

5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Ctenitis squamigera* (pauoa)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2010. Endangered and threatened wildlife and plants; initiation of 5-year status reviews of 58 species in Washington, Oregon, California, and Hawaii. Federal Register 75(226):71726-71729.

Lead Region/Field Office:

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

Name of Reviewer(s):

Vickie Caraway, Plant Biologist, PIFWO

Daniel Clark, Oahu, Kauai, Northwest Hawaiian and American Samoa Islands Team Manager, PIFWO

Marie Brueggemann, Plant Recovery Coordinator, PIFWO

Recovery Program Lead, PIFWO

Kristi Young, Programmatic Deputy Field Supervisor, 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 January 31, 2012. The review was based on a review of current, available information since the last 5-year review for *Ctenitis squamigera* (USFWS 2009). The National Tropical Botanical Garden provided an initial draft of portions of the five-year review and recommendations for conservation actions needed prior to the next five-year review. The document was reviewed by the Plant Biologist, Islands Team Manager and Plant Recovery Coordinator, followed by the Recovery Program Lead. It was subsequently reviewed by the Programmatic 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).

Review Analysis:

Please refer to the previous 5-year review for *Ctenitis squamigera* published on July 21, 2009 (available at http://ecos.fws.gov/docs/five_year_review/doc1123.pdf) for a complete review of the species' status, threats, and management efforts. No significant new information regarding the species biological status has come to light since listing to warrant a change in the Federal listing status of *Ctenitis squamigera*.

This large scaly terrestrial fern is endemic to the Hawaiian Islands (Palmer 2003).

Ctenitis squamigera may no longer be extant on Hawaii, East Maui, Lanai, or Molokai

(USFWS 2007; Hank Oppenheimer, Plant Extinction Prevention Program [PEPP], pers. comm. 2011; Ane Bakutis, PEPP, pers. comm. 2011). The current status and trends for *Ctenitis squamigera* are provided in the tables below.

New status information:

- On West Maui, a number of small populations remain. In the Panaewa section of West Maui Natural Area Reserve, one individual is known from Manowaiopae Gulch, last seen in 2010, and 10 to 14 individuals from Kahana Valley (H. Oppenheimer, pers. comm. 2011), which represents no change from the last five-year review. In Ukumehame, the population has increased from two to at least three individuals. There are between two to four individuals at Puu Kaeo, one individual at Kahana Iki, and one or two individuals in Puehuehu Nui (H. Oppenheimer, pers. comm., 2011), which also represent no change from the last five-year review.
- On East Maui, Pohakea Gulch currently contains three individuals (H. Oppenheimer, pers. comm. 2011), where 28 were reported in the last five-year review.
- Although *Ctenitis squamigera* was historically recorded from Kauai, it was considered extirpated until 2011, when one individual was discovered in Nualolo Valley (1,005 meters [3,300 feet] elevation) and one individual in Awaawapuhi Valley (950 meters [3,120 feet] elevation) (Wood in press).
- *Ctenitis squamigera* has not been recently observed on Oahu (Oahu Army Natural Resources Program [OANRP] 2011b).

Overall, the numbers of individuals have declined from approximately 230-240 reported in the previous five-year review, to approximately 210-220 in 2013, although many populations have not been thoroughly surveyed in the intervening years.

New threats:

Climate change - 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) funded climate modeling that will help resolve these spatial limitations. High spatial resolution climate outputs are expected to be available sometime in 2013.

Ecosystem-altering invasive plant species - In Ukumehame on West Maui, the population is threatened by competition from the introduced invasive plant species *Erigeron karvinskianus* (daisy fleabane) (H. Oppenheimer, pers. comm. 2011).

New management actions:

- Ecosystem-altering invasive plant species control
 - Weed control is ongoing at Makua on Oahu (OANRP 2011b).
 - Weed control is ongoing for the Kaena Point population on Oahu (OANRP 2011b).
- Ungulate exclosures -Makua on Oahu is fenced from goats (OANRP 2011b).
- Captive propagation for genetic storage and reintroduction

- OANRP has completed genetic storage for 160 individuals from six different populations on Oahu (OANRP 2011a).
- Three collections of spores from the 1990s and one from 2006 are in storage at National Tropical Botanical Garden (2011).
- Spores are in storage at the Harold L. Lyon Arboretum Micropropagation Laboratory (2012).

Synthesis:

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for four species of Hawaiian ferns (USFWS 1998), based on whether the species is an annual, a short-lived perennial (fewer than ten years), or a long-lived perennial. *Ctenitis squamigera* 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.*, fencing, weeding) and be represented in an *ex situ* (off-site) collection. In addition, at least three populations should be documented on each island where it now occurs or occurred historically. Each of these populations must be naturally reproducing and increasing in number, with a minimum of 50 mature individuals per population (minimum of 150 mature plants).

Two populations of approximately 100 individuals each are currently known, and the remaining populations have 20 or fewer individuals each. The stabilization goals for this species have not been met, since three populations of 50 or more mature individuals do not exist (Table 1) and all threats are not being sufficiently managed throughout all of the populations (Table 2). Therefore, *Ctenitis squamigera* meets the definition of endangered, as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

- Captive propagation for genetic storage and reintroduction
 - Continue collection of genetic resources for storage, future propagation and reintroduction into protected suitable habitat within historical range.
 - Augment current natural populations to increase number of individuals.
 - Investigate methods of propagation and storage of spores.
- Ungulate exclosures - Complete exclosure fences to protect individuals from the adverse effects of feral pigs and goats.
- Ecosystem-altering invasive plant species control - Eradicate introduced invasive plant species within ungulate exclosures and maintain the exclosures free of introduced invasive plants.
- Alliance and partnership development - Initiate planning and contribute to implementation of ecosystem-level management and restoration to benefit this species.
- Surveys / Inventories - Survey geographical and historical range for a thorough current assessment of the species' status.
- Genetic research - Assess genetic variability within extant populations.
- Population biology research - Study *Ctenitis squamigera* populations with regard to population size and structure, geographical distribution, spore production and

gametophytic stage development, longevity, specific environmental requirements, limiting factors, and threats.

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

Date	No. wild individuals	No. outplanted	Stabilization Criteria identified in Recovery Plan	Stabilization Criteria Completed?
1994 (listing)	~80	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
1998 (recovery plan)	~100	0	All threats managed in all 3 populations	No
			Complete genetic storage	No
			3 populations with 50 mature individuals each	No
2003 (critical habitat)	192	Unknown	All threats managed in all 3 populations	Unknown
			Complete genetic storage	Unknown
			3 populations with 50 mature individuals each	Unknown
2008 (5-yr review)	~234 -242	0	All threats managed in	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Partially
2013 (5-yr review)	~210-220	0	All threats managed in all 3 populations	Partially (Table 2)
			Complete genetic storage	No
			3 populations with 50 mature individuals each	Partially, one population on Maui and one on Oahu

Table 2. Threats to *Ctenitis squamigera* and ongoing conservation efforts

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulates – goats cause habitat modification and herbivory	A, D	Ongoing	Partially, East Makaleha, some in West Maui.
Fire – habitat modification and plant destruction	E	Ongoing	Partially on Oahu
Invasive introduced plants	E	Ongoing	Partially, ongoing but not for entire Makua population
Climate change	A, E	Increasing	No
Human disturbance from hikers and vehicles	A,E	Ongoing	No

References:

See previous 5-year review for a full list of references (USFWS 2009). Only references for new information are provided below.

Harold L. Lyon Arboretum Micropropagation Laboratory. 2012. Micropropagation database. University of Hawaii at Manoa, Honolulu, Hawaii. Unpublished.

National Tropical Botanical Garden. 2011. Report on controlled propagation of listed and candidate species, as designated under the U.S. Endangered Species Act. 48 pages. Unpublished.

Palmer, Daniel D. 2003. Hawaii’s ferns and fern allies. University of Hawaii Press, Honolulu, Hawaii. 324 pages.

Oahu Army Natural Resources Program. 2011a. Genetic storage summary. U.S. Army Garrison Hawaii, Schofield Barracks, Hawaii. Unpublished.

Oahu Army Natural Resources Program. 2011b. Population structure summary, *Ctenitis squamigera*. U.S. Army Garrison Hawaii, Schofield Barracks, Hawaii. 1 page. Unpublished.

[USFWS] U.S. Fish and Wildlife Service. 1998. Final recovery plan for four species of Hawaiian ferns. U.S. Fish and Wildlife Service, Portland, Oregon. 78 pages.

[USFWS] U.S. Fish and Wildlife Service. 2007. Reinitiation of the 1999 Biological Opinion of the U.S. Fish and Wildlife Service for U.S. Army military training at Makua Military Reservation, island of Oahu. Unpublished.

[USFWS] U.S. Fish and Wildlife Service. 2009. *Ctenitis squamigera* (pauoa) 5-year review summary and evaluation. U.S. Fish and Wildlife Service, Honolulu,

Hawaii. 8 pages. Available online at
http://ecos.fws.gov/docs/five_year_review/doc2456.pdf.

Wood, K. R. In press. Possible extinctions, rediscoveries and new plant records within the Hawaiian Islands. Bishop Museum Occasional Papers. 1 page. In press.

Personal communications:

Bakutis, Ane. 2011. Molokai Coordinator Plant Extinction Prevention Program. E-mail to Margaret Clark, National Tropical Botanical Garden, dated November 22, 2011. Subject: USFWS 5 yr reviews need update.

Oppenheimer, Hank. 2011. Maui Nui Coordinator, Plant Extinction Prevention Program. E-mail to Margaret Clark, National Tropical Botanical Garden, dated December 28, 2011. Subject: *Ctenitis squamigera*.

U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of *Ctenitis squamigera* (pauoa)

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
- No Change in listing status

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