Tetramolopium capillare
(Pamakani)

5-Year Review
Summary and Evaluation

U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Honolulu, Hawaii

5-YEAR REVIEW

Species reviewed: *Tetramolopium capillare* (Pamakani)

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5-YEAR REVIEW
Tetramolopium capillare (Pamakani)

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office:
Region 1, Endangered Species Program, Division of Recovery, Jesse D'Elia, (503) 231-2071

Lead Field Office:
Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor, (808) 792-9400

Cooperating Field Office(s):
N/A

Cooperating Regional Office(s):
N/A

1.2 Methodology used to complete the 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 8, 2010. The review was based on the designation of critical habitat for *Tetramolopium capillare* and the recovery plan for the Maui plant cluster (USFWS 2003, 1997), as well as a review of current, available information. The Bernice Pauahi Bishop Museum 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 a recovery biologist and the Plant Recovery Coordinator. The document was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

1.3 Background:

1.3.1 Federal Register (FR) Notice citation announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2010. Endangered and threatened wildlife and plants; 5-year review status of 69 species in Idaho, Washington, Hawaii, Guam, and the Commonwealth of the Northern Mariana Islands. Federal Register 75(67):17947-17950.

1.3.2 Listing history

Original Listing
FR notice: USFWS. 1994. Endangered and threatened wildlife and plants; endangered status for the plant *Tetramolopium capillare* (pamakani); final rule. Federal Register 59(189):49860-49863.
Date listed: September 30, 1994
Entity listed: Species
Classification: Endangered

Revised Listing, if applicable
FR notice: N/A
Date listed: N/A
Entity listed: N/A
Classification: N/A

1.3.3 Associated rulemakings:

USFWS. 2003. 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.

Critical habitat was designated for *Tetramolopium capillare* in a single unit, totaling 1,782 hectares (4,404 acres) on the island of Maui on State and private lands (USFWS 2003).

USFWS. 2012. Endangered and threatened wildlife and plants; listing 38 species on Molokai, Lanai, and Maui as endangered and designating critical habitat on Molokai, Lanai, Maui and Kahoolawe for 135 species. Federal Register 77(112):34464-34775.

Critical habitat revisions are being proposed for *Tetramolopium capillare* (USFWS 2012).

1.3.4 Review History:

Species status review [FY 2011 Recovery Data Call (August 2011)]: Undetermined

Recovery achieved:
1 (0-25%) (FY 2007 Recovery Data Call)

1.3.5 Species' Recovery Priority Number at start of this 5-year review:

2

1.3.6 Current Recovery Plan or Outline

Name of plan or outline: USFWS. 1997. Recovery plan for the Maui plant cluster. U.S. Fish and Wildlife Service, Portland, Oregon. 130 pages +

appendices. Available online at <http://www.fws.gov/pacificislands/recoveryplans.html>.
Date issued: July 29, 1997
Dates of previous revisions, if applicable: N/A

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate?

____ ***Yes***
__X_ ***No***

2.1.2 Is the species under review listed as a DPS?

____ ***Yes***
__X_ ***No***

2.1.3 Was the DPS listed prior to 1996?

____ ***Yes***
____ ***No***

2.1.3.1 Prior to this 5-year review, was the DPS classification reviewed to ensure it meets the 1996 policy standards?

____ ***Yes***
____ ***No***

2.1.3.2 Does the DPS listing meet the discreteness and significance elements of the 1996 DPS policy?

____ ***Yes***
____ ***No***

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy?

____ ***Yes***
__X_ ***No***

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

__X_ ***Yes***
____ ***No***

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-

to date information on the biology of the species and its habitat?

__X_ ***Yes***
____ ***No***

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria?

__X_ ***Yes***
____ ***No***

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

A synthesis of the threats (Listing Factors A, B, C, D, and E) affecting this species is presented in Section 2.3.2 and Table 2.

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for the Maui plant cluster (USFWS 1997), based on whether the species is an annual, a short-lived perennial (fewer than ten years), or a long-lived perennial. *Tetramolopium capillare* is a short-lived perennial, and to be considered stabilized, which is the first step in recovering the species, the taxon must be managed to control threats (*e.g*., fenced) and be represented in an *ex situ* (off-site) collection. In addition, a minimum of three populations should be documented on Maui. For the species to be considered stable, each of these populations must be naturally reproducing and increasing in number, with a minimum of 50 mature individuals per population.

This recovery objective has not been met.

For downlisting, a total of five to seven populations of *Tetramolopium capillare* should be documented on the island of Maui. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with a minimum of 300 mature individuals per population. Each population should persist at this level for a minimum of five consecutive years before downlisting is considered.

This recovery objective has not been met.

For delisting, a total of eight to ten populations of *Tetramolopium capillare* should be documented on the island of Maui. Each of these populations must be naturally reproducing, stable or increasing in number, and secure from threats, with 300 mature individuals per population. Each population should persist at this level for a minimum of five consecutive years before delisting is considered.

This recovery objective has not been met.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

No new information.

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Tetramolopium capillare was rediscovered in the early 1990s on Hale Pohaku and below Koai peaks, located between the Olowalu and Ukumehame drainages in southwestern West Maui (Hawaii Biodiversity and Mapping Program 2010; National Tropical Botanical Garden 2010a; USFWS 1994, 1997).

When *Tetramolopium capillare* was listed in 1994 it was known from two populations totaling 12 individuals (USFWS 1994). In 1993, two new populations of *T. capillare* totaling 100 to 125 individuals were located on cliff faces in Kauaula Valley, several drainages north of the recently rediscovered individuals (National Tropical Botanical Garden 2010a; USFWS 1997). When the recovery plan was issued, population numbers were revised to 2 to 4 populations totaling fewer than 200 individuals (USFWS 1997). In around 2000, the upper of the two Kauaula Valley populations was destroyed in a landslide (H. Oppenheimer, Plant Extinction Prevention Program, pers. comm. 2010).

When critical habitat was designated in 2003, the census stood at five populations totaling 166 individuals from State (West Maui Forest Reserve) and privately owned lands within the West Maui Mountains Watershed Partnership, south of Kanaha Stream, Kauaula, Ulaula, and Koai (USFWS 2003).

In February 2006, a population of 19 individuals of a species of *Tetramolopium* was discovered at two sites in Hahakea Gulch, north of the Kauaula population (Oppenheimer 2006). A voucher specimen was collected and seeds from three individuals were obtained and sent to Lyon Arboretum, Maui Nui Botanical Garden, and Dr. Tim Lowrey of the University of New Mexico, an authority on the genus *Tetramolopium* in Hawaii. Individuals in this population do not match the description of *T. capillare*, but instead appear to be more similar to *T. filiforme* of Oahu, another federally listed species.

Efforts in March and May 2006 to relocate individuals of genuine *Tetramolopium capillare* in its known habitat on the ridge west of Ukumehame Valley leading to Koai, Ulaula, and Hale Pohaku were unsuccessful (Oppenheimer 2006). Subsequent surveys in the area in 2008 and 2009 also failed to relocate the species (Plant Extinction Prevention Program 2008, 2009), despite the presence of suitable habitat.

In 2010, there were no known genuine populations of *Tetramolopium capillare* (USFWS 2010). Meanwhile, population numbers for *Tetramolopium* species stands at around 120 individuals, with 19 individuals located at Hahakea and about 100 individuals at the lower (north fork) Kauaula Valley site (Plant Extinction Prevention Program 2010). A revisit of the upper Kauaula site in 2010 revealed no individuals of *T. capillare*, despite the presence of good habitat (H. Oppenheimer, pers. comm. 2010).

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

No new information.

2.3.1.4 Taxonomic classification or changes in nomenclature:

Tetramolopium capillare is a short-lived perennial in the sunflower family (Asteraceae). This West Maui endemic was first collected in 1819 and described in 1830 in the genus *Senecio* by C. Gaudichaud-Beaupré, and in 1965 was transferred to *Tetramolopium* by H. St. John (USFWS 1994, 1997). On West Maui, the geographic range of *T. capillare* overlaps that of the closely related *T. remyi*. Both species possess leaves with edges rolled under, an adaptation to xeric habitats; however, *T. capillare* can be separated by its sprawling habit, shorter flowering stalk, and smaller flower heads (Wagner *et al*. 1999; USFWS 1994, 1997, 2003).

Oppenheimer (2006) described the population at the two sites in Hahakea Gulch, as having disk florets as maroon; ray florets as white, turning lavender; and leaves as neither sclerophyllous (having stiff, firm leaves) nor strongly involute (leaf margins rolled inward toward the upper side), all characters that match those of *Tetramolopium filiforme* (Wagner *et al*. 1999). In contrast, *Tetramolopium capillare* has disk florets that are greenish yellow, tinged red; ray florets that are white; and leaves that are sclerophyllous and strongly involute (Wagner *et al*. 1999). Furthermore, comparison at Bishop Museum of the Hahakea voucher with material collected from the Kauaula population discovered in the 1990s revealed a perfect match between the two (Oppenheimer 2006). This finding brings into question the true identity of the bulk of the extant *T. capillare*

population. Dr. Lowrey has already stated that the Hahakea specimen is not *T. capillare* and would instead key out to *T. filiforme* in Wagner *et al.* (1999), but has not yet decided whether the Hahakea population merits being described as a new entity (H. Oppenheimer, pers. comm. 2010).

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):

No new information.

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

Wagner *et al*. (1999) reported that *Tetramolopium capillare*, known from Lahainaluna to Wailuku on West Maui, was last collected in 1955 by H. St. John on Kuia Ridge above Lahainaluna in dry scrubland of *Dodonaea viscosa* (aalii) and *Sida fallax* (ilima), in an area since highly overgrazed (Hawaii Biodiversity and Mapping Program 2010) and also known to harbor two other rare species, *Gouania hillebrandii* and *Spermolepis hawaiiensis* (H. Oppenheimer, pers. comm. 2010). Wagner *et al*. (1999) considered the species likely extinct, or if extant, then extremely localized.

From available habitat descriptions provided by plant collectors (Oppenheimer 2006; Hawaii Biodiversity and Mapping Program 2010; National Tropical Botanical Garden 2010a), it is clear that the unidentified *Tetramolopium* grows in a wetter habitat than *T. capillare*. The latter grows as groundcover in lowland dry grassland/shrubland to montane mesic shrubland in the company of native species including *Heteropogon contortus* (pili grass), *Dodonaea viscosa* (aalii), *Myoporum sandwicense* (naio), *Leptecophylla tameiameiae* (pukiawe), *Bidens menziesii* (kookoolau), and *Waltheria indica* (uhaloa) (National Tropical Botanical Garden 2010a).

The unidentified *Tetramolopium* grows on wet cliff faces in *Metrosideros polymorpha* (ohia) montane wet forest and shrubland with more varied associates, including *Dicranopteris linearis* (uluhe), *Sadleria* sp. (amau), *Artemisia* sp., *Cheirodendron* sp. (olapa), *Dubautia* sp., *Broussaisia* sp., *Lobelia* sp., *Adiantum* sp., *Blechnum* sp., *Selaginella* sp., and *Pteris lidgatei* (Hawaii Biodiversity and Mapping Program 2010; National Tropical Botanical Garden 2010a; H. Oppenheimer, pers. comm. 2010).

A collection by Hank Oppenheimer of the Maui Nui Plant Extinction Prevention Program in February 2006 provides the most recent habitat data for the undetermined *Tetramolopium* species. Nineteen small

subshrubs were observed in Hahakea Gulch at 823 meters (2,700 feet) elevation, rooted in cracks of vertical basaltic rock walls 1.5 to 8 meters (5 to 26 feet) above the stream, in open, bare areas. Associated native plant species included *Metrosideros polymorpha* var. *glaberrima* (ohia), *Hedyotis formosa* (pilo), *Cyanea elliptica* (haha), *Eragrostis grandis* (no common name [NCN]), *Carex meyenii* (NCN), and *Selaginella arbuscula* (lepelepe a moa) (Oppenheimer 2006).

2.3.1.7 Other:

No new information.

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

Threats:

- Ungulate degradation of habitat (Hawaii Biodiversity and Mapping Program 2010; Plant Extinction Prevention Program 2008, 2009)
    - Axis deer (*Axis axis*)
    - Feral goats (*Capra hircus*)
- Established ecosystem-altering invasive plant species degradation of habitat (Plant Extinction Prevention Program 2008, 2009; Oppenheimer 2006; USFWS 1994, 1997, 2003).
    - *Cortaderia jubata* (pampas grass)
    - *Erigeron karvinskianus* (daisy fleabane)
    - *Lantana camara* (lantana)
    - *Leucaena leucocephala* (koa haole)
    - *Melinus repens* (natal redtop)
    - *Rubus rosifolius* (thimbleberry)
- Landslides and flooding (Oppenheimer 2006)

Current conservation efforts:

- Ecosystem-altering invasive plant species control – After the upper of the two Kauaula Valley populations of *Tetramolopium* species was destroyed in a landslide around 2000, the site was subsequently invaded by a large infestation o*f Cortaderia jubata* (pampas grass), which the Maui Invasive Species Committee is working on controlling (H. Oppenheimer, pers. comm. 2010).

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

None reported.

2.3.2.3 Disease or predation:

Threats:

- Ungulate predation or herbivory (Plant Extinction Prevention Program 2008, 2009)
    - Axis deer (*Axis axis*)
    - Feral goats (*Capra hircus*)

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Threats:

- Lack of adequate hunting regulation in areas with ungulates – The lack of adequate ungulate control and the existence of established hunting programs in areas where *Tetramolopium capillare* occurs continue to threaten this species.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Threats:

- Fire (Plant Extinction Prevention Program 2008, 2009)
- Low numbers (USFWS 1994, 1997, 2003; Plant Extinction Prevention Program 2008, 2009)
- Established invasive plant species competition (Oppenheimer 2006; H. Oppenheimer, pers. comm. 2010; USFWS 1994, 1997, 2003)
    - *Adiantum raddianum* (maidenhair fern)
    - *Blechnum appendiculatum* (palm fern)
    - *Buddleia asiatica* (dog tail)
    - *Lythrum maritimum* (loosestrife)
    - *Sonchus oleraceus* (sow thistle)
    - *Verbena litoralis* (seashore verbena)
- Climate change may pose a threat to this species. 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.

Current conservation efforts:

- Captive propagation for genetic storage and reintroduction:
    - The National Tropical Botanical Garden (2010b, 2011) reported that they had 140 seeds in genetic storage, collected from the Hale Pohaku population, and may have some seed from the Kauaula population as well (H. Oppenheimer, pers. comm. 2010). They no longer have seeds in storage.
    - A few seeds germinated at Maui Nui Botanical Garden from material collected at Hahakea in 2006 but none of the seedlings survived (Oppenheimer 2006).
    - The Center for Conservation Research and Training Seed Storage Laboratory (2010) reported seeds in genetic storage from the suspected population from Kauaula (2,914 seeds) and the Hahakea population (36 seeds).

2.4 Synthesis

The interim stabilization goals for this species have not been met, as no extant individuals are currently known to exist, although there is still suitable habitat remaining (Table 1), and all threats are not being managed (Table 2). Therefore, *Tetramolopium capillare* meets the definition of endangered as it remains in danger of extinction throughout its range.

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

Date	No. wild individuals	No. outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization Criteria Completed?
1994 (listing)	12	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
1997 (recovery plan)	<200	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2003 (critical habitat)	166	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2012 (5-year review)	0	0	All threats managed in all 3 populations	Partially (see Table 2)
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No

Table 2. Threats to *Tetramolopium capillare* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulates – Degradation of habitat and herbivory	A,C,D	Ongoing	No
Established ecosystem-altering invasive plant species degradation of habitat	A	Ongoing	Partially: Control of *Cortaderia jubata* at Kauaula Valley
Landslides and flooding	E	Ongoing	No
Fire	E	Ongoing	No
Established invasive plant species competition	E	Ongoing	No
Low numbers	E	Ongoing	Partially: Captive propagation for genetic storage and reintroduction and monitoring
Climate change	A, E	Increasing	No

3.0 RESULTS

3.1 Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
____ *Extinction*
____ *Recovery*
____ *Original data for classification in error*
__X__ No change is needed

3.2 New Recovery Priority Number:

Brief Rationale:

3.3 Listing and Reclassification Priority Number:

Reclassification (from Threatened to Endangered) Priority Number: ____
Reclassification (from Endangered to Threatened) Priority Number: ____
Delisting (regardless of current classification) Priority Number: ____

Brief Rationale:

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Captive propagation for genetic storage and reintroduction:
    - Propagate a portion of the 140 seeds from the Hale Pohaku population in genetic

storage at National Tropical Botanical Garden.

  - If sites are relocated, collect soil from known locations of *T. capillare* and take to the Olinda Rare Plant Facility in the hope of germinating a seed bank that will include sprouts of the taxon.

- Surveys / inventories – Continue to conduct thorough surveys of the Hale Pohaku area in habitat where *Tetramolopium capillare* was last seen, especially in *Dodonaea* dry shrubland and *Heteropogon* grassland.
- Taxonomy research – Monitor the taxonomic status of the Kauaula and Hahakea populations. If not classifiable under *T. capillare*, it may be described as a new taxon that will need to be tracked.
- Ungulate exclosures:
  - Continue to construct fenced exclosure around existing and reintroduced populations to provide protection from feral ungulates.
  - Monitor fenced exclosures for evidence of breaching by feral ungulates.
- Fire protection – Develop and implement fire management plans for all wild and reintroduced populations.
- Alliance and partnership development – Work with Hawaii 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.

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Wagner, W. L., D. R. Herbst and S. H. Sohmer. 1999. Manual of the flowering plants of Hawaii, revised edition. University of Hawaii and Bishop Museum Press, Honolulu, Hawaii. 1,918 pages.

Personal communications:

Oppenheimer, Hank. 2010. Maui Nui Coordinator, Plant Extinction Prevention Program, Lahaina, Hawaii. E-mail to Clyde Imada, Bishop Museum, dated October 13, 2010. Subject: *Tetramolopium capillare*.

Signature Page
U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Tetramolopium capillare* (Pamakani)

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

Appropriate Listing/Reclassification Priority Number, if applicable:_____

Review Conducted By:
Chelsie Javar, Fish and Wildlife Biologist
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Date 8/28/2012