5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Zanthoxylum dipetalum* var. *tomentosum* (aʻe, kāwaʻu)

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, Hawaiʻi

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 2019. The review was based on a review of current, available information since the last 5-year review for *Zanthoxylum dipetalum* var. *tomentosum* (USFWS 2015). 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 *Zanthoxylum dipetalum* var. *tomentosum* published in the Federal Register on June 2, 2009 and August 6, 2015 (available at *https://ecos.fws.gov/docs/five_year_review/doc2427.pdf* *https://ecos.fws.gov/docs/five_year_review/doc4569.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 *Z. dipetalum* var. *tomentosum*.

This long-lived perennial tree in the Rutaceae (rue, citrus) family is endangered. The status and trends for *Zanthoxylum dipetalum* var. *tomentosum* are provided in the tables below.

New Status Information:

- Currently, there are nine mature and one immature wild individuals at Pu‘uwa‘awa‘a on the island of Hawai‘i (Adkins 2020, in litt.).

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. This assessment concluded that *Zanthoxylum dipetalum* (at the species level) is vulnerable to the impacts of climate change, with a vulnerability score of 0.246 (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 variety into the future, such as locating key microsites that overlap with current and future climate envelopes for outplanting efforts.

New Management Actions:

- Ungulate management and control—In 2018, the Plant Extinction Prevention Program (PEPP) installed plastic deer mesh around an exclosure to exclude feral pigs and nonnative game birds to protect newly found natural seedlings (PEPP 2018).
- Captive propagation for genetic storage and reintroduction—
    - In 2018, the rare plant nursery at Pu‘uwa‘awa‘a reported propagation of 95 individuals of *Zanthoxylum dipetalum* var. *tomentosum* (Pu‘uwa‘awa‘a 2018). In addition, 33 seeds were collected from plants at five locations in Pu‘uwa‘awa‘a and sent them to the Volcano Rare Plant Facility (VRPF) for propagation.
    - The VRPF reported propagation from at least 6 founders with 11 individuals currently in inventory representing all 6 (VRPF 2015-2019). PEPP reported collection of 33 fruit and 21 cuttings from two individuals for propagation at the rare plant facility at Pu‘uwa‘awa‘a (PEPP 2017).
- Reintroduction or translocation—
    - From 2015 to 2019, VRPF propagated 207 individuals for reintroduction back to Pu‘uwa‘awa‘a (27 of these were given to the State) (VRPF 2015-2019).
    - In 2018, the first recruits were documented from wild plants at the Waihou management unit.
    - In 2019, the Division of Forestry and Wildlife reintroduced approximately 140 individuals of *Zanthoxylum dipetalum* var. *tomentosum* at five locations within Pu‘uwa‘awa‘a (PEPP 2019; Adkins 2020, in litt.).

Table 1. Status and trends of *Zanthoxylum dipetalum* var. *tomentosum* from listing through current 5-year review.

Date	No. wild individuals	No. outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization Criteria Completed?
1996 (listing)	24	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 25 mature individuals each	No
1998 (recovery plan)	24	20	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 25 mature individuals each	No
2003 (critical habitat)	14	2–3	All threats managed in all 3 populations	Partially
			Complete genetic storage	No
			3 populations with 25 mature individuals each	No
2009 (5-year review)	13	19	All threats managed in all 3 populations	Partially
			Complete genetic storage	No
			3 populations with 25 mature individuals each	No
2015 (5-year review)	11	27	All threats managed in all 3 populations	Partially

			Complete genetic storage	Partially
			3 populations with 25 mature individuals each	No
Date	**No. wild individuals**	**No. outplanted**	***Preventing Extinction Criteria identified by HPPRCC**	***Preventing Extinction Criteria Completed?**
2020 (5-year review)	10	ca 200, survivability uncertain	All threats managed in all 3 populations	Partially
			Complete genetic storage	Mostly complete
			Reproduction (i.e. viable seeds, seedlings) at all 3 populations	Partially
			3 populations with 50 mature individuals each	No

* 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 *Zanthoxylum dipetalum* var. *tomentosum* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulate destruction and degradation of habitat	A, D	Ongoing	Partial, small exclosures for each occurrence
Established ecosystem altering invasive plant species degradation of habitat and competition	A, E	Ongoing	Partial, nonnative plant control within fenced areas
Drought destruction and degradation	A	Ongoing	Partial, supplemental water provided
Fire destruction and degradation	A	Ongoing	Partial, nonnative plant control within exclosures
Climate change degradation or loss of habitat	A	Ongoing	None

Unrestricted collection for scientific and horticultural use	B	Ongoing	None
Rodent predation and herbivory	C	Ongoing	None
Invertebrate predation and herbivory—Black twig borer, ants, scale, mealybugs, thrips, aphids	C	Ongoing	None
Loss of vigor due to low numbers and small populations	E	Ongoing	Partial, collection, propagation from seeds, cuttings, and air-layering, and reintroduction

Synthesis:
Currently, there are nine wild mature and one immature individuals of *Zanthoxylum dipetalum* var. *tomentosum* in one population 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 *Z. dipetalum* var. *tomentosum* is vulnerable to the effects of climate change. Over 200 plants were propagated from collections of seeds and cuttings, and 11 plants are currently in *ex situ* storage representing six wild trees. Approximately 200 individuals have been reintroduced to Pu‘uwa‘awa‘a since the last 5-year review. There have been improvements made to small exclosures to prevent incursion by feral pigs and nonnative game birds.

Stabilizing (interim), downlisting, and delisting objectives were provided in the Big Island II: Addendum to the Recovery Plan for Big Island Plant Cluster (USFWS 1998), and have been updated according to 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.

Zanthoxylum dipetalum var. *tomentosum* is a long-lived perennial tree that is an obligate outcrosser. 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 three 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. There is one population totaling nine mature individuals (Table 1, Table 2). Almost founders are represented in a nursery living collection for genetic storage (Table 1). In addition, not all threats are being managed (Table 1, Table 2). The number of remaining wild individuals continues to decline with uncertainty regarding survival of reintroductions. Therefore, *Zanthoxylum dipetalum* var. *tomentosum* meets the definition of Endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:
There are no new threats and no other significant new information is reported regarding the species' biological status since the last 5-year review in 2015. Thus, the following recommendations for future actions are reiterated for the 5-year review for 2020.

- Surveys and inventories—Survey the current and historical range of *Zanthoxylum dipetalum* var. *tomentosum* to assess its current status and search for new individuals.
- Ungulate exclosures—Continue to construct exclosures and improve existing exclosures at known populations and monitor and maintain fencing to protect *Z. dipetalum* var. *tomentosum* from feral ungulates and nonnative game birds.
- Ecosystem-altering invasive plant species control—Control invasive nonnative plants at all wild and reintroduced populations of *Z. dipetalum* var. *tomentosum*.
- Drought monitoring and control—Assess the need for supplemental watering and provide if necessary.
- Fire monitoring and control—Develop and implement a fire management plan for the existing population.
- Climate change adaptation strategy—Assess the modeled effects of climate change on this species and use to determine future landscape needed for its recovery.
- Rodent control—Implement effective control measures for rodents.
- Invertebrate control—Determine effective control measures and implement if necessary for the black twig borer, and ants and associated pest species including scale, mealybugs, thrips, and aphids.
- Captive propagation for genetic storage and reintroduction—
    - Continue collection of material for genetic storage and propagation for reintroduction.
    - Research effective propagation methods including use of cuttings and air-layering for this species.
- Reintroduction and translocation—Continue reintroduction into suitable protected habitat and establish new viable populations.
- Population biology research—
    - Assess the level of genetic diversity remaining within the species through genetic studies.

    - Develop a breeding program to maintain the genetic diversity of the species.
- Alliance and partnership development—Continue to work with the Division of Forestry and Wildlife and other partners and land managers in planning and implementation of ecosystem-level restoration and management to benefit this species.

References:

Adkins, E. 2020, in litt. Email response to request for information on listed plants at Pu‘uwa‘awa‘a, 16 JUL 2020.

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] 2017. Plant Extinction Prevention Program FY 2017 annual report (Oct 1, 2016-Sep 30, 2017), US FWS CFDA program #15.657; Endangered species conservation-recovery implementation funds, Cooperative Agreement F14AC00174, December 12, 2017, UH Manoa, PCSU, PEPP. 235 pp.

[PEPP] 2018. Plant Extinction Prevention Program, annual recovery subpermit FWSPIFWO-26 report (January 1st, 2018–December 31st 2018), as designated under the U.S. Endangered Species Act. Unpublished report submitted to U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii. 192 pp.

[PEPP] 2019. Plant Extinction Prevention Program, annual recovery subpermit FWSPIFWO-26 report (January 1st, 2018–December 31st 2018), as designated under the U.S. Endangered Species Act. Unpublished report submitted to U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii. 569 pp.

Pu‘uwa‘awa‘a. 2018. Report on controlled propagation of listed 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, Hawai‘i.

[USFWS] U.S. Fish and Wildlife Service. 1998. Big Island II: Addendum to the recovery plan for the Big Island plant species. Portland. 69 pp. + appendices.

[USFWS] 2009. *Zanthoxylum dipetalum* var. *tomentosum* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. *https://ecos.fws.gov/docs/five_year_review/doc2427.pdf.*

[USFWS] 2015. *Zanthoxylum dipetalum* var. *tomentosum* 5-year review summary and evaluation. USFWS Pacific Islands Fish and Wildlife Office, Honolulu, HI. *https://ecos.fws.gov/docs/five_year_review/doc4569.pdf.*

[USFWS] 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.

[VRPF] Volcano Rare Plant Facility. 2015-2019. Summary of reports on controlled propagation of listed 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, Hawai‘i.

U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of *Zanthoxylum dipetalum* var. *tomentosum*
(aʻe, kāwaʻu)

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**

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