation protocol development – Pohakuloa Training Area houses a climate-controlled greenhouse and a plant holding compound to acclimate plants scheduled for reintroduction to conditions more similar to those they will encounter in the wild (USFWS 2003a).
- Reintroduction / translocation site identification – The U.S. Army's reintroduction goal is to increase the number and distribution of rare plant taxa in their known historic range. Besides reintroducing individuals at Pohakuloa Training Area, an immediate goal is to establish two off-site, easily accessible reintroduction sites per species to serve as genetic storage, and to learn and understand species-specific habitat preferences. A site is deemed suitable if 50 percent or more of the individuals survive and at least 50 percent healthy vigor is achieved (U.S. Army 2009).
- Reintroduction / translocation site selection – For *H. haplostachya*, the U.S. Army's three main off-installation reintroduction sites are Puuhuluhulu, Kipuka Oweowe, and Puuwaawaa Cone Unit, which all are located on State lands managed by the Department of Lands and Natural Resources, Division of Forestry and Wildlife (U.S. Army 2009).
- Reintroduction / translocation implementation:
    - For the following years, Pohakuloa Training Area participated in the following: 2007, 10 reintroductions (4 Kipuka Oweowe, 6 Puuwaawaa); 2009, 238 reintroductions (64 Kona Veterans Cemetery, 119 Puuwaawaa, 23 Puuhuluhulu, 32 Pohakuloa Training Area) (Pohakuloa Training Area 2007, 2009); 2010, 47 reintroductions (20 National Tropical Botanical Garden Kaupulehu Preserve, 21 Puuwaawaa, 4 Kipuka Oweowe, 2 Puuhuluhulu) (Pohakuloa Training Area 2010).
    - The National Tropical Botanical Garden (2010) reported 55 reintroductions at Pohakuloa Training Area.
    - The Volcano Rare Plant Facility (2010) reported 20 reintroductions at Puu Ka Pele.
- Reintroduction / translocation population management and monitoring:
    - The Biological Opinion required the Army to collect, grow, and establish enough material of *H. haplostachya* to adequately replace plants anticipated to be impacted by construction of a Battle Action Course needed for the Stryker Brigade Combat Team transformation; it was anticipated that 392 individuals (1 to 1.2 percent of the total population) would be affected (CEMML 2006). In 2007, only three severely stressed individuals were found and relocated to the Pohakuloa Training

Area nursery (CEMML 2008). One survived the translocation, and was producing seed. Another three translocated individuals produced approximately 1,400 seeds in 2006 (CEMML 2008).

- Reintroductions of 6 individuals in 2007 brought *H. haplostachya* reintroduction totals to 26 at four sites since 2003 (CEMML 2008). Only 1 of 10 reintroductions was still surviving after four years at Kipuka Kalawamauna East Outplanting 5, although a single recruit was noted in 2007 (CEMML 2008). None of the six reintroductions at Puuhuluhulu survived until the end of 2007, and 10 reintroductions at Puuwaawaa and Kipuka Oweowe had not yet been monitored (CEMML 2008).

- Population viability monitoring – Surveyed annually as per Biological Opinion requirements, due to ungulates and drought, the zone has not supported the 200 to 300 individuals reported in 2002, and in 2007 only three severely stressed individuals were found (CEMML 2008). Higher than average rainfall in late 2007 promoted germination in wild populations, but no updated population census was available.

- Conservation finance – As part of a Section 7 consultation for a Saddle Road realignment that would help offset the potential loss of *Haplostachys haplostachya* individuals, the Federal Highway Administration agreed to contribute $50,000 to Hawaii Volcanoes National Park to sponsor the establishment of three populations of *H. haplostachya* in protected areas within the Kahuku portion of the Park and within the estimated ecological range of this species (USFWS 2010b).

- Alliance and partnership development – Involved in the development and execution of the Pohakuloa Implementation Plan are 20 biologists from 11 organizations/agencies representing the U.S. Army; USFWS; U.S. Forest Service; National Park Service; U.S. Geological Service; Research Corporation, University of Hawaii; Center for Environmental Management of Military Lands, Colorado State University; Volcano Rare Plant Facility; DLNR, DOFAW; and Rana Productions (U.S. Army 2009). Among their tasks are the following: identify action areas for species management; estimate the minimum viable population for rare taxa at Pohakuloa Training Area; determine definitions of success for population viability of rare taxa; develop reintroduction and augmentation protocols for rare plant taxa; determine how to achieve the greatest possible genetic representation for each plant taxon; determine and execute habitat improvements (*e.g.*, control of invasive introduced plants, feral ungulates, rodents, invertebrates, dust, etc.); and develop an invasive plant

management plan to reduce and control the threats of incipient weeds and enhance habitat quality (U.S. Army 2009).

- Fire protection – In 2003, the Pohakuloa Training Area completed an Integrated Wildland Fire Management Plan to reduce the threat of wildfires (U.S. Army Garrison 2009). In June 2012, Pohakuloa Training Area drafted a revision of their 2003 Integrated Wildland Fire Management Plan (CEMML 2012)..

2.4 Synthesis

The downlisting goals for this species have only been partially met. All known populations of *Haplostachys haplostachya* exist at Pohakuloa Training Area, containing over 10,000 individuals (Table 1). The majority of these populations are fenced and managed to control threats, and there is good representation in *ex situ* collections (Table 2). However, no additional populations of *H. haplostachya* have been reestablished in a secured, managed habitat on the islands of Maui and Kauai. Therefore, *Haplostachys haplostachya* meets the definition of endangered as it remains in danger of extinction throughout its range.

Table 1. Status of *Haplostachys haplostachya* from listing through 5-year review.

Date	No. wild individuals	No. outplanted	Downlisting Criteria identified in Draft Recovery Plan	Downlisting Criteria Completed?
1991 (listing)	Unknown	Unknown	Secure and manage existing habitat on Hawaii Island	No
			Secure and manage three additional populations on Maui and Kauai	No
1998 (recovery plan)	Unknown	Unknown	Secure and manage existing habitat on Hawaii Island	No
			Secure and manage three additional populations on Maui and Kauai	No
2003 (critical habitat)	25,150 - 39,000	Unknown	Secure and manage existing habitat on Hawaii Island	No
			Secure and manage three additional populations on Maui and Kauai	No
2012 (5-year review)	>10,000	370	Secure and manage existing habitat on Hawaii Island	Partially (see Table 2)
			Secure and manage three additional populations on Maui and Kauai	No

Table 2. Threats to *Haplostachys haplostachya* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulates – Degradation of habitat and herbivory	A, C, D	Ongoing	Partially: Ungulate exclosures and Ungulate control at Pohakuloa Training Area
Established ecosystem-altering invasive plant species degradation of habitat	A	Ongoing	Partially: Ecosystem-altering invasive plant species control at Pohakuloa Training Area
Agricultural and urban development	A	Ongoing	Partially: Compliance and enforcement and alliance and partnership development at Pohakuloa Training Area
Invertebrate predation or herbivory	C	Ongoing	No
Disease	C	Ongoing	No
Hiking and trail maintenance	E	Ongoing	Yes: At Pohakuloa Training Area
Fire	E	Ongoing	Partially: Fire protection at Pohakuloa Training Area
Drought	E	Ongoing	No
Military activities	E	Ongoing	Partially: Compliance and enforcement and alliance and partnership development at Pohakuloa Training Area
Climate change	A, E	Increasing	No

3.0 RESULTS

3.1 Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
____ *Extinction*
____ *Recovery*
____ *Original data for classification in error*
__X__ No change is needed

3.2 New Recovery Priority Number:

Brief Rationale:

3.3 Listing and Reclassification Priority Number:

Reclassification (from Threatened to Endangered) Priority Number: ____
Reclassification (from Endangered to Threatened) Priority Number: ____
Delisting (regardless of current classification) Priority Number: ____

Brief Rationale:

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Captive propagation for genetic storage and reintroduction:
  - Continue to collect cuttings or seed from tagged individuals, keeping close track of the maternal source for use in ex situ propagation.
  - Continue to collect seeds from all existing populations and send to at least two or three different venues for propagation and storage.
- Reintroduction / translocation implementation – Continue to reintroduce the species back into its known historical range.
- Reintroduction / translocation protocol development – Continue efforts to establish appropriate reintroduction sites outside of Pohakuloa Training Area to achieve the goal of establishing populations on the islands of Maui and Kauai.
- Surveys / inventories – Continue to conduct surveys for new populations, both within the Pohakuloa Training Area and other habitats where the species has been found historically.
- Population viability monitoring – Continue to annually monitor population structure, vigor, demography, and phenology to better understand how to manage the species.
- Ungulate exclosures:
  - Complete large fence units associated with the Pohakuloa Training Area and remove any ungulates remaining inside the fence.
  - Monitor existing fences for any signs of breaching.
- Ungulate control – Continue to protect all populations against browsing and disturbances from feral ungulates.
- Established ecosystem-altering invasive plant species control – Continue to control established ecosystem-altering invasive plant species around all populations.
- Reintroduced /translocated population management and monitoring – Continue to monitor reintroduction sites for successful establishment and recruitment to better determine optimum reintroduction habitats for the species.
- Threats research – Study *Haplostachys haplostachya* populations with regard to threats of invertebrate herbivory and mildew disease.
- Site / area / habitat protection – Develop and implement effective measures to reduce the impacts of urban and agricultural development, hiking and trail maintenance, drought, and military activities.

- Fire protection – Continue to implement fire management plans for all wild and reintroduced populations.
- Genetics research – Determine whether various varieties are valid and should be resurrected and whether *Haplostachys* is a valid genus.
- Revise recovery criteria:
    - Revise the draft recovery plan to include additional recovery criteria based on current scientific research.
    - Finalize the recovery plan for *Haplostachys haplostachya*.
- Alliance and partnership development – Continue to work with U.S. Army Garrison, National Park Service, and other land managers to initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this species.
- Threats research – Assess the modeled effects of climate change on this species, and use to determine future landscape needed for the recovery of the species.

5.0 REFERENCES

Anonymous. 2003. Rare plant discoveries at Pohakuloa Training Area (PTA). Ecosystem Management Program Bulletin 27:2–3.

Arnett, M. 2002. Report of survey for rare plants on the Keamuku Parcel, island of Hawaii, Center for Environmental Management of Military Lands Colorado State University, Fort Collins, Colorado. 96 pages.

Beavers, A.M., and R.E. Burgan. 2002. Analysis of fire history and management concerns at Pohakuloa Training Area. TPS 02-02. Center for Environmental Management of Military Lands, Fort Collins, Colorado. 32 pages + appendices.

Center for Conservation Research and Training Seed Storage Laboratory. 2010. Seed bank inventory. Honolulu, Hawaii. Microsoft Access database. Unpublished.

[CEMML] Center for the Environmental Management of Military Lands, Colorado State University. 2003. Programmatic biological assessment for transformation of the 2nd Brigade 25th Infantry Division (light) U.S. Army, Island of Hawaii. Colorado State University, Fort Collins, Colorado, prepared for the U.S. Army Corps of Engineers, Honolulu District, Hawaii. 376 pages.

[CEMML] Center for the Environmental Management of Military Lands, Colorado State University, Pohakuloa Training Area Natural Resources Staff. 2006. Report of the ecosystem management program at Pohakuloa Training Area, Island of Hawaii; July 2003 - December 2005. U.S. Army Garrison, Pohakuloa Training Area, Hawaii. 144 pages.

[CEMML] Center for the Environmental Management of Military Lands, Colorado State University, Pohakuloa Training Area Natural Resources Staff. 2008. Report for the ecosystem management program Pohakuloa Training Area, Island of Hawaii year 2007. U.S. Army Garrison, Pohakuloa Training Area, Hilo, Hawaii. 85 pages + appendices.

[CEMML] Center for the Environmental Management of Military Lands, Colorado State University. 2012. Draft integrated wildland fire management plan, U.S. Army Garrison, Hawaii. June 2012. 139 pages + appendices.

Evans, S., D. Faucette, S. Henderson, K. Kawakami, L. Schnell, and D. Scott. 2002. Annual Report for the Ecosystem Management Program and Kipuka Alala Habitat Management Activities, Pohakuloa Training Area, Island of Hawaii. Environmental Office of Pohakuloa Training Area, Hawaii.

Harold L. Lyon Arboretum. 2010. Micropropagation database. Honolulu, Hawaii. Unpublished.

Hawaii Volcanoes National Park. 2010. Controlled propagation report to U.S. Fish and Wildlife Service. Volcano, Hawaii. Unpublished.

Hawaii Volcanoes National Park. 2011. Controlled propagation report to U.S. Fish and Wildlife Service. Volcano, Hawaii. Unpublished.

Hillebrand, W. 1888. Flora of the Hawaiian Islands: a description of their phanerogams and vascular cryptogams. Carl Winter, Heidelberg, Germany; Williams & Norgate, London; B. Westermann and Co., New York. 673 pages.

Lindqvist, C., and V.A. Albert. 2002. Origin of the Hawaiian endemic mints within North American *Stachys* (Lamiaceae). American journal of botany 89(10):1709-1724.

Morden, C.W., and W. Loeffler. 1999. Fragmentation and genetic differentiation among subpopulations of the endangered Hawaiian mint *Haplostachys haplostachya* (Lamiaceae). Molecular ecology 8(4):617-625.

National Tropical Botanical Garden. 2010. Controlled propagation report to U.S. Fish and Wildlife Service. Kalaheo, Hawaii. Unpublished.

National Tropical Botanical Garden. 2011a. Herbarium database. Available online at <http://ntbg.org/herbarium/>. Accessed 3 March 2011.

National Tropical Botanical Garden. 2011b. Living collections database. Kalaheo, Hawaii. Unpublished.

National Tropical Botanical Garden. 2011c. Controlled propagation report to U.S. Fish and Wildlife Service. Kalaheo, Hawaii. Unpublished.

Pohakuloa Training Area. 2007. Controlled propagation report to U.S. Fish and Wildlife Service. Pohakuloa, Hawaii. Unpublished.

Pohakuloa Training Area. 2009. Controlled propagation report to U.S. Fish and Wildlife Service. Pohakuloa, Hawaii. Unpublished.

Pohakuloa Training Area. 2010. Controlled propagation report to U.S. Fish and Wildlife Service. Pohakuloa, Hawaii. Unpublished.

Pohakuloa Training Area. 2011. Controlled propagation report to U.S. Fish and Wildlife Service. Pohakuloa, Hawaii. Unpublished.

Shaw, R.B. 1997. Rare plants of Pohakuloa Training Area, Hawaii. Center for Ecological Management of Military Lands, Fort Collins, Colorado. Unnumbered pages.

Sherff, E.E. 1934. Some new or otherwise noteworthy members of the families Labiatae and Compositae. Botanical gazette 96:136-153.

St. John, H. 1973. List and summary of the flowering plants in the Hawaiian Islands. Pacific Tropical Botanical Garden Memoirs 1:1-519.

[U.S. Army] U.S. Army Garrison. 2009. Draft Integrated Natural Resources Management Plan (INRMP), U.S. Army Garrison, Hawaii, Pohakuloa 2010-2014. 141 pages + appendices.

[USFWS] U.S. Fish and Wildlife Service. 1979. Endangered and threatened wildlife and plants; determination that three Hawaiian plants are endangered species; final rule. Federal Register 44(211):62468-62470.

[USFWS] U.S. Fish and Wildlife Service. 1993. Draft recovery plan for *Haplostachys haplostachya* and *Stenogyne angustifolia*. U.S. Fish and Wildlife Service, Portland, Oregon. 55 pages. Available online at <http://www.fws.gov/pacificislands/recoveryplans.html>.

[USFWS] U.S. Fish and Wildlife Service. 2003a. Endangered and threatened wildlife and plants; final designation and nondesignation of critical habitat for 46 plant species from the island of Hawaii, Hawaii; final rule. Federal Register 68(127):39624-39761.

[USFWS] U.S. Fish and Wildlife Service. 2003b. Biological opinion of the U.S. Fish and Wildlife Service for routine military training and transformation of the 2nd brigade 25th infantry division (light) U.S. Army installations, Island of Hawaii. Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii. Unpublished.

[USFWS] U.S. Fish and Wildlife Service. 2010a. Rare plant tracking database. Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii. Unpublished.

[USFWS] U.S. Fish and Wildlife Service. 2010b. Reinitiation of Section 7 Consultation for the West Side W -7 Alignment, Saddle Road (State Route 200) Improvement Project between Mamalahoa Highway (State Route 190) to Milepost 6, Hawaii. Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii. 19 pages. Unpublished.

Volcano Rare Plant Facility. 2008. Controlled propagation report to U.S. Fish and Wildlife Service. Volcano, Hawaii. Unpublished.

Volcano Rare Plant Facility. 2009. Controlled propagation report to U.S. Fish and Wildlife Service. Volcano, Hawaii. Unpublished.

Volcano Rare Plant Facility. 2010. Controlled propagation report to U.S. Fish and Wildlife Service. Volcano, Hawaii. Unpublished.

Volcano Rare Plant Facility. 2011. Controlled propagation report to U.S. Fish and Wildlife Service. Volcano, Hawaii. Unpublished.

Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1999. Manual of the flowering plants of Hawaii, revised edition. University of Hawaii and Bishop Museum Press, Honolulu, Hawaii. 1,918 pages.

Signature Page
U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Haplostachys haplostachya* (Honohono)

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

Appropriate Listing/Reclassification Priority Number, if applicable:_____

Review Conducted By:
Chelsie Javar, Fish and Wildlife Biologist
Marie Bruegmann, Plant Recovery Coordinator
Jess Newton, Endangered Species Recovery Program Leader
Assistant Field Supervisor for Endangered Species

Field Supervisor, Pacific Islands Fish and Wildlife Office

for

Jess Newton

Date 8/28/2012