

5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Stenogyne angustifolia* var. *angustifolia* (no common name)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2018. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 156 species in Oregon, Washington, Hawaii, Palau, Guam, and the Northern Mariana Islands. Federal Register 88(83): 20088–20092, May 7, 2018.

Lead Region/Field Office:

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

Name of Reviewer:

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Megan Laut, Conservation & Restoration Team Manager, PIFWO

Methodology used to complete this 5-year review:

This review was conducted by staff of the Pacific Islands Fish and Wildlife Office (PIFWO) of the U.S. Fish and Wildlife Service (Service) beginning in October 2019. The review was based on a review of current, available information since the last 5-year review for *Stenogyne angustifolia* var. *angustifolia* (USFWS 2012). The evaluation by Cheryl Phillipson, Biologist, was reviewed by Lauren Weisenberger, Plant Recovery Coordinator, and Megan Laut, Conservation and Restoration Team Manager.

Background:

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

Review Analysis:

Please refer to the previous 5-year reviews for *Stenogyne angustifolia* var. *angustifolia* published in the Federal Register on August 28, 2012 (available at https://ecos.fws.gov/docs/five_year_review/doc4058.pdf) for a complete review of the species' status, threats, management efforts, and references cited. We are not aware of any significant new information regarding the species' biological status since listing to warrant a change in the Federal listing status of *S. angustifolia* var. *angustifolia*.

This short-lived perennial scandent vine in the Lamiaceae (mint) family is endangered and found on the island of Hawai'i. The current status and trends for *Stenogyne angustifolia* var. *angustifolia* are provided in the tables below.

New Status Information:

- At the time of the 5-year review in 2012 there were estimated to be more than 5,000 wild individuals of *Stenogyne angustifolia* var. *angustifolia* in 5 to 15 populations. Numbers continue to decline and 9 out of 14 historic populations are extirpated (Pali o Ka‘eo, Kahuku East, Ka‘ū Desert, Kaūmana-Punahoa, Pu‘uanahulu-Mauka I, Ka‘ūpūlehu Mauka, Kīpuka Kalawamauna North Fence-Ke‘āmuku, Waikoloa, and Pu‘ukapu. Currently, there are estimated to be between 2,517 to 3,238 wild individuals on the Pōhakuloa Training Area (PTA) at Nā‘ōhule‘elua-Kīpuka Kalawamauna (both juvenile and adult individuals), Kīpuka Alāla South and North, and Mixed Tree Fence South and East; and 92 wild individuals at Pu‘uanahulu Mauka 2 and Pu‘uanahulu Mauka *Stenogyne* Unit (CEMML 2020, p. 8; DLNR-DOFAW 2020). In total, there are approximately 3,330 individuals of *S. angustifolia* var. *angustifolia* in five populations.
- Some information regarding possible pollination strategies were not provided in the previous 5-year review and are provided here. The lack of odor, flower shape (a smaller lower lip and long flower tube), color (ranging between red, pink, and yellow), stamen position, and high levels of nectar suggest that *Stenogyne angustifolia* var. *angustifolia* is likely pollinated by native honeycreeper birds (Weller and Sakai 1990, pp. 831–843; Lindqvist and Albert 2002, p. 1710). In addition, numerous insects have been observed crawling on the stems, leaves, and flowers and may also serve as pollination vectors (USFWS 1993, p. 17). *Stenogyne angustifolia* var. *angustifolia* has fleshy fruit which indicates possible dispersal by birds (Carlquist 1980, p. 96; Lindqvist and Albert 2002, p. 1710).
- Aslan et al. (2018, entire) conducted a study of *Stenogyne angustifolia* var. *angustifolia* to determine the effects of lack of native pollinators on its long-term viability and contribution to the overall ecological community. The robust size and open shape of *S. angustifolia* var. *angustifolia* flowers, along with their high accessibility, visibility, and nectar content, suggested to the researchers that *S. angustifolia* var. *angustifolia* is adapted to animal-mediated pollination. However, only one flower visitor was observed at the focal high-elevation study site: an individual of the non-native sweat bees (*Lasioglossum impavidum*). Experimental pollination treatments showed that *S. angustifolia* var. *angustifolia* is self-compatible and demonstrates some autogamy, setting fruit and seed in the absence of pollinators. However, experimental additions of pollen increased fruit production, indicating that plants may be pollen-limited and that lack of pollinators carries a reproductive cost for this species. Ecological communities throughout Hawai‘i are highly modified and the distribution and diversity of the native pollinator community that occurred with *S. angustifolia* var. *angustifolia* are wholly unknown. The lack of visitation by native pollinators and extremely rare visitation by nonnative pollinators suggest that individuals of *S. angustifolia* var. *angustifolia* are contributing little to the ecological community in the high-elevation habitat and this species have become “ecologically extinct” (Aslan et al. 2018, p. 1). The authors suggest potential conservation measures could be taken,

such as hand-pollination and translocation to areas with the presence of more pollinators.

- In July of 2018, a wildland fire occurred when a U.S. Marine Corps H-1 aircraft inadvertently discharged flares while the aircraft was at approximately 500 ft (152 m) above ground level over a training area. The fire burned 368 acres (ac) (149 hectares (ha)) at varying intensities resulting in a patchwork burned and unburned areas. About 43 percent of *Stenogyne angustifolia* var. *angustifolia* locations were within the burned area of Kipuka Kalawamauna East and North. Five percent of the known plant locations (from 204 locations pre-fire to 193 locations post-fire) including 1,263 individuals of *S. angustifolia* var. *angustifolia* were lost. Re-sprouting from below-ground rhizomes and seeds in the soil seed bank was observed in the protected fenced area. The response of the population to this fire, is being monitored (CEMML 2020, pp. 11, 48–49).
- This species from the island of Hawai‘i was first described by Gray (1862, p. 348). Subsequently, Sherff (1935, pp. 69–72) recognized six island-endemic varieties: var. *hillebrandii* (Moloka‘i), var. *mauiensis* (Maui), and vars. *meeboldii*, *salicifolia*, and *spathulata* (Hawai‘i), in addition to var. *angustifolia* on the island of Hawai‘i. Only *Stenogyne angustifolia* var. *angustifolia* was included in the Service’s final rule determining endangered status in 1979 (44 FR 62468, October 30, 1979; Weller and Sakai 1999, p. 835). Weller and Sakai (1999, p. 835) subsequently grouped all the varieties as synonymous; however, the federally listed name has not yet been updated to reflect this revision of *S. angustifolia* var. *angustifolia*. This taxonomic revision narrows the range of this species to an island endemic (island of Hawai‘i) as the other varieties on Moloka‘i and Maui (previously synonymous of *Stenogyne angustifolia*) are determined to be extinct. The species still warrants its status as endangered under the Act. We recommend accepting the listed species name as *S. angustifolia*.

New Threats:

- Climate change loss or degradation of habitat—Climate change may pose a threat to this species. Fortini *et al.* (2013) conducted a landscape-based assessment of climate change vulnerability for native plants of Hawai‘i using high resolution climate change projections. Climate change vulnerability is defined as the relative inability of a species to display the possible responses necessary for persistence under climate change. The assessment by Fortini *et al.* (2013) conducted at the species level concluded that *Stenogyne angustifolia* is vulnerable to the impacts of climate change, with a vulnerability score of 0.306 (on a scale of 0 being not vulnerable to 1 being extremely vulnerable to climate change). Therefore, additional management actions may be needed to conserve this taxon into the future, such as locating key microsites that overlap with current and future climate envelopes for outplanting efforts.

New Management Actions:

- Surveys and inventories—Field surveys to monitor and confirm the status of wild and reintroduced populations of *Stenogyne angustifolia* var. *angustifolia* are

conducted within PTA, Pu‘uanahulu, and Pu‘uwa‘awa‘a (PWW) (DLNR-DOFAW 2016, 2018; CEMML 2018, p. 4).

- Ungulate monitoring and control—
 - In 2013, 14 fence units were installed in PTA encompassing 15,300 hectares (ha) (37,807 acres (ac)) of dryland habitat. Ungulate eradication efforts continued periodically through the next few years until a new plan was established in an effort to create an uninterrupted enforcement of ungulate removal. By 2017, all conservation fence units were considered ungulate free (Fleishman 2019, p. 1). Currently, fences are maintained through the Fence Maintenance Project run by the PTA Natural Resources Office. All populations of *Stenogyne angustifolia* var. *angustifolia* at PTA are within fenced areas.
 - Fencing for the Kapāpala Unit of Hawai‘i Volcanoes National Park (HVNP) is maintained and spans lava flows where reintroductions of *Stenogyne angustifolia* var. *angustifolia* occurred (HVNP 2019, p. 25).
 - The majority of wild plants within the Pu‘uanahulu Game Management Area (GMA) are fenced within two separate units; however, two locations remained unfenced and remain at risk of trampling and herbivory.
- Nonnative invasive plant control—The PTA is actively working to control and eradicate invasive plants through the Invasive Plants Program under the PTA Natural Resources Office. This program is comprised of three sections: vegetation control by mechanical removal and herbicide application (CEMML 2016, p. 165), fuel break management, and invasive plants survey and monitoring. The program not only controls invasive plants but works to reduce the fire fuel created by invasive plants. Additional actions include the implementation and maintenance of fire breaks, fuel breaks, and fuel monitoring corridors (CEMML 2016, pp. 83–84).
- Captive propagation for genetic storage and reintroduction—
 - Since 2005, several hundred plants representing 28 wild individuals of *Stenogyne angustifolia* var. *angustifolia* have been propagated at the PTA nursery for outplanting and living collection purposes. Seeds were collected from wild populations (2,175 seeds), from the PTA greenhouse (1,926 seeds), and from translocated populations (119 seeds) (CEMML 2018, p. 4; CEMML 2019, p. 10; CEMML 2020, p. 37). Twenty eight founders are represented in *ex situ* seed storage at PTA and two founders from State lands are represented at the Volcano Rare Plant Facility (VRPF 2013-2019). The DLNR reported propagation from 21 cuttings from wild and nursery plants at Pu‘uwa‘awa‘a and Pu‘uanahulu (PWW 2018).
 - Conservation activities by HVNP staff consist of collecting and storing seeds, and propagating plants in their nursery (HVNP 2020, p. 4). In 2016, 13 individuals were in storage for controlled propagation at HVNP representing four wild PTA individuals (HVNP 2016), but none currently are maintained in *ex situ* storage.
 - The VRPF has been propagating *Stenogyne angustifolia* var. *angustifolia* from two Pu‘uwa‘awa‘a founders for outplanting efforts and to maintain a living collection since 2013 (VRPF 2013-2019). Between 2013 and 2018,

24 plants were propagated and 19 individuals were used for reintroduction (VRPF 2013-2019).

- As of 2019, the National Tropical Botanical Garden (NTBG) has seeds in storage representing one wild plant from PTA; however, their viability is unknown due to the length in time that has lapsed since seeds were received (April 1992) (NTBG 2019).
- Reintroduction—
 - Two reintroduction sites by PTA are considered successful, where natural recruitment of at least 50 individuals occurred (CEMML 2019, p. 16). Two hundred and forty-five individuals of *Stenogyne angustifolia* var. *angustifolia* were reintroduced into five sites at PTA and Pu‘uwa‘awa‘a (CEMML 2017, p. 101). As of 2019, 186 remain (CEMML 2020, pp. 48–49), and three sites at PTA have seen reproduction via vegetative propagation, though they are not all currently extant (CEMML 2017, p. 101; 2020, pp. 48–49). An additional 10 plants representing seven founders were transferred from PTA to HVNP in 2012. Two plants were planted in a test site maintained by USGS. As of 2012, one plant remained at the test site in a cage (HVNP 2019, p. 25). DLNR-DOFAW reintroduced 50 individuals to Hauaina Reservoir Paddock, 20 individuals to Kīpuka ‘Owē‘owē, 15 individuals to the Cone Unit Sites, and 120 individuals to the Uhiuhi 12-acre U.S. Forest Service plots (DLNR-DOFAW 2016, 2018).
 - VRPF reported reintroduction of 19 propagated plants at Pu‘uwa‘awa‘a (VRPF 2013–2019).
- Population biology—In 2019, germination trials were initiated on 73 seeds and are currently ongoing (CEMML 2019, p. 10; CEMML 2020, pp. 40, 119–120).

Table 1. Status and trends of *Stenogyne angustifolia* var. *angustifolia* from listing through current 5-year review.

Date	No. wild individuals	No. outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization Criteria Completed?
1979 (listing)	<10	0	Existing habitat on Hawai‘i Island must be secured and managed	No
			Increase and stabilize population size and numbers	No
1993 (draft recovery plan)	9 populations, no estimates of individuals available	0	Existing habitat on Hawai‘i Island must be secured and managed	Partially

			Increase and stabilize population size and numbers	No
2012 (5-year review)	>5,000	>200	Existing habitat on Hawai‘i Island must be secured and managed	Partially
			Increase and stabilize population size and numbers	Partially
Date	No. wild individuals	No. outplanted	*Preventing Extinction Criteria identified by HPPRCC	*Preventing Extinction Criteria Completed?
2020 (5-year review)	ca 3,330	ca 479 planted, >200 remain (many others unknown)	All threats managed in all 6 populations	Partially, exclosures at PTA, PWW, HVNP
			Complete genetic storage	Partially, ~30 founders represented
			Reproduction (i.e. viable seeds, seedlings) at all 3 populations	Partially, 2 populations recruiting
			6 populations with 50 mature individuals each	Partially, 1 pop >50 maure

* The Preventing Extinction Stage was established in 2011. Prior to 2011, the Interim Stabilization Stage was the first stage towards recovery (now it is the second stage after Preventing Extinction).

Table 2. Threats to *Stenogyne angustifolia* var. *angustifolia* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulate destruction and degradation of habitat and herbivory	A, C, D	Ongoing	Partial, 3 populations in exclosures

Established ecosystem altering invasive plant species degradation of habitat and competition	A, E	Ongoing	Partial, nonnative plant control at PTA
Fire destruction and degradation of habitat	A	Ongoing	Partial, nonnative plant control efforts and firebreaks at PTA
Climate change degradation and loss of habitat	A	Ongoing	None
Military training activities	E	Ongoing	Partial, management at PTA
Loss of vigor due to low numbers, low recruitment	E	Ongoing	Partial, germination trials, propagation, and reintroduction

Synthesis:

Currently, there are approximately 3,330 wild individuals of *Stenogyne angustifolia* var. *angustifolia* within PTA and Pu‘uanahulu GMA on the island of Hawai‘i. A landscape-based assessment of climate change vulnerability for native plants of Hawai‘i using high resolution climate change projections was made by Fortini *et al.* (2013) and their analysis showed that *S. angustifolia* var. *angustifolia* is vulnerable to the effects of climate change. Currently, of the 245 reintroduced individuals at PTA, 186 survive, and 234 individuals were reintroduced at Pu‘uwa‘awa‘a, Pu‘uanahulu, and Hawai‘i Volcanoes National Park, with only one surviving at HVNP and an unknown number surviving at Pu‘uwa‘awa‘a/Pu‘uanahulu. Three populations are provided protection from feral ungulates by fencing and ungulate control, with some nonnative plant management. Natural recruitment has been reported at two populations. Germination trials and propagation from cuttings trials are ongoing. Stewardship of *Stenogyne angustifolia* var. *angustifolia* and other endangered plants at PTA was mandated by the Service’s Biological Opinion in 2003 and is ongoing.

Stabilizing (interim), downlisting, and delisting objectives were provided in the draft Recovery Plan for *Haplostachys haplostachya* and *Stenogyne angustifolia* (USFWS 1993), and are being updated following the Recovery Outline for Hawaiian Multi-Island Species (2019), the draft recovery plan for the Hawaiian multi-island species (in prep), and the draft revised recovery objective guidelines developed by the Hawai‘i and Pacific Plants Recovery Coordinating Committee (HPPRCC 2011). The HPPRCC identifies an additional initial objective, the Preventing Extinction Stage, in addition to the Interim Stabilization, Delisting, and Downlisting objectives. Furthermore, life history traits such as breeding system, population size fluctuation or decline, and reproduction type (sexual or vegetative), have been included in the calculation of goals for the number of populations and reproducing individuals for each stage. The goals for each stage remain grouped by life span defined as annual, short-lived perennial (fewer than 10 years), or long-lived perennial.

Stenogyne angustifolia var. *angustifolia* is a short-lived perennial scandent vine that relies on vegetative reproduction as well as sexual reproduction. To prevent extinction, which is the first milestone in recovering the species, the taxon must be managed to control threats (e.g., fenced) and have 50 individuals (or the total number of individuals if fewer than 50 exist) from each of three populations represented in *ex situ* (secured off-site, such as a nursery or seed bank) collections that are well managed. In addition, a minimum of six populations should be documented on the island of Hawai‘i where they now occur or occurred historically and each of these populations must be naturally reproducing (i.e., viable seeds, seedlings, saplings) with a minimum of 50 mature, reproducing individuals per population.

The preventing extinction goals for this species have not been met. Currently, only one very large population (estimated at 2,478 total individuals) totals more than 50 mature individuals and natural recruitment is reported for only two populations. Genetic representation is complete for only around 30 founders (Table 1). Not all threats are being managed (Table 1, Table 2). Therefore, *Stenogyne angustifolia* var. *angustifolia* meets the definition of Endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

We are not aware of any new threats or significant new information regarding the species’ biological status since the last 5-year review in 2012. Thus, the following recommendations for future actions are reiterated for the 5-year review for 2020.

- Surveys and inventories—Continue to conduct thorough surveys of all current and historical range for an assessment of the species’ status.
- Ungulate monitoring and control—Continue to construct and maintain fenced enclosures to protect individuals from the negative impacts of habitat destruction and degradation, and browsing and trampling by ungulates.
- Established ecosystem-altering invasive plant monitoring and control—Increase efforts to control established ecosystem-altering nonnative invasive plant species, and those that compete with *Stenogyne angustifolia* var. *angustifolia* at all populations.
- Fire management—Continue to develop and implement fire management plans for all wild and reintroduced populations.
- Climate change adaptation strategy—Assess the modeled effects of climate change on this species and use to determine future landscape needed for the recovery of the species.
- Captive propagation for genetic storage and reintroduction—Continue collection and propagation efforts for maintenance of genetic stock and for reintroduction into protected suitable habitat within historical range.
- Reintroduction and translocation—Determine optimal sites for reintroduction and continue to reintroduce individuals into these areas that are managed for known threats.
- Population biology research and monitoring—

- Continue hand pollination efforts and reintroduction to sites with presence of more pollinators to improve genetic robustness.
- Assess genetic variation within and between populations and determine which populations may be clonal or hybrids with other *Stenogyne* species.
- Monitor population structure, vigor, demography, and phenology to better understand best management practices for the species.
- Military activity effects—Continue to develop and implement effective measures to reduce the impacts of military activities.
- Revise recovery criteria—Revise the draft recovery plan and finalize a new recovery plan to include recovery criteria based on current scientific research.
- Update the taxonomy on the list of Endangered and Threatened Species in the CFR.
- Alliance and partnership development—Continue to work with the U.S. Army Garrison, Department of Land and Natural Resources, and other partners and land managers in planning and implementation of ecosystem-level restoration and management to benefit this species.

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U.S. FISH AND WILDLIFE SERVICE

SIGNATURE PAGE for 5-YEAR REVIEW of *Stenogyne angustifolia* var. *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
- No Change in listing status

For Field Supervisor, Pacific Islands Fish and Wildlife Office

Date _____