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. 2019. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 91 species in Oregon, Washington, Hawaii, and American Samoa. Federal Register 84(112): 27152–27154, June 11, 2019.

Lead Region/Field Office:

Interior Region 12/Pacific Islands Fish and Wildlife Office (PIFWO), Honolulu, Hawai‘i

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 2020. The review was based on a review of current, available information since the last 5-year review for *Ctenitis squamigera* (USFWS 2013). 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 *Ctenitis squamigera* in the Federal Register on July 21, 2009 and July 30, 2013 (available at *https://ecos.fws.gov/docs/tess/species_nonpublish/1391.pdf* and *https://ecos.fws.gov/docs/tess/species_nonpublish/2061.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 *C. squamigera*.

This short-lived perennial fern in the Dryopteridaceae (oak fern) family is endangered and endemic to Kaua‘i, O‘ahu, Moloka‘i, Lāna‘i, Maui, and possibly the island of Hawai‘i. The status and trends for *Ctenitis squamigera* are provided in the tables below.

New Status Information:

- In 2012, critical habitat was designated for *Ctenitis squamigera* on O‘ahu in seven units in the lowland mesic ecosystem (676 hectares [ha], 1,669 acres [ac]) (77 FR 57648, September 18, 2012). In 2016, critical habitat was designated for *C. squamigera* on Moloka‘i in one unit in the lowland mesic ecosystem (3,549 ha, 8,770 ac), on Maui in 23 units in the lowland dry, lowland mesic, lowland wet, montane mesic, and wet cliff ecosystems (12,650 ha, 31,261 ac), and 727 ha (1,796 ac) of critical habitat were proposed in the dry cliff and wet cliff ecosystems on Lāna‘i but were excluded in the final rule (77 FR 34464, June 11, 2012; 81 FR 17790, March 30, 2016).
- Currently, there are two individuals in two populations on Kaua‘i; 14 individuals in two sites in Makaleha in the Wai‘anae mountains of O‘ahu, 13 of which have not been monitored since 2013; one individual on Lāna‘i, and approximately 50 individuals in five populations on west Maui (PEPP 2014, 2015, 2019, 2020; ANRP 2020).

New Threats:

- 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. The assessment concluded that *Ctenitis squamigera* is vulnerable to the impacts of climate change with a vulnerability score of 0.413 (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 taxon into the future, such as locating key microsites that overlap with current and future climate envelopes for outplanting efforts.
- Predation and herbivory by rats are observed to be threats to *Ctenitis squamigera* at the Ukumehame occurrence on west Maui and the West Makaleha occurrence on O‘ahu (PEPP 2019).

New Management Actions:

- Surveys and inventories—
    - The Plant Extinction Prevention Program (PEPP) surveys and monitors the wild and reintroduced populations on Kaua‘i, O‘ahu, and Maui (PEPP 2014, 2015, 2018, 2020).
    - *Ctenitis squamigera* is present in The Nature Conservancy’s (TNC) Kapunakea Preserve. Ungulate and nonnative plant management in the preserve may provide protection to those occurrences (TNC 2015, p. 2).
    - The State’s Native Ecosystems Protection and Management (NEPM) program monitors a reintroduction of *C. squamigera* at Pahole (O‘ahu) (ANRP 2020).
- Ungulate monitoring and control—Fenced areas include Pahole and Makaleha on O‘ahu, and five sites on west Maui (Kahana, Honokōwai, Launiupoko, Ukumehame, and the Pāpalaua Manawainui Plant Sanctuary (PEPP 2019; ANRP 2020). The occurrence on Lāna‘i is within an exclosure; however, animals may be present (Donoho 2015, in litt.)

- Invasive nonnative plant control—
    - PEPP conducts nonnative plant control at the Ukumehame occurrence on west Maui (PEPP 2017, 2019).
    - The State's Native Ecosystems Protection and Management (NEPM) program manages a fenced site at Pahole on Oʻahu (ANRP 2020).
- Control of predation and herbivory by rats—PEPP reported rat control conducted at the Ukumehame occurrence on west Maui (PEPP 2017). The ANRP has set up rat bait stations (to protect the endemic *Pritchardia* species) at the East Makaleha occurrence on Oʻahu in 2007 (ANRP 2020).
- Collection and propagation—
    - Lyon Arboretum Micropropagation Laboratory reported storage of six explants representing two founders from Makaleha (Oʻahu). The Lyon Arboretum Seed Conservation Laboratory reported storage of approximately 75,000 spores representing two founders from Makaleha (Oʻahu) (Lyon Arboretum 2020). These collections represent a total of three founders from the area.
    - The Pahole Rare Plant Facility reported propagation of a 1-gallon pot of plants representing one founder from Makaleha (Oʻahu) (Pahole 2020).
    - PEPP collected two plants from East Makaleha (Oʻahu) and sent them to Lyon Arboretum for storage (PEPP 2014). PEPP collects spores from the wild plant at Awaʻawapuhi (Kauaʻi) (PEPP 2015).
- Reintroduction—
    - Pahole Rare Plant Facility reported reintroduction of two individuals at a restoration area in the southern Koʻolau mountains (Oʻahu) (Pahole 2020).
    - NEPM reported reintroduction of two plants at Pahole (Oʻahu) and the site is fenced and being maintained (nonnative plant control) in cooperation with PEPP (NEPM Nursery 2020; PEPP 2018).

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

Date	No. wild individuals	No. outplanted	Stability Criteria identified in Recovery Plan	Stability Criteria Completed?
1994 (listing)	80 total on Oʻahu, Lānaʻi, Maui	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 total on Oʻahu, Lānaʻi, Maui	0	All threats managed in all 3 populations	No
			Complete genetic storage	No

			3 populations with 50 mature individuals each	No
2003 (critical habitat)	0 (Kaua‘i) 80 (O‘ahu) 20 (Moloka‘i) 42 (Lāna‘i) 41 (Maui)	Unknown	All threats managed in all 3 populations	Unknown
			Complete genetic storage	Unknown
			3 populations with 50 mature individuals each	Unknown
2009 (5-year review)	0 (Kaua‘i) ca 107 (O‘ahu) 20 (Moloka‘i) unknown (Lāna‘i) 107–111 (Maui)	0	All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Partially
2012 (critical habitat, O‘ahu)	ca 100 (O‘ahu)		All threats managed in all 3 populations	Partially
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	Partially
2013 (5-year review)	2 (Kaua‘i) Unknown (O‘ahu) 17–24 (Maui) total ca 210–220	0	All threats managed in all 3 populations	Partially
			Complete genetic storage	No
			3 populations with 50 mature individuals each	Partially

2016 (critical habitat, Maui Nui)	20 (Molokaʻi) 80–84 (Maui)	0	All threats managed in all 3 populations	Partially, 2 sites on Oʻahu fenced; 1 site on Lānaʻi fenced; 5 sites on Maui fenced
			Complete genetic storage	Partially
			3 populations with 50 mature individuals each	No
Date	**No. wild individuals**	**No. outplanted**	***Preventing Extinction Criteria identified by HPPRCC**	***Preventing Extinction Criteria Completed?**
2021 (5-year review)	2 (Kauaʻi) ca 14 (Oʻahu) 0 (Molokaʻi) 1 (Lānaʻi) ca 50 (Maui)	4 (Oʻahu)	All threats managed in all 3 populations	Partially, 2 sites on Oʻahu fenced; 1 site on Lānaʻi fenced; 5 sites on Maui fenced; nonnative plant control at Kapunakea and Ukumehame (Maui) and Pahole (Oʻahu)
			Complete genetic storage	Partially, 4 founders from Oʻahu and 1 founder from Kauaʻi represented
			Natural reproduction at each population	No
			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 *Ctenitis squamigera* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Degradation and destruction of habitat by feral ungulates	A	Ongoing	Partial, ungulate exclosures on Oʻahu, Lānaʻi, and Maui
Established ecosystem altering invasive plant species degradation of habitat	A	Ongoing	Partial, nonnative plant control within exclosures and at reintroductions
Drought destruction and degradation of habitat	A	Ongoing	None
Fire destruction and degradation of habitat	A	Ongoing	Partial, fire management plan for military training area on Oʻahu
Predation and herbivory by rats	C	Ongoing	Partial, some control at Ukumehame (Maui) and nearby for protection of a *Pritchardia* population on Oʻahu
Climate change degradation or loss of habitat	E	Ongoing	Partial, some reintroduction efforts ongoing
Human disturbance by hikers and vehicles	E	Ongoing	None

Synthesis:
Currently, the largest number of wild individuals is on west Maui (ca 50); there are two wild individuals on Kauaʻi, approximately 14 individuals on Oʻahu (though most have not been monitored since 2013), and one individual on Lānaʻi. Ungulate exclosures on Oʻahu, Maui, and Lānaʻi protect eight occurrences. Nonnative plant control is ongoing within three ungulate exclosures and at two reintroduction sites. Rats are controlled at Ukumehame (Maui) and East Makaleha (Oʻahu). Spores and propagules are in storage representing than four founders from Oʻahu and one founder from Kauaʻi.

Stabilizing (interim), downlisting, and delisting objectives were provided in the Final Recovery Plan for Four Species of Hawaiian Ferns (USFWS 1998) and have been updated according to the draft revised recovery objective guidelines developed by the Hawaiʻi 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.

Ctenitis squamigera is a short-lived perennial fern. 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 where they now occur or occurred historically and each of these populations must be naturally reproducing (i.e., viable spores, sporelings), with a minimum of 50 mature, reproducing individuals per population.

The preventing extinction goals for this species have not been met. The population on Moloka‘i is extirpated and numbers have declined on most islands. There are no populations with 50 reproducing individuals. Limited propagation and reintroduction are ongoing; however, there is no natural recruitment and limited genetic storage representation. In addition, not all threats are being managed (Table 2). Therefore, *Ctenitis squamigera* meets the definition of Endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:
Predation and herbivory by rats are additional threats on Maui and O‘ahu. We are not aware of any other significant new information regarding the species’ biological status since the last 5-year review in 2013. Thus, the following recommendations for future actions are added or reiterated for the 5-year review for 2021.

- Surveys and inventories—Continue to survey geographical and historical range for a current assessment of the species’ status, especially in areas where the taxon was recently extirpated.
- Ungulate monitoring and control—Continue to monitor and maintain exclosures and construct additional exclosures or strategic fencing where possible to protect all occurrences.
- Invasive plant monitoring and control—Continue to control established ecosystem-altering nonnative invasive plant species at all occurrences.
- Fire monitoring and control—Continue to develop and implement fire prevention management plans for sites with known occurrences.
- Rat control—Continue to implement effective rat control methods at populations when necessary.
- Captive propagation for genetic storage and reintroduction—Continue collection of genetic resources for storage, propagation, and reintroduction.
- Reintroduction and translocation—Continue reintroduction into suitable habitat within historical range to increase numbers of populations and individuals to build resiliency and redundancy and reduce the impacts of drought and climate change.
- Human disturbance—Develop and implement effective measures (i.e., education, signage) to reduce the impacts of hikers and vehicles.

- Alliance and partnership development—Continue to work with partners and other land managers in planning and implementation of ecosystem-level restoration and management to benefit this taxon.

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[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, Hawai‘i. 192 pp. + appendices.

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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
_X____ No Change in listing status

For **Field Supervisor, Pacific Islands Fish and Wildlife Office**

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