5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Zanthoxylum hawaiiense* (ae, manele)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2008. Endangered and threatened wildlife and plants; initiation of 5-year status reviews of 70 species in Idaho, Montana, Oregon, Washington, and the Pacific Islands. Federal Register 73(83):23264-23266.

Lead Region/Field Office:

Region 1/Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii

Name of Reviewer(s):

Marie Bruegmann, Pacific Islands Fish and Wildlife Office, Plant Recovery Coordinator
Marilet A. Zablan, Pacific Islands Fish and Wildlife Office, Assistant Field Supervisor for Endangered Species
Jeff Newman, Pacific Islands Fish and Wildlife Office, Acting Deputy Field Supervisor

Methodology used to complete this 5-year 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 29, 2008. The review was based on the final critical habitat designation for *Zanthoxylum hawaiiense* and other species from the islands of Lanai, Molokai, Hawaii, Maui, and Kauai (USFWS 2003a,b,c,d,e) as well as a review of current, available information. The National Tropical Botanical Garden 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 the Plant Recovery Coordinator. The document was then reviewed by the Assistant Field Supervisor for Endangered Species and Acting Deputy Field Supervisor before submission to the Field Supervisor for approval.

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).

Application of the 1996 Distinct Population Segment (DPS) Policy:

This Policy does not apply to plants.

Review Analysis:

Please refer to the final critical habitat designation for *Zanthoxylum hawaiiense* published in the Federal Register on February 27, March 18, July 2, and May 14, 2003 (USFWS 2003a, b, c, d, e) for a complete review of the species' status including biology and habitat, threats, and management efforts. No new threats and no significant new

information regarding the species' biological status have come to light since listing to warrant a change in the Federal listing status of *Z. hawaiiense*.

Zanthoxylum hawaiiense probably grew more widely in Hawaii's prehistorical past. Abundant fossil seeds (identified as *Z. hawaiiense* or *kauaense*) were found at a coastal site on the island of Kauai (Burney *et al.* 2001). Now found only at higher elevations on the islands of Kauai, Maui, Molokai, and Hawaii, and no longer found on Lanai. Approximately 550 individuals are currently known statewide. The number of individuals was estimated at 250 in 1996. This rise in the number of wild individuals is the result of increased surveying on the island of Hawaii.

On the island of Kauai, in Kawaiiki Valley, from the mouth of Koaie confluence, one mature individual was seen in 2007 at an elevation of 792 meters (2,600 feet) (Tangalin 2008; Wood 2008). In 2000, one mature individual was seen in Koaie Canyon at 732 meters (2,400 feet) elevation (Wood 2000). On West Maui, at Puehuehunui, near the southeastern rim of Kauaula, two locations at elevations of 1,006 meters (3,300 feet) and 853 meters (2,800 feet) had a total of 7 mature, and 10 immature individuals in 2006 (Wood 2008). On East Maui, in the western part of Auwahi, three vigorous mature individuals were seen in 1999 at 1,067 meters (3,500 feet) elevation (Wood 2008). Three still remained there in 2006 (Starr 2008). On Molokai, at Pelekunu Preserve, Puu Hoi Ridge, two mature individuals were observed in 1989 at 549 to 616 meters (1,800 to 2,020 feet) elevation (Hawaii Biodiversity and Mapping Program 2008). One mature individual was seen in 1991 above Kamalo at 880 meters (2,887 feet) elevation (Wood 2008). In 2005, 1 mature individual and 25 seedlings were seen in Makolelau Gulch, where in 1993 there had been 3 mature individuals (Hawaii Biodiversity and Mapping Program 2008) between 670 and 823 meters (2,200 and 2,700 feet) elevations (Perlman 2008a; Tangalin 2005). The largest numbers of *Zanthoxylum hawaiiense* are on the island of Hawaii. At the Pohakuloa Training Area, at elevations from 1,402 to 1,615 meters (4,600 to 5,300 feet) most recent surveys reported 465 individuals, a substantial increase in number. These are almost all mature individuals, with few known immature individuals (Evans *et al.* 2006; Hawaii Biodiversity and Mapping Program 2008). The Hawaii Department of Land and Natural Resources' Department of Forestry and Wildlife reports that in 2006, 65 widely scattered individuals were counted within the Puu Waawaa Forest Reserve and the Puu Anahulu Game Management Area on the island of Hawaii (Hawaii Department of Land and Natural Resources 2008).

Zanthoxylum hawaiiense is a dioecious tree now occurring primarily as solitary individuals, widely scattered in their locations. Eighty percent or more of the plants are estimated to occur singly, and as a result, research is planned to determine the sex of fruiting individuals within the Pohakuloa Training Area (Evans *et al.* 2006). This will help determine whether distance and isolation are impeding regeneration, and if resource managers need to assist in pollination. The U.S. Department of Agriculture, Agricultural Research Service, National Center for Genetic Resource Preservation, in Fort Collins, Colorado has also recently been researching germination problems of other Hawaiian Rutaceae (M. Clark, National Tropical Botanical Garden, pers. comm. 2008). Reproduction in this species has become problematic. Research on its reproductive

process is being pursued in order to facilitate propagation for augmentation of existing populations (Evans *et al.* 2006).

Classification of the Kauai individual of *Zanthoxylum* in Kawaiiki has been somewhat controversial among taxonomists, but most agree it is *Zanthoxylum hawaiiense* (Perlman 2008b).

On Kauai at Kawaiiki, the habitat is degraded *Diospyros sandwicensis* (lama) - *Metrosideros polymorpha* (ohia) mesic mixed lowland forest and cliffs with alien vegetation. Associated species include *Alectryon macrococcus* (mahoe), *Antidesma platyphyllum* (hame), *Bobea timonioides* (ahakea), *Dodonaea viscosa* (aalii), *Hibiscus waimeae* subsp. *waimeae* (kokio keokeo), *Isodendrion laurifolium* (aupaka), *Kokia kauaiensis* (kokio), *Munroidendron racemosum* (no common name [NCN]), *Myrsine* sp. (kolea), *Nestegis sandwicensis* (olopua), *Nototrichium sandwicensis* (kulei), *Pisonia sandwicensis* (kaulu), *Pleomele aurea* (hala pepe), *Psydrax odorata* (alahee), *Pteralyxia kauaiensis* (kaulu), *Sida fallax* (ilima), *Xylosma hawaiiense* (maua), and *Zanthoxylum dipetalum* (kawau) (Perlman 1993, 2008a; Wood 2008).

At Koaie, the habitat is *Diospyros sandwicensis - Metrosideros polymorpha* mixed mesic forest with ferns including *Doodia kunthiana* (okupukupu), *Microlepia strigosa* (palapalai), *Sphenomeris chinensis* (palaa), *Polypodium pellucidum* (ae lau nui), *Psilotum nudum* (moa nahele), *Pteridium aquilinum* var. *decompositum* (bracken fern), and *Pteris irregularis* (mana, iwa puakea). Other associated species include *Acacia koaia (koaia)*, *Alectryon macrococcus* var. *macrococcus* (mahoe), *Alyxia stellata* (maile), *Antidesma platyphyllum* var. *hillebrandii* (hame), *Bidens sandvicensis* subsp. *sandvicensis* (kookoolau), *Bobea brevipes* (ahakea lau lii), *Bonamia menziesii* (NCN), *Carex meyenii* (NCN), *Dodonaea viscosa* (aalii), *Eragrostis variabilis* (kawelu), *Kadua affinis* (manono), *Leptecophylla tameiameiae* (pukiawe), *Melanthera subcordata* (nehe), *Nestegis sandwicensis* (olopua), *Peperomia* spp. (ala ala wai nui), *Pipturus albidus (*mamaki), *Pipturus kauaiensis* (mamaki), *Pleomele aurea* (hala pepe), *Pouteria sandwicensis* (alaa), *Pritchardia minor* (loulu), *Psychotria greenwelliae* (kopiko), *P. mariniana* (kopiko), *Psydrax odorata* (alahee), *Santalum freycinetianum* var. *pyrularium* (iliahi), *Sida fallax* (ilima), *Tetraplasandra kavaiensis* (ohe ohe), and *Xylosma hawaiiense* (maua) (Wood 2000).

On West Maui, on Kauaula's southeastern rim, the habitat is mixed mesic shrubland/grassland with steep to vertical rocky slopes and ridges native plant species including *Bidens micrantha* (kookoolau), *Dianella sandwicensis* (uki uki), *Dicranopteris linearis* (uluhe), *Dodonaea viscosa* (aalii), *Leptecophylla tameiameiae* (pukiawe), *Morelotia gahniiformis* (NCN), occasional *Neraudia melastomifolia* (maaloa), and *Melicope hawaiiense* (mokihana) (Wood 2007, 2008).

On East Maui, in western Auwahi, *Zanthoxylum* grows in aa lava with pockets of rich soil, in mixed open dry forest with *Bidens micrantha* (kookoolau), *Dianella sandwicensis* (uki uki), *Dicranopteris linearis* (uluhe), *Dodonaea viscosa* (aalii), *Morelotia*

gahniiformis (NCN), *Nestegis sandwicensis* (olopua), *Osteomeles anthyllidifolia* (ulei), and *Pleomele auwahiensis* (hala pepe) (Wood 2006, 2008).

On Molokai, in the areas where *Zanthoxylum* has been seen, the habitat is *Leptecophylla tameiameiae* (pukiawe) shrubland with remnant *Diospyros sandwicensis – Metrosideros polymorpha* mesic forest patches. Associated native species are *Antidesma* sp. (hame), *Bidens menziesii* (kookoolau), *Chamaesyce celastroides* var. *lorifolia* (akoko), *Charpentiera* sp. (papala), *Dodonaea viscosa* (aalii), *Dubautia linearis* (naenae), *Lipochaeta rockii* (nehe), *Lysimachia* sp. (NCN), *Melicope hawaiiensis* (mokihana), *Myoporum sandwicensis* (naio), *Myrsine lanaiense* (kolea), *Nesoluma polynesicum* (keahi), *Nestegis sandwicensis* (olopua), *Nothocestrum latifolium* (aiea), *Nototrichium sandwicense* (kului), *Ochrosia* sp. (holei), *Pleomele auwahiensis* (hala pepe), *Pittosporum argentifolium* (hoawa), *Pritchardia munroi* (*loulu*), *Pouteria sandwicensis* (alaa), *Reynoldsia sandwicensis* (ohe), *Sadleria* sp. (amau), *Santalum* sp. (iliahi, sandalwood), *Scaevola* sp. (naupaka), *Schiedea lydgatei*, *Sophora chrysophylla (mamane)*, *Streblus pendulinus* (aiai), *Viola chamissoniana* subsp. *tracheliifolia* (pamakani), and *Wikstroemia* sp. (akia) (Perlman 1993, 2008a; Tangalin 2005; Wood 2008).

On the island of Hawaii, *Zanthoxylum hawaiiense* occurs on both aa and pahoehoe flows of varying ages. Plant communities in which it is found are open *Metrosideros polymorpha* forest with sparse to dense shrub understory and *Myoporum sandwicensis - Dodonaea viscosa* shrubland. Associated species include *Alphitonia ponderosa* (kauila), *Coprosma* sp. (pilo), *Exocarpos gaudichaudii* (hulumoa), *Festuca hawaiiensis* (fescue), *Haplostachys haplostachya* (honohono), *Kadua coriacea* (kioele), *Melicope hawaiensis* (mamaki), *Myrsine* sp. (kolea), *Osteomeles anthyllidifolia* (ulei), *Pittosporum terminalioides* (hoawa), *Santalum* sp., *Silene lanceolata* (NCN), *Stenogyne angustifolia* (NCN), *Tetramolopium arenarium subsp. arenarium* (NCN), and *Wikstroemia* sp. (akia) (Evans *et al.* 2006; Hawaii Biodiversity and Mapping Program 2008)

On Kauai, Kokee and Waimea Canyon State Parks have serious erosion resulting from negative impacts from goats (*Capra hircus*) (Factor A). Invasive introduced plant species are also a threat, in Kawaiiki they including *Triumfetta semitriloba* (Sacramento bur), *Setaria parviflora* (knot root bristle grass), *Lantana camara* (lantana), and *Melia azedarach* (chinaberry, pride-of-India) (Perlman 2008a; Wood 2008). In Koaie, invasive introduced plant species include *Adiantum hispidulum (*rough maidenhair fern), *Aleurites moluccana* (kukui), *Commelina diffusa* (honohono), *Cordyline fruticosa* (ti), *Gastridium ventricosum* (nitgrass), *Grevillea robusta* (silk oak), *Kalanchoe pinnata* (airplant), *Lantana camara* (lantana), *Ludwigia octovalvis* (primrose willow), *Melia azedarach* (pride-of-India), *Paspalum urvillei* (Vasey grass), *Passiflora edulis* (passion fruit), *Pluchea carolinensis* (sourbush), *Psidium cattleianum* (strawberry guava), and *P. guajava* (common guava) (Factor E) (Wood 2000).

Fire is a threat (Factor E) on West Maui as are invasive introduced plant species including *Buddleia asiatica* (dog tail), *Psidium guajava* (common guava), *Grevillea robusta* (silk oak), *Ageratina adenophora* (pamakani haole), *Rubus rosifolius*

(thimbleberry), and *Erigeron karvinskianus* (daisy fleabane) (Factor E) (Wood 2006, 2008). Signs of goat activity were abundant in Eastern Makolelau Gulch when visited by Perlman in 1993 (Factors A and C) (Hawaii Biodiversity and Mapping Program 2008).

Fire is a threat to dry areas of the island of Hawaii (Factor E). Invasive introduced plant species in Pohakuloa Training Area where *Zanthoxylum hawaiiense* is located include *Pennisetum setaceum* (fountain grass) and *Kalanchoe tubiflora* (chandelier plant) (Factor E) (Beavers 2000; Evans *et al.* 2006). The weedy grass *P. setaceum* now dominates the western-most portion of the Pohakuloa Training Area, creating a serious fire threat and endangering several listed plant species in the area. Military activities regularly result in small fires there (Beavers 2000).

In 1996, rats (*Rattus* spp.) negatively impacted *Zanthoxylum hawaiiense* by collecting and consuming seeds (Factor C) (USFWS 1996). In Kauai's Kawaiiki Valley, goats, pigs (*Sus scrofa*), and rats are all threats to this species (Factors A and C) (Perlman 2008a). On Molokai, deer (*Axis axis*) and rats are threats to *Z. hawaiiens*e (Factor C) (Perlman 1993, 2008a). Threats on the island of Hawaii are browsing by ungulates, including sheep (*Ovis aries*), mouflon sheep (*Ovis musimon*), goats, and pigs, and rats (Factors A and C). U.S. Army staff has set up bait grids for controlling rats and fencing to exclude browsing ungulates (Evans *et al.* 2006). Some fences have been erected also by the Hawaii Division of Forestry and Wildlife, which reports that bark stripping, probably by sheep, has occurred on a majority of the trees at Puu Waawaa and Puu Anahulu on the island of Hawaii (Factor C) (Hawaii Department of Land and Natural Resources 2008; S. Fretz, Hawaii Department of Land and Natural Resources, pers. comm. 2008).

Climate change may also pose a threat to *Zanthoxylum hawaiiense* (Factors A and E). However, current climate change models do not allow us to predict specifically what those effects, and their extent, would be for this species.

The USFWS (2003f) identified areas of the Pohakuloa Training Area to be protected by large-scale fences. Training Areas 1 through 20 as well as portions of 21 and 22 are leased from the State of Hawaii. There are several listed plant species found in these areas. The lease agreement between the State of Hawaii and the U.S. Army, which was negotiated in 1965 and pre-dates the Endangered Species Act, does not allow for the construction of large-scale fences. Thus, a resolution of this issue is necessary to proceed with the fencing provisions stated in the biological opinion. Lease agreements must be renegotiated by the State of Hawaii and the U.S. Army (Evans *et al.* 2006).

PTA staff reports that they have 23 seeds from six wild individuals in storage for this species. However, the seeds are often found without a developed embryo, and there are difficulties with low viability, and slow, sporadic germination over a period of several years. They hope to improve this with additional collections from other individuals (Evans *et al.* 2006; U.S. Army 2009). The National Tropical Botanical Garden (2009) has 46 seeds representing populations from West Maui. The Volcano Rare Plant Facility (2009) has 9 seeds in storage.

Stabilizing, downlisting, and delisting objectives are provided in the Recovery Plan for the Big Island Plant Cluster (USFWS 1996), based on whether the species is an annual, a short-lived perennial (fewer than 10 years), or a long-lived perennial. *Zanthoxylum hawaiiense* is a long-lived perennial, and to be considered stable, the taxon must be managed to control threats (*e.g.*, fenced) and be represented in an *ex situ* (at other than the plant's natural location, such as a nursery or arboretum) collection. In addition, a minimum of three populations should be documented on the islands of Kauai, Maui, Molokai, Lanai, and Hawaii or any of the islands on which it occurred historically. Each of these populations must be naturally reproducing and increasing in number, with a minimum of 25 mature individuals per population.

The interim stabilization goals for this species have not been met (see Table 1), as only one population has more than 25 individuals and not all threats are being managed. Therefore, *Zanthoxylum hawaiiense* meets the definition of endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

- Fence wild populations to exclude ungulates.
- Develop and implement an effective and efficient rat control method.
- Control invasive introduced plant species to remove competition and control fire.
- Continue research into seed quality and reproduction.
- Work with Hawaii Division of Forestry and Wildlife and U.S. Army to initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this species.

References:

Beavers, A. 2000. Analysis of fire history and management concerns at Pohakuloa Training Area. The Center for Environmental Management of Military Lands, Fort Collins, Colorado. 65 pages. Unpublished.

Burney, D.A., H.F. James, L.P. Burney, S.L. Olson, W. Kikuchi, W.L. Wagner, M. Burney, D. McCloskey, D. Kikuchi, F.V. Grady, R. Gage, and R. Nishek. 2001. Fossil evidence for a diverse biota from Kauai and its transformation since human arrival. Ecological Monographs 71(4):615-641.

Evans, S.A., L. Schnell, K. Kawakami, J. Taylor, L. Tominaga, B. Tucker, and E. Wascher. 2006. Report of the ecosystem management at Pohakuloa Training Area, island of Hawaii; July 2003 to December 2005. U.S. Army Garrison, Pohakuloa Training Area, Hawaii. 155 pages. Unpublished.

Hawaii Biodiversity and Mapping Program. 2008. Program database. University of Hawaii, Center for Conservation, Research and Training, Honolulu, Hawaii. Unpublished.

Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife. 2008. Division of Forestry and Wildlife master all plants at Puu Waa Waa and Puu Anahulu. Unpublished.

National Tropical Botanical Garden. 2009. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. National Tropical Botanical Garden, Kalaheo, Hawaii. Unpublished.

Perlman, S. 1993. Rutaceae: *Zanthoxylum hawaiiense* Hillebr. SP 13364. Herbarium database. National Tropical Botanical Garden, Kalaheo, Hawaii. Available online at <http://ntbg.org/herbarium>.

Perlman, S. 2008a. *Zanthoxylum hawaiiense* summary of field notes. National Tropical Botanical Garden, Kalaheo, Hawaii. 2 pages. Unpublished.

Perlman, S. 2008b. *Zanthoxylum hawaiiense*. National Tropical Botanical Garden, Kalaheo, Hawaii. 2 pages. Unpublished.

Starr, F.K. 2008. *Zanthoxylum hawaiiense* sapling at Auwahi, Maui, March 25, 2006. Available online at <http://www.hear.org/starr/plants/images/species/>. Accessed 28 October 2008.

Tangalin, N. 2005. Rutaceae: *Zanthoxylum hawaiiense* Hillebr. NTBG #050234. Living collections database. National Tropical Botanical Garden, Kalaheo, Hawaii. Available online at <http://ntbg.org/conservation/database.php>.

Tangalin, N. 2008. *Zanthoxylum hawaiiense*. National Tropical Botanical Garden, Kalaheo, Hawaii. 1 pages. Unpublished.

U.S. Army. 2009. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. Unpublished.

[USFWS] U.S. Fish and Wildlife Service. 1994. Endangered and threatened wildlife and plants; endangered status for 21 plant species from the Island of Hawaii, Hawaii; final rule. Federal Register 59(43):10305-10325.

[USFWS] U.S. Fish and Wildlife Service. 1996. Recovery plan for the Big Island plant cluster. U.S. Fish and Wildlife Service, Portland, Oregon. 252 pages.

[USFWS] U.S. Fish and Wildlife Service. 2003a. Endangered and threatened wildlife and plants; final designation of critical habitat for three plant species from the island of Lanai, Hawaii; final rule. Federal Register 68(6):1220-1274.

[USFWS] U.S. Fish and Wildlife Service. 2003b. Endangered and threatened wildlife and plants; final designations and nondesignations of critical habitat for 42 plant species from the island of Molokai, Hawaii; final rule. Federal Register 68(52):12982-13141.

[USFWS] U.S. Fish and Wildlife Service. 2003c. 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. 2003d. Endangered and threatened wildlife and plants; designation of critical habitat for 60 plant species from the islands of Maui and Kahoolawe, Hawaii; final rule. Federal Register 68(93):25934-26165.

[USFWS] U.S. Fish and Wildlife Service. 2003e. Endangered and threatened wildlife and plants; final designation or nondesignation of critical habitat for 95 plant species from the islands of Kauai and Niihau, Hawaii; final rule. Federal Register 68(39):9116-9479.

[USFWS] U.S. Fish and Wildlife Service. 200ef. 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. Honolulu, Hawaii. 213 pages.

Volcano Rare Plant Facility. 2009. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. Unpublished.

Wood, K.R. 2000. *Zanthoxylum hawaiiense*, biogeographical data. National Tropical Botanical Garden, Kalaheo, Hawaii. 2 pages. Unpublished.

Wood, K.R. 2006. Living collections database. National Tropical Botanical Garden. Available online at http://ntbg.org/conservation/database.php.

Wood, K.R. 2008. *Zanthoxylum hawaiiense* Hillebr. National Tropical Botanical Garden, Kalaheo, Hawaii. 3 pages. Unpublished.

Wood, K. R. 2007. New plant records, rediscoveries, range extensions, and possible extinctions within the Hawaiian Islands. Bishop Museum Occasional Papers 96: 13–17.

Personal Communications:

Clark, Margaret. 2008. Seed Bank Manager, National Tropical Botanical Garden, Kalaheo, Hawaii. Memo to the files dated October 5, 2008.

Fretz, Scott. 2008. Wildlife Program Manager. Hawaii Department of Land and Natural Resources, Honolulu, Hawaii. E-mail to Margaret Clark, National Tropical Botanical Garden, dated October 5, 2008. Subject: HCP at Puu Anahulu and Puu Waawaa.

Table 1. Status of *Zanthoxylum hawaiiense* from listing through 5-year review.

Date	No. wild indivs.	No. outplanted	Stability Criteria identified in Recovery Plan	Stability Criteria Completed?
1994 (listing)	166 +	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 25 mature individuals each	No
1996 (recovery plan)	250	0	All threats managed in all 3 populations	No
			Complete genetic storage	Partially
			3 populations with 25 mature individuals each	No
2003 (critical habitat)	203	Unknown	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 25 mature individuals each	No
2009 (5-year review)	550	Unknown	All threats managed	Partially
			Complete genetic storage	Partially
			3 populations with 25 mature individuals each	No

U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of *Zanthoxylum hawaiiense* (ae, manele)

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

Field Supervisor, Pacific Islands Fish and Wildlife Office

_____ Date AUG 2 7 2010