

Stenogyne angustifolia
(No common name)

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: *Stenogyne angustifolia* (No common name)

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5-YEAR REVIEW
***Stenogyne angustifolia* (No common name)**

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office:

Region 1, Endangered Species Program, Division of Recovery, Jesse D'Elia,
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Lead Field Office:

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor, (808)
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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 the draft recovery plan for *Haplostachys haplostachya* and *Stenogyne angustifolia* and other species from the island of Hawaii (USFWS 1993), 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. 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 species, State of Hawaii; final rule. Federal Register 44(211):62468-62470.

Date listed: October 30, 1979

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 rulemakings:

No critical habitat has been designated for *Stenogyne angustifolia*.

1.3.4 Review History:

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

Undetermined

Recovery achieved:

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

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

2

1.3.6 Current Recovery Plan or Outline

Name of plan or outline: 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*

☒ *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, B, C, D, and E) affecting this species is presented in Section 2.3.2 and Table 2.

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

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 must be reestablished in a secured, managed habitat on Maui and Molokai, to preclude the possibility of the species being irreversibly devastated by some stochastic event.

This recovery objective has not been met.

For the taxon to be delisted, the downlisting criteria must be met. In addition, all threats must be reduced or eliminated to all the 12 populations of *Stenogyne angustifolia* to allow for natural reproduction (as identified in 1993 draft recovery plan). These 12 populations must be stable or increasing and should be comprised of an adequate number of reproductive, self-regenerating adults to produce a mixture of reproductive stages (e.g., 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:

There is still little known about the life history of *Stenogyne angustifolia*. Plants have been observed flowering most months during the year (USFWS 1993; Center for the Environmental Management of Military Lands [CEMML] 2003a). The species was noted to hybridize with the sympatric *S. rugosa* and *S. microphylla* in the Kipuka Kalawamauna Endangered Plant Habitat, where individuals of *S. angustifolia* were occasionally noted with more than two flowers at each node, a feature

more characteristic of *S. rugosa* (Shaw 1997). Beavers and Burgan (2002) noted that *S. angustifolia* seeds re-sprout and regenerate after fire if precipitation occurs; however, the effects of frequent and more severe fires are unknown and could affect plant health and the seed bank (CEMML 2003a).

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Historically, *Stenogyne angustifolia* has never been common, as reflected by the sparingly few vouchers stored at Bishop Museum's herbarium (Bishop Museum 2011). On both Molokai (Kalaupapa cliff) and Maui (Honuaula, Ulupalakua area; Kula; Hamakua, northwestern slope of Haleakala), the species was last collected in the 1800s (Hawaii Biodiversity and Mapping Program 2010), and those populations are all presumed extinct (USFWS 2010); they will not be further considered in this review.

On Hawaii Island as well, the species was rarely collected, and collections prior to 1950 are from the Waimea District (1840); Kau, between Kilauea and Kapapala (1868); Puna (1800s); North Kona, Huehue (1932); Kahuku (1935); and the 1859 lava flow at 2,133 meters (7,000 feet) elevation (1949) (Hawaii Biodiversity and Mapping Program 2010; Bishop Museum 2011). It is uncertain whether any of these vouchers are from localities with any hope of still-extant plants. For the 1868 collection between Kilauea and Kapapala, Hawaii Volcanoes National Park (2004) reported that the species had not been located in the park since then, and it was believed to be extirpated from the area.

Stenogyne angustifolia was presumed extinct until fewer than 10 individuals were rediscovered in 1977 at Kipuka Kalawamauna, located on the northwestern side of the U.S. Army's Pohakuloa Training Area (USFWS 1993), and currently remains as the site of the largest extant population for the species. The range of the species within the Training Area extends from the southern part of the Keamuku Parcel and Puu Keekee, through Kipuka Kalawamauna, and south to Kipuka Alala (Shaw 1997; CEMML 2003a).

Post-1977 collections outside of the Training Area borders have been made at Waikoloa and Puu Anahulu (Shaw 1997; Arnett 2002; CEMML 2003a), but had not been monitored (as of 2003). The Waikoloa collection was made in September 1985 (*Hobdy* 2451) from the edge of the Keamuku lava flow in Waikoloa, southwest of Puu Heewai, at about 1,035

meters (3400 feet) elevation, consisting of up to a few dozen individuals in four or five spots on very old lava (Hawaii Biodiversity and Mapping Program 2010; Bishop Museum 2011). The Puu Anahulu collection was made in August 1978 (*Warshauer and McEldowney FRW 2103*) in the Puu Anahulu ahupuaa, northeast of Puu Nahaha and east of Hainoa and Kalamalu, at about 1,310 meters (4,300 feet) elevation, consisting of three small individuals (Hawaii Biodiversity and Mapping Program 2010; Bishop Museum 2011).

In 1993, when the draft recovery plan for *Stenogyne angustifolia* was published (USFWS 1993), 7 to 14 populations were known to occur at Pohakuloa Training Area within a 2,000 hectare (5,000 acre) area, and all appeared to be healthy. No estimates were provided for numbers of individuals, but two of the populations contained more than 100 individuals (USFWS 1993). Shaw (1997) estimated over 100,000 individuals at Pohakuloa Training Area, but Evans *et al.* (2002) [as cited in Arnett (2002) and CEMML (2003a)] recalculated those estimates at Pohakuloa Training Area to be 5,000 to 7,500 individuals within 5 to 15 populations. One possible reason for the variation in estimates resides in the growth habit of *S. angustifolia*, which can make it difficult to estimate true population sizes. Shoots of *S. angustifolia* recline and trail on the ground, then root at the nodes and produce shoots, which can appear to be independent plants. The species also spreads by a network of rhizomes, and a patch of apparently several individuals may actually be vegetative growth from a single genetic individual (USFWS 1993).

In 2002, 11 individuals from three locations were discovered in the southern corner of the Keamuku Parcel, located to the northwest of Kipuka Kalawamauna (Arnett 2002). Between July 2003 and December 2005, over 900 new individuals at more than 300 new locations were found at Pohakuloa Training Area, for a grand total of more than 1,300 individuals of *S. angustifolia* at over 400 different locations, mostly concentrated in the vicinity of Kipuka Kalawamauna (CEMML 2006). At the end of 2007, the census at Pohakuloa Training Area was 1,684 to 1,936 individuals (CEMML 2008). An anecdotal estimate of 25,000 to 50,000 individuals at Pohakuloa Training Area was attributed to botanist Steve Evans, and needs to be confirmed (USFWS 2010). The number of discrete populations at Pohakuloa Training Area is also unclear.

In 2004, seed was collected from a single population at Puuwaawaa by staff of Hawaii Volcanoes National Park (2004); no estimate of the number of individuals within the population was provided.

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 mints from Hawaii 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 Hawaii genera were found to be monophyletic but deeply nested inside the genus *Stachys*, and Lindqvist and Albert (2002) 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 mints from Hawaii 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 mints from Hawaii (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 2010, no nomenclatural changes had been published.

2.3.1.4 Taxonomic classification or changes in nomenclature:

Stenogyne angustifolia is a short-lived, low-growing perennial vine in the mint family (Lamiaceae) endemic to Molokai, Maui, and Hawaii Island. Originally collected from the Waimea District on Hawaii Island in 1840, the species was described by Asa Gray in 1862 (USFWS 1993; CEMML 2003a). Subsequently, Sherff (1935) recognized five island-endemic varieties: var. *hillebrandii* (Molokai), var. *mauiensis* (Maui), and vars. *meeboldii*, *salicifolia*, and *spathulata* (Hawaii), in addition to var. *angustifolia* of Hawaii Island. Only *Stenogyne angustifolia* var. *angustifolia* was included in the final rule determining endangered status in 1979 (USFWS 1979; Wagner *et al.* 1999). Wagner *et al.* (1999) subsequently grouped all the variants as synonyms, and the federally listed name was updated to reflect that of *S. angustifolia*, which now comprised records from three islands.

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):

Stenogyne angustifolia is typically found in the Pohakuloa Plateau, which is an area composed of a basaltic plain that is located between 1,500 to 1,800 meters (5,000 to 6,000 feet) elevation between Mauna Kea, Mauna Loa, and Hualalai (USFWS 1994). The substrate is derived from very old Mauna Kea aa and pahoehoe lava flows that are more than 10,000 years old (Shaw 1997). Associated plant communities include *Chamaesyce* treelands, open *Metrosideros* (ohia) treelands with sparse and dense shrub understory, *Metrosideros* mixed treelands, open and mixed *Dodonaea viscosa* (aalii) shrublands, *Myoporum sandwicense-Dodonaea viscosa* (naio-aalii) shrublands, *Myoporum sandwicense-Sophora chrysophylla* (naio-mamane) mixed shrublands, *Myoporum* shrublands, and *Leptecophylla tameiameiae* (pukiawe) mixed shrublands (Shaw 1997; Arnett 2002). At Pohakuloa Training Area associated native plant species include *Sida fallax* (ilima), *Chenopodium oahuense* (aweoweo), *Coprosma montana* (pilo), *Osteomeles anthyllidifolia* (ulei), *Wikstroemia phillyreifolia* (akia), *Bidens menziesii* (kookoolau), *Panicum tenuifolium* (pili), *Lipochaeta subcordata* (nehe), and *Eragrostis atropioides* (no common name) (Shaw 1997; Arnett 2002).

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 – Shaw (1997) and the Center for the Environmental Management of Military Lands (2003) noted that rooting activities by feral pigs (*Sus scrofa*) could damage and kill the underground stems of *S. angustifolia*.
- Established ecosystem-altering invasive plant species degradation of habitat (Arnett 2002; CEMML 2006; Shaw and Castillo 1997)
 - o *Pennisetum setaceum* (fountain grass) is the main invasive weed problem in *S. angustifolia* habitat
 - o *Senecio madagascariensis* (fireweed)
 - o *Verbascum thapsus* (mullein)

Current conservation efforts:

- Ungulate exclosure:
 - At the end of 2007, out of 21 Areas of Species Recovery units at the Pohakuloa Training Area containing 1,684 to 1,936 individuals of *Stenogyne angustifolia*, only 4 units (containing 661 to 774 individuals of *S. angustifolia*) were 100 percent protected by fences (CEMML 2008). This situation should be alleviated by the completion of the Large Fence Units, scheduled for completion in 2011 or 2012 (U.S. Army Garrison 2009).
 - As of 2009, fenced units at Pohakuloa Training Area containing *S. angustifolia* included the Kipuka Kalawamauna East Fence Unit (U.S. Army Garrison 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; these contiguous fence units will enclose about 7,921 hectares (19,572 acres) and consist of 101 kilometers (63 miles) of fencing to protect the greatest number of threatened and endangered plants and their habitats from the destructive impact of feral ungulates and other feral animals (U.S. Army Garrison 2009).
 - The existing 1.2-meters (4.0-foot) Kipuka Kalawamauna East Fence Unit will be retrofitted to 1.8-meters (6.0-feet) once the Large Fence Units are completed in 2011 or 2012 to ensure adequate protection of the *S. angustifolia* population inside the fence from ungulate browse (CEMML 2008).
- Ecosystem-altering invasive plant species control – At the end of 2007, out of 21 Areas of Species Recovery units at the Pohakuloa Training Area only 4 units contained *S. angustifolia* and most of the populated units had little to no weed control (CEMML 2008).

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 – At first this species did not

appear to be highly palatable to feral sheep (*Ovis aries*) and goats (*Capra hircus*) and appeared to be consumed only during the driest periods or after fire. However, later observations on the abundance of individuals found within large-scale fenced units and their relative scarcity outside of fenced units suggested that the species is in fact impacted by ungulates, and that browse is not commonly observed for the species because individuals are probably uprooted and completely consumed by ungulates (CEMML 2006).

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 *Stenogyne angustifolia* 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:

- Military activities – Some populations at Pohakuloa Training Area are impacted by Army training activities (Arnett 2002; CEMML 2003a; USFWS 1993, 2003b; Evans *et al.* 2007).
- Fire (USFWS 1993; Shaw and Castillo 1997)
- Hybridization – Hybridization with other species of *Stenogyne* in Pohakuloa Training Area (USFWS 1993)
- Established invasive plant species competition (USFWS 1993)
 - *Delairea odorata* (German ivy), at the Puu Huluhulu reintroduction site (CEMML 2006)
 - *Kalanchoe tubiflora* (chandelier plant) (CEMML 2006)
 - *Stellaria media* (common chickweed) at the Puu Huluhulu reintroduction site (CEMML 2006)
 - *Tagetes minuta* (stinkweed) (Arnett 2002)
- 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:

- Captive propagation protocol development – The species can be propagated rather easily from seeds or cuttings (Shaw 1997).
- Captive propagation for reintroduction and translocation:
 - Seeds are collected for storage at the National Seed Storage Laboratory at Colorado State University, and occasionally used for seed germination tests.
 - In 2010, the National Tropical Botanical Garden (2010) reported they had 123 seeds in storage from Pohakuloa Training Area. In 2011, there were no seeds reported in storage at the National Tropical Botanical Garden (2011).
 - In 2011, Pohakuloa Training Area (2011) reported they had no seeds in storage. In 2010, Pohakuloa Training Area (2010) reported they had 866 seeds in storage and 73 plants in controlled propagation at their nursery. All seeds and cuttings were collected from Pohakuloa Training Area and represented 28 wild individuals. In previous years, seeds in storage at Pohakuloa Training Area were: 2009, 30 seeds in genetic storage, representing a single wild individual from Pohakuloa Training Area; in 2008, 159 seeds and 10 cuttings were in genetic storage representing 17 wild individuals from Pohakuloa Training Area; in 2007, 3 plants were in controlled propagation, representing 3 wild individuals from Kipuka Kalawamauna of Pohakuloa Training Area; in 2006, 150 seeds were in genetic storage and 47 plants were in controlled propagation collected from Kipuka Kalawamauna of Pohakuloa Training Area.
 - For the year 2004, Hawaii Volcanoes National Park (2004) reported 27 seedlings derived from seed and 91 plants derived from cuttings under propagation, representing about 12 founder lines from Pohakuloa Training Area.
 - Volcano Rare Plant Facility (2011) reported five individuals in genetic storage and seven individuals in controlled propagation.
 - The Center for Conservation Research and Training Seed Storage Facility (2010) reported no seed storage efforts for this species.
 - No micropropagation efforts were reported 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 2003).
- Reintroduction / translocation site selection – For *S. angustifolia*, the three main off-installation reintroduction sites are Puu Huluhulu, Kipuka Oweowe, and Puuwaawaa Cone Unit, which are all located on lands managed by the State of Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife (U.S. Army Garrison 2009).
- Reintroduction / translocation implementation:
 - At the end of 2005, apparently all reintroductions at Pohakuloa Training Area and Hawaii Volcanoes National Park were clones of a single individual (CEMML 2006).
 - For the year 2004, Hawaii Volcanoes National Park (2004) reported 16 individuals were reintroduced at Kipuka Kulalio in the Mauna Loa Special Ecological Area from seeds/cuttings collected at Pohakuloa Training Area.
 - By the end of 2005, about 141 individuals had been reintroduced at Pohakuloa Training Area and Hawaii Volcanoes National Park (CEMML 2006).
 - Between 2005 and 2007, 204 individuals of *S. angustifolia* from Pohakuloa Training Area were reintroduced at two sites in the upper Mauna Loa Special Ecological Area and along the Mauna Loa Trail (L. Pratt, U.S. Geological Survey, Pacific Island Ecosystems Research Center, pers. comm. 2011); it was not reported whether the reintroductions were derived from seeds or rooted cuttings.
 - The reintroduction of 10 individuals in 2007 brought the total of reintroductions for *S. angustifolia* to 106 individuals at four sites (Puu Huluhulu, Kipuka Oweowe, Puuwaawaa, KAS Reintroduction 1) since 2002 (CEMML 2008). Recruitment at these sites was noted in the form of vegetative reproduction, with stems extending to 400 centimeters (157 inches) in length.
 - Since 2008, additional reintroductions have taken place at Puuwaawaa, 69 individuals (Volcano Rare Plant Facility 2008, 2010; Pohakuloa Training Area 2010); Puu Huluhulu, 15 individuals (Pohakuloa Training Area 2010); Kipuka Oweowe, 4 individuals (Pohakuloa Training Area 2010); West Hawaii Veteran's Cemetery, 2 individuals (Pohakuloa

Training Area 2010); and Pohakuloa Training Area, 10 individuals (Pohakuloa Training Area 2010).

- Reintroduced / translocated population management and monitoring:
 - The reintroduction of 204 individuals at the upper Mauna Loa Special Ecological Area and along the Mauna Loa Trail were observed in flower and with fruit after reintroduction, but no seedling recruitment was noted (L. Pratt, pers. comm. 2011). The mortality rate of the reintroduction was reported as high, with only one percent of the reintroduction (three plants) remaining after 35 to 50 months in the ground (L. Pratt, pers. comm. 2011).
 - Survival at the Puuhuluhulu site for 30 individuals at the end of 2005 was 80 percent, with vegetative reproduction noted (CEMML 2006).
- Compliance and enforcement – Stewardship of *Stenogyne angustifolia* 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) (USFWS 2003b), and the U.S. Army's Integrated Natural Resources Management Plan (INRMP) (USFWS 2003a; U.S. Army Garrison 2009). In 2003, the USFWS published the Biological Opinion for the Pohakuloa Training Area (USFWS 2003b); among their requirements were construction of large-scale fence units to protect endangered species habitat, ungulate control within the fence units, and annual monitoring, weed control, threat management, and reintroduction guidelines (U.S. Army Garrison 2009). At Pohakuloa, the requirements of the Biological Opinion have been woven into the Integrated Natural Resources Management Plan (INRMP). In implementing the INRMP, the USFWS provides oversight to ensure that the conservation management strategies are achievable, will benefit the species, are effectively implemented and monitored for effectiveness, and revised as necessary.
- 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; State of Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife; and Rana Productions (U.S. Army Garrison

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 Garrison 2009).

- Fire protection – In 2003, the Pohakuloa Training Area completed an Integrated Wildland Fire Management Plan to reduce the threat of wildfires (CEMML 2003b). In June 2012, Pohakuloa Training Area drafted a revision of their 2003 Integrated Wildland Fire Management Plan (CEMML 2012).
- Competitive invasive plant species control – At the end of 2007, out of 21 Areas of Species Recovery units at the Pohakuloa Training Area only 4 units contained *S. angustifolia* and most of the populated units had little to no weed control (CEMML 2008).
- Surveys/ inventories – To identify new populations of threatened and endangered plant species in areas previously not surveyed and areas of suitable habitat at Pohakuloa Training Area (USFWS 2003a; Evans *et al.* 2007).

2.4 Synthesis

The interim stabilization objectives for this species have been partially met. Work by the U.S. Army Pohakuloa Training Area and Hawaii Volcanoes National Park has increased and stabilized population sizes and numbers. Threats to the single large population of *Stenogyne angustifolia* at Pohakuloa Training Area are being managed under an Integrated Natural Resources Management Plan and Pohakuloa Implementation Plan, pending completion of the Large Fence Units on the western side of Pohakuloa Training Area that will provide protection from feral ungulate threats (Table 2). There is also a good representation of the species in *ex situ* collections (Table 1). However, there is only a single large main population of *S. angustifolia* located at Pohakuloa Training Area and the possibility of the species being irreversibly devastated by a stochastic event is still high. In addition, no efforts to reestablish three additional populations on Maui and Molokai have been attempted. Therefore, *Stenogyne angustifolia* meets the definition of endangered as it remains in danger of extinction throughout its range.

Table 1. Status of *Stenogyne angustifolia* from listing through 5-year review.

Date	No. wild individuals	No. outplanted	Stabilization Criteria identified in Draft Recovery Plan	Stabilization Criteria Completed?
1979 (listing)	<10	0	Existing habitat on Hawaii Island must be secured and managed	No
			Increase and stabilize population size and numbers	No
1993 (draft recovery plan)	>200 in 7 – 14 populations	0	Existing habitat on Hawaii Island must be secured and managed	Partially (see Table 2)
			Increase and stabilize population size and numbers	No
2012 (5-year review)	>5,000	>200	Existing habitat on Hawaii Island must be secured and managed	Partially (see Table 2)
			Increase and stabilize population size and numbers	Partially

Table 2. Threats to *Stenogyne angustifolia* 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 at Pohakuloa Training Area
Established ecosystem-altering invasive plant species degradation of habitat	A	Ongoing	Partially – Very minimal ecosystem-altering invasive plant species controlled at Pohakuloa Training Area
Fire	E	Ongoing	Partially – Fire protection plan at Pohakuloa Training Area
Military activities	E	Ongoing	Partially – Compliance and enforcement, and alliance and partnership development at Pohakuloa Training Area
Established invasive plant species competition	E	Ongoing	Partially: Very minimal competitive invasive plant species controlled at Pohakuloa Training Area
Hybridization	E	Ongoing	No
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*

☒ **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.
- Ungulate exclosure:
 - Complete the Large Fence Units at Pohakuloa Training Area to prevent further ungulate damage to the species and reduction of degradation of its habitat.
 - Monitor existing fences for any signs of breaching.
- 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.
 - Plan and implement a strategy to achieve the goal of establishing populations on the islands of Maui and Molokai.
- Reintroduction / translocation population management and monitoring – Continue to monitor reintroduction sites for successful establishment and recruitment of the species to better determine optimum reintroduction sites for the species.
- Surveys / inventories – Continue to conduct surveys for new populations, both in the Pohakuloa Training Area and other habitats where the species has been historically found.
- Genetic research – Tag and sample a number of plants in several populations for genetic studies to determine genetic variation within the populations. In some cases it may confirm that populations are clonal and represent a single individual, and may help to produce a more accurate census of the total number of individuals for the species.
- Population viability monitoring – Annually monitor the population structure, vigor, demography, and phenology to better understand how to manage the species.
- Ungulate control – Protect all populations against browsing and disturbances from feral ungulates.

- Established ecosystem-altering invasive plant species control – Increase efforts to control established ecosystem-altering invasive plant species around all populations within Pohakuloa Training Area.
- Competitive invasive plant species control – Increase efforts to control establish invasive plant species are all known populations, and especially those located at Pohakuloa Training Area.
- Site / area / habitat protection – Develop and implement effective measures to reduce the impact of military activities.
- Fire protection – Continue to implement fire management plans for all wild and reintroduced populations.
- Population biology research – Study populations to better understand whether plants are hybridizing with other species of *Stenogyne* at Pohakuloa Training Area.
- Revise recovery criteria:
 - Revise the draft recovery plan to include additional recovery criteria based on current scientific research.
 - Finalize the recovery plan for *Stenogyne angustifolia*.
- Alliance and partnership development – Continue to work with U.S. Army Garrison, Hawaii Division of Forestry and Wildlife, 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.

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Signature Page
U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Stenogyne angustifolia* (No common name)

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:

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for

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Date 8/28/2012