5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Tetramolopium remyi* (no common name)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

Lead Region/Field Office:

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

Name of Reviewer(s):

Marie Bruegmann, Plant Recovery Coordinator, PIFWO
Jess Newton, Recovery Program Lead, PIFWO
Assistant Field Supervisor for Endangered Species, PIFWO

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 March 16, 2009. The review was based on final critical habitat designation for *Tetramolopium remyi* and other species from the islands of Maui, Kahoolawe, and Lanai (USFWS 2003a, b), 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 Tamara Sherrill, biological consultant, was reviewed by the Plant Recovery Coordinator. The document was then reviewed by the Recovery Program Lead and the Assistant Field Supervisor for Endangered Species 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 *Tetramolopium remyi* published in the Federal Register on January 9 and May 14, 2003 (USFWS 2003a, b) 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 *T. remyi*.

Tetramolopium remyi was listed as endangered in 1991. At that time, it was known from a single population of 35 plants on Lanai (USFWS 1991). It was known historically from dry exposed ridges and flats in the foothills of southwest Maui, but has not been reported from there in many years. It was last seen on Maui in 1944 (USFWS 2003b).

Tetramolopium remyi has been collected in the past in widely scattered locations on dry ridges of Lanai at 100 to 250 meters (330 to 820 feet) elevation. In 1992, only a single population of *Tetramolopium remyi* was known, at Awalua Ridge, containing six to seven individuals, but with only two seedlings observed in 1993 (USFWS 1995). This location was revisited in 2007, 2008, 2009, and 2010 with no individuals or recruitment of seedlings observed (Oppenheimer 2010; Perlman 2010; Wood 2010).

Botanists from the National Tropical Botanical Garden visited the site in Awehi, on the north slope of Mauna o Umi in 1997, and observed only two individuals. In December 2000, they were unable to relocate the plants, but six months later 30 seedlings were observed at 274 to 305 meters (900 to 1,000 feet) elevation (Perlman 2010; Wood 2010). In October 2001, no plants were found (Perlman 2010), and in 2003, 150 individuals were reported (USFWS 2003a) but from 2004 through 2007, regular observations at the site at various times during the year revealed 15 to 30 individuals in various life stages, from seedlings through senescence (Perlman 2010). This may be a second Mauna o Umi population, the earlier population being on the east slope, and the latter population located on the north slope (Oppenheimer 2010). In 2007, Hank Oppenheimer of the Plant Extinction Prevention Program and botanists from the National Tropical Botanical Garden found only 10 mature individuals and 10 seedlings. An earlier visit in that year reported 14 individuals (13 mature, one immature) (Hawaii Department of Land and Natural Resources 2007; Oppenheimer 2010). By September 2007, there were only five adults and no seedlings, a decrease in numbers presumably due to drought conditions. In March 2008, only three mature individuals and 10 seedlings were observed (Perlman 2010). In May 2008, all the seedlings were reported dead due to drought conditions. In January 2009, the three adults were still alive. During the same year in July, there were only two adults and approximately 15 seedlings. As of March 2010, a single adult and a single seedling remains, despite efforts of hand watering each individual two to three times a year in 2008, 2009, and continuing into 2010 (Oppenheimer 2010).

Fluctuations in population size are highly dependent on seasons and rainfall. In March 2010, Oppenheimer collected soil from where living adults and seedlings had recently occurred as marked with flagging in an effort to determine if a seed bank had established. This soil was taken to the Olinda Rare Plant Facility, but as of April 2010, no seeds had germinated (Oppenheimer 2010). These plants are not conspicuous and the area is not visited often, so additional populations could exist (USFWS 1995). Given the distance between Awalua and Mauna o Umi, there is a lot of potential habitat that needs to be surveyed (Oppenheimer 2010).

The habitat where *Tetramolopium remyi* occurs is lowland dry shrubland on dry, exposed ridges or flats at 150 to 770 meters (500 to 2,500 feet) elevation. The only known extant population occurs at about 200 meters (660 feet) elevation, on nearly barren red soils in a

highly overgrazed area in *Heteropogon contortus* (pili grass) and *Dodonaea viscosa* (aalii) shrubland. Associated native plant species include *Argemone glauca* (pua kala), *Bidens mauiensis* (kookoolau), *Doryopteris decipiens* (kumuniu), *Eragrostis variabilis* (kawelu), *Heteropogon contortus* (pili grass), *Lipochaeta heterophylla* (nehe), *L. lavarum* (nehe), *Myoporum sandwicensis* (naio), *Panicum fauriei* (no common name [NCN]), *Sida fallax* (ilima), *Waltheria indica* (uhaloa), and *Wikstroemia oahuensis* (akia) (Oppenheimer 2010; USFWS 1995; Wood 2010).

Trampling by feral axis deer (*Axis axis*) and mouflon sheep (*Ovis musimon*) is a threat to the habitat of *Tetramolopium remyi* (Listing Factors A and D). The area where *T. remyi* occurs was severely degraded by grazing and browsing of livestock in the past (Listing Factor A). Much of the native vegetation was removed because of grazing, thus increasing wind erosion of the fragile soils and creating opportunities for invasion by introduced plant species (Listing Factors A and E). These introduced invasive plant species include *Vachellia farnesiana* (klu), *Acacia mearnsii* (black wattle), *Andropogon virginicus* (broomsedge), *Cenchrus ciliaris* (buffelgrass), *Chamaecrista nictitans* (partridge pea), *Conyza bonariensis* (hairy horseweed), *Grevillea robusta* (silk oak), *Lantana camara* (lantana), *Melinis minutiflora* (molasses grass), *Melinis repens* (Natal grass), *Opuntia ficus-indica* (panini), *Pennisetum setaceum* (fountain grass), *Pluchea carolinensis* (marsh fleabane), *Prosopis pallida* (kiawe), and *Urochloa maxima* (Guinea grass). These introduced plant species also creates a fuel load, which increases the risk of fires (Listing Factor E) (Oppenheimer 2010; USFWS 1995; Wood 2010). Drought (Listing Factor E) is a serious threat to this species (Oppenheimer 2010).

Browsing by feral ungulates is not a threat to this species (Listing Factor C) (USFWS 1995; Wood 2010). This non-palatability to feral ungulates may be related to similar tribes within the Asteraceae family that are poisonous or unpalatable such as *Senecio madagascariensis*. Oppenheimer has observed several dead standing adults where it would have been browsed by ungulates if the species were palatable (Oppenheimer 2010).

Climate change may also pose a threat to *Tetramolopium remyi* (Listing Factors A and E). 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.

In addition to all of the other threats, species like *Tetramolopium remyi* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations and localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks (Listing Factor E). The extent of these natural processes on this single island endemic are exacerbated by anthropogenic threats, such as habitat loss for human development or predation by introduced species (Listing Factor E) (USFWS 2010).

The National Tropical Botanical Garden has grown *Tetramolopium remyi* in their nursery in the past. At present they have approximately 5,000 seeds from first generation cultivated plants in long-term storage from Mauna o Umi and Awalua Road (National Tropical Botanical Garden 2009a, b). The Lyon Arboretum has 8,970 seeds in long-term storage collected from 2002 to 2006 (Center for Conservation Research and Training Seed Storage Facility 2009). Seeds collected by the Plant Extinction Prevention Program in 2007 at Mauna o Umi were taken to Maui Nui Botanical Gardens (Oppenheimer 2010; Hawaii Department of Land and Natural Resources 2007). However, these seeds did not germinate.

The seeds of *Tetramolopium remyi* are difficult to collect because they develop relatively quickly after pollination, and the sites where they are located are very windy, so the achenes (dry, single-seeded fruits) are easily dispersed. Effort were made to collect seeds by bagging flowers, however the plants are too weak to support the bags. Maui Nui Botanical Garden has a few seeds collected from cultivated plants grown by the State Division of Forestry and Wildlife from seed collected from the Awalua Road population at the west end in the 1990's (Maui Nui Botanical Gardens 2009; Oppenheimer 2010). There is small fence (a wire cage) around the last mature individual at Mauna o Umi to prevent trampling by axis deer and mouflon sheep (Oppenheimer 2010).

Stabilizing, downlisting, and delisting objectives are provided in the Lanai plant cluster recovery plan (USFWS 1995), based on whether the species is a short-lived perennial (fewer than 10 years) or a long-lived perennial. *Tetramolopium remyi* is a short-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 island of Lanai, and if possible, the island of Maui, where it occurred historically. Each of these populations must be naturally reproducing and increasing in number, with a minimum of 50 mature individuals per population.

The interim stabilization goals for this species have not been met, as there is only one population with one mature individual (Table 1) and all threats are not being managed (Table 2). Therefore, *Tetramolopium remyi* meets the definition of endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

- Continue monitoring and watering individual wild plants.
- Maintain the small fence around the last mature individual at the Mauna o Umi to prevent trampling by axis deer and mouflon sheep.
- Construct large-scale fences around all naturally occurring and reintroduced individuals to control feral ungulates.
- Collect material for genetic storage and propagation for reintroduction.

- Test the viability of the seeds in storage at National Tropical Botanical Garden and Lyon Arboretum and determine if storage method needs to be modified.

- Reintroduce into protected suitable habitat within the species historical range.

- Collect fruit from any reintroduced individuals that set seed to add to the genetic diversity of the *ex situ* material.

- Control introduced invasive plant species around all populations.

- Conduct surveys to determine the current status of the species and for additional populations.

- Develop and implement a wildfire management plan.

- Assess the modeled effects of climate change on this species, and use to determine future landscape needed for the recovery of the species.

- Work with Hawaii Division of Forestry and Wildlife, Plant Extinction Prevention Program, and other land managers to initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this species.

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[USFWS] U.S. Fish and Wildlife Service. 1991. Endangered and threatened wildlife and plants; determination of endangered or threatened status for 6 plants from the island of Lanai, Hawaii. Federal Register 56(183):47686-47695.

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[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.

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Table 1. Status of *Tetramolopium remyi* from listing through 5-year review.

Date	No. wild indivs	No. outplanted	Stability Criteria identified in Recovery Plan	Stability Criteria Completed?
1991 (listing)	35	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
1995 (recovery plan)	2	0	All threats managed in all 3 populations	No
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
2003 (critical habitat)	150	Unknown	All threats managed in all 3 populations	No
			Complete genetic storage	Unknown
			3 populations with 50 mature individuals each	No
2010 (5-year review)	2	0	All threats managed in all 3 populations	No (Table 2)
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No: only 2 individuals remaining

Table 2. Threats to *Tetramolopium remyi*.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulates – habitat modification	A, D	Ongoing	Partially: single individual fenced at Mauna o Umi
Fire	E	Ongoing	No
Drought	E	Ongoing	Partially: hand watering of remaining individuals
Small population size	E	Ongoing	Yes: seeds collected and propagules growing in nurseries
Invasive introduced plants	A, E	Ongoing	No
Climate change	A, E	Increasing	No

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SIGNATURE PAGE for 5-YEAR REVIEW of *Tetramolopium remyi* (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

Field Supervisor, Pacific Islands Fish and Wildlife Office

Date SEP 2 0 2011