5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Neraudia angulata* (no common name)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2017. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 138 species in Hawaii, Oregon, Washington, and California. Federal Register 82(75): 18665–18668, April 20, 2017.

Lead Region/Field Office:

Region 1/Pacific Islands Fish and Wildlife Office (PIFWO), Honolulu, Hawai‘i

Name of Reviewer:

Cheryl Phillipson, Biologist, PIFWO
Lauren Weisenberger, Plant Recovery Coordinator, PIFWO
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 2018. The review was based on a review of current, available information since the last 5-year review for *Neraudia angulata* (USFWS 2013). The evaluation completed 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 *Neraudia angulata* published in the Federal Register on January 18, 2008 and August 9, 2013 (available at *https://ecos.fws.gov/docs/five_year_review/doc1853.pdf* and *https://ecos.fws.gov/docs/five_year_review/doc4228.pdf*) for a complete review of the species' status, threats, and management efforts. 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 *N. angulata*.

This short-lived perennial shrub in the Urticaceae (nettle) family is endangered and endemic to O‘ahu. The current status and trends for *Neraudia angulata* are provided in the tables below.

New Status Information:

- *Neraudia angulata* occurs in seven populations from Mākua to Hālona in the Waiʻanae mountains, totaling 58 mature and 27 immature individuals (Army Natural Resources Program-Oʻahu (ANRP) 2018).
- There are two varieties, *dentata* and *angulata*. Characteristics, as well as intermediate characteristics, have been seen within and among populations. The taxonomy of *N. angulata* is in need of further study (ANRP 2013).
- In 2012, 17 critical habitat units in three ecosystems (lowland dry, lowland mesic, dry cliff) were designated for *Neraudia angulata* in the Waiʻanae mountains of Oʻahu (7,788 ac, 3,152 ha) (77 FR 57648, September 18, 2012).
- In 2013, it was estimated that there were fewer than 50 individuals remaining of *Neraudia angulata* var. *dentata* (PEPP 2013). The remainder of the individuals are either variety *angulata*, or hybrids between the two varieties.

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 Hawaiʻi 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) concluded that *Neraudia angulata* is extremely vulnerable to the impacts of climate change, with a vulnerability score of 0.854 (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:

- Ungulate control— *Neraudia angulata* occurs in seven areas fenced and managed by the ANRP (Kaluakauila, Kahanahāiki, Manuwai, ʻŌhikilolo, Kamaileʻunu II, Waiʻanae Kai-Mauka, and Līhuʻe) (ANRP 2018).
- Nonnative plant control—Nonnative plants are controlled in four management units (Kaluakauila, ʻŌhikilolo-Mākua, Mākaha, and Manuwai) (ANRP 2018).
- Rodent control—Rats are controlled in the Waiʻanae Kai Mauka population unit (ANRP 2018).
- Invertebrate control—There is local control of slugs at Manuwai using quarterly applications of Ferroxx-AQ (ANRP 2018).
- Propagation and reintroduction—
    - A total of 463 mature and 71 immature plants are reintroduced at Kaluakauila (258), Makua (25), Punapōhaku (283), Mākaha (90), Manuwai (157), and Waiʻanae Kai Mauka (4) (ANRP 2018).
    - Twenty-two founders are represented in propagation in the nursery, 14 of which have adequate representation (at least 3 replicates per plant) (ANRP 2018).

- Waimea Arboretum reports propagation and storage of 12 individuals representing seven wild individuals of *Neraudia angulata* var. *angulata* (Waimea Arboretum 2013, 2014, 2015).

Synthesis:
Currently there are 85 individuals of *Neraudia angulata* in the Waiʻanae mountains of Oʻahu. A landscape-based assessment of climate change vulnerability for native plants of Hawaiʻi using high resolution climate change projections was made by Fortini *et al.* (2013) and their analysis showed that *N. angulata* is extremely vulnerable to the effects of climate change. Almost all the known individuals of *N. angulata* occur within fenced and managed areas. Over 500 individuals have been propagated and reintroduced.

Stabilizing (interim), downlisting, and delisting objectives were provided in the Recovery Plan for the Oʻahu Plants (USFWS 1998), and have been updated according to the draft revised recovery objective guidelines developed by the Hawaiʻi 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.

Neraudia angulata is a short-lived perennial dioecious shrub. To prevent extinction, which is the first step 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. In addition, a minimum of three populations should be documented on Oʻahu where they now occur or occurred historically and each of these populations must be naturally reproducing (*i.e.,* viable seeds, seedlings, saplings) and increasing in number, with a minimum of 100 mature, reproducing individuals per population.

The preventing extinction goals for this species have not been met. There are no populations totaling more than 100 individuals. Although most threats are managed, genetic representation is incomplete (Table 1, Table 2). Therefore, *Neraudia angulata* meets the definition of Endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:
Other than the new data on this taxon's extreme vulnerability to climate change, we are not aware of any new threats or significant new information regarding the species' biological status since the last 5-year review in 2013. Thus, the following recommendations for future actions are reiterated for the 5-year review for 2019.

- Ungulate monitoring and control—Continue to construct and monitor fencing around all populations to provide protection from the negative impacts of feral ungulates.
- Invasive plant monitoring and control—Continue to control established ecosystem-altering nonnative invasive plant species, and those that compete with *Neraudia angulata* at all populations.
- Fire management—Implement wildfire management plans for all populations and coordinate control efforts.
- 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.
    - Predator and herbivore control—Implement effective control methods for rats and slugs.
    - Continue to monitor for infestations by the black twig borer and assess the need for control. Keep apprised of any new technologies for control of the black twig borer.
- Captive propagation—
    - Collect cuttings and seeds from tagged individuals keeping close track of the maternal source for use in *ex situ* propagation.
    - Send seed collections to two or more facilities for propagation and storage.
- Reintroduction—Continue to reintroduce individuals into new populations or augment existing populations that are managed for current threats.
- Genetic research—Assess genetic variability within the extant populations and evaluate the extent of risk posed by possible hybridization between varieties.
- Alliance and partnership development—Work with the ANRP, the Division of Forestry and Wildlife, and other land managers to initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this species.

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

Date	No. wild individuals	No. outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization Criteria Completed?
1991 (listing)	<15	0	All threats managed in all three populations	No
			Complete genetic storage	No
			Three populations with 50 mature individuals each	No
1998 (recovery plan)	70–110	0	All threats managed in all three populations	No
			Complete genetic storage	Partially
			Three populations with 50 mature individuals each	No
2003 (critical habitat)	51	12	All threats managed in all three populations	Partially
			Complete genetic storage	Partially
			Three populations with 50 mature individuals each	No
2008 (5-year review)	353	27	All threats managed in all three populations	Partially
			Complete genetic storage	Partially
			Three populations with 50 mature individuals each	Partially, one population
2012 (critical habitat)	209	0	All threats managed in all three populations	Partially
			Complete genetic storage	Partially

			Three populations with 50 mature individuals each	Partially, possibly two populations
2013 (5-year review)	330–396	205	All threats managed in all three populations	Partially
			Complete genetic storage	Partially
			Three populations with 50 mature individuals each	Partially, two populations
Date	**No. wild individuals**	**No. outplanted**	***Preventing Extinction Criteria identified by HPPRCC**	***Preventing Extinction Criteria Completed?**
2019 (5-year review)	548	8	All threats managed in all three populations	Partially
			Complete genetic storage	Partially
			Reproduction (*i.e.* viable seeds, seedlings) at all three populations	Unknown
			Three populations with 100 mature individuals each	Partially, two reintroduced populations total >100

* 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 after Preventing Extinction).

Table 2. Threats to *Neraudia angulata* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulate destruction and degradation of habitat	A	Ongoing	Partial, ungulate control at seven Army management units
Established ecosystem altering invasive plant species degradation of habitat	A	Ongoing	Partial, nonnative plant control at four Army management units
Fire management	A	Ongoing	Partial, fire management plan available
Climate change degradation or loss of habitat	A	Ongoing	None
Ungulate predation and herbivory	C	Ongoing	Partial, ungulate control at seven Army management units
Rodent predation and herbivory	C	Ongoing	Partial, rat control at one population
Invertebrate predation and herbivory —Slugs	C	Ongoing	Partial, control at one population
Invertebrate predation and herbivory —Black twig borer	C	Potential	Monitoring only
Competition with established invasive plant species	E	Ongoing	Partial, nonnative plant control at four Army management units

References:

See previous 5-year reviews for a full list of references (USFWS 2008, 2013). Only references for new information are provided below.

[ANRP] Army Natural Resource Program-O‘ahu. 2013. 2013 status report for the Makua and Oahu implementation plans. 177 pp.

[ANRP] 2018. 2018 status report for the Makua and Oahu implementation plans. 217 pp.

Fortini, L., J. Price, J. Jacobi, A. Vorsino, J. Burgett, K. Brinck, F. Amidon, S. Miller, S. Gon II, G. Koob, and E. Paxton. 2013. A landscape-based assessment of climate change vulnerability for all native Hawaiian plants. Technical report HCSU-044. Hawaii Cooperative Studies Unit, University of Hawaii at Hilo, Hawaii. 134 pp.

[HPPRCC] Hawai‘i and Pacific Plants Recovery Coordinating Committee. 2011. Revised recovery objective guidelines. 8 pp.

[PEPP] Plant Extinction Prevention Program. 2013. Annual report fiscal year 2013 (July 1, 2012-June 30, 2013). 207 pp.

[USFWS] U.S. Fish and Wildlife Service. 2012. Endangered and threatened wildlife and plants; Endangered status for 23 species on Oahu and designation of critical habitat for 124 species; final rule. Department of the Interior, Federal Register 77 (181): 57648–57862, September 18, 2012.

[USFWS] 2013. *Neraudia angulata* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. *https://ecos.fws.gov/docs/five_year_review/doc4228.pdf.*

[USFWS] 2017. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 138 species in Hawaii, Oregon, Washington, and California. Federal Register 82(75): 18665–18668, April 20, 2017.

Waimea Arboretum. 2013. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii.

Waimea Arboretum. 2014. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii.

Waimea Arboretum. 2015. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii.

U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of *Neraudia angulata* (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

For **Field Supervisor, Pacific Islands Fish and Wildlife Office**

MEGAN LAUT Digitally signed by MEGAN LAUT
Date: 2019.09.27 09:55:35 -10'00'

Date_____