

Silene hawaiiensis
(Hawaiian catch-fly)

**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: *Silene hawaiiensis* (Hawaiian catch-fly)

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5-YEAR REVIEW
***Silene hawaiiensis* / Hawaiian catch-fly**

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office:

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Lead Field Office:

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor, (808)
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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 29, 2008. The review was based on the proposed critical habitat designation for *Silene hawaiiensis* and other species from the island of Hawaii (USFWS 2003a), 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 Assistant Field Supervisor for Endangered Species and Acting Deputy Field Supervisor 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. 2008. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 70 species in Idaho, Montana, Oregon, Washington, and the Pacific Islands. Federal Register 73(83):23264-23266.

1.3.2 Listing history

Original Listing

FR notice: USFWS. 1994. Endangered and threatened wildlife and plants; determination of endangered or threatened status for 21 plants from the island of Hawaii, State of Hawaii. Federal Register 59(43):10305-10325.

Date listed: March 4, 1994

Entity listed: Species

Classification: Threatened

Revised Listing, if applicable

FR notice: N/A

Date listed: N/A

Entity listed: N/A

Classification: N/A

1.3.3 Associated rule makings :

USFWS. 2003a. Endangered and threatened wildlife and plants; designations of critical habitat for plant species from the island of Hawaii, Hawaii; proposed rule. Federal Register 68(127):39624-39722.

Critical habitat was designated for *Silene hawaiiensis* in two units totaling 2,796 hectares (6,908 acres) on the island of Hawaii (USFWS 2003a).

1.3.4 Review History:

Species status review [FY 2009 Recovery Data Call (August 2009)]:

Declining

Recovery achieved:

1 (0-25%) (FY 2007 Recovery Data Call – this was the last year this was reported)

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

8

1.3.6 Current Recovery Plan or Outline

Name of plan or outline: Recovery plan for the Big Island plant cluster. U.S. Fish and Wildlife Service. Portland, Oregon. 252 pages.

Date issued: September 26, 1996.

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
 No

2.1.2 Is the species under review listed as a DPS?

Yes
 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
 No

2.2 Recovery Criteria

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

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?

Yes
 No

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

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 (Factors A, C, D, and E) affecting this species is presented in section 2.4. Factor B (overutilization for commercial, recreational, scientific, or educational purposes) is not known to be a threat to this species.

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. *Silene hawaiiensis* is a short-lived perennial that was listed as threatened. To be considered for delisting, the taxon must be managed to control threats (*e.g.*, fenced, weeding, etc.) in the five largest populations and be represented in an *ex situ* (off-site) collection. In addition, a minimum of eight to ten populations should be documented on island where the species now occur or occurred historically. Each of these populations must be naturally reproducing and increasing in number, with a minimum of 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

In addition to the status summary table below, information on the species' status and threats was included in the final critical habitat rule referenced above in section 1.3.3 ("Associated Rulemakings") and in section 2.4 ("Synthesis") below, which also includes any new information about the status and threats of the species.

Table 1. Status of *Silene hawaiiensis* from listing through 5-year review.

Date	No. wild individuals	No. outplanted	Delisting Criteria identified in Recovery Plan	Delisting Criteria Completed?
1994 (listing)	~ 3,000	Unknown	All threats managed in the 5 largest populations	Partially
			Complete genetic storage	No
			8-10 populations with 300 mature individuals each	Unknown
			Naturally reproducing, stable, and increasing in number	Unknown
			Sustained for 5 years	Unknown
1996 (recovery plan)	~ 11,000	20	All threats managed in the 5 largest populations	Partially
			Complete genetic storage	Partially
			8-10 populations with 300 mature individuals each	No
			Naturally reproducing, stable, and increasing in number	Unknown
			Sustained for 5 years	Unknown
2003 (critical habitat)	~ 2,540	Unknown	All threats managed in the 5 largest populations	Partially
			Complete genetic storage	Partially
			8-10 populations with 300 mature individuals each	Unknown
			Naturally reproducing, stable, and increasing in number	Unknown
			Sustained for 5 years	Unknown
2009 (5-year review)	~ 8,360	0	All threats managed in the 5 largest populations	Partially

			Complete genetic storage	Partially
			8-10 populations with 300 mature individuals each	No
			Naturally reproducing, stable, and increasing in number	Unknown
			Sustained for 5 years	Unknown

2.3.1 Biology and Habitat

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

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:

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

2.3.1.4 Taxonomic classification or changes in nomenclature:

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.):

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

2.3.1.7 Other:

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:

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

2.3.2.3 Disease or predation:

2.3.2.4 Inadequacy of existing regulatory mechanisms:

2.3.2.5 Other natural or manmade factors affecting its continued existence:

2.4 Synthesis

More flower production in *Silene hawaiiensis* occurred between April and July 2006 than between August and September 2007, perhaps indicating an earlier annual timeframe for seed production (U.S. Army Garrison 2007). However, *S. hawaiiensis* could also be considered an opportunistic flowering species. Flowering appears to be dependent upon precipitation more than the time of year (Center for Environmental Management of Military Lands 2006). Individuals of *S. hawaiiensis* observed in the harsh climate around the Southwest Rift Zone of Kilauea Crater often have very prominent exposed roots, of a tap root type which are thought to be an important survival characteristic for this species (Bridges and Huddleston 1999).

Silene hawaiiensis is known only from the island of Hawaii. It occurs in Hawaii Volcanoes National Park and at the Pohakuloa Training Area. In the Southwest Rift Zone downwind from Kilauea Crater in the Hawaii Volcanoes National Park, Kau District, it occurs on Crater Rim Drive 1.5 miles past the observatory and on the north-east side of the Crater Rim road adjacent to Halemaumau Crater. About 100 individuals of *S. hawaiiensis* were seen on the side of the road in 1991 at 1,100 meters (3,609 feet) elevation (Bridges and Huddleston 1999; National Tropical Botanical Garden 2009; Wood 2009).

Since monitoring began in 1997 at the Pohakuloa Training Area, there has been a steady decline in the number of individuals at Range 8, which is one of eight management units where this species is present. Only 31 individuals were located in this management unit during the 2005 monitoring period, representing 31 percent of the population size from 1997. Although fewer individuals were present, the average height of plants since 1997 has increased, and ungulate browse damage has decreased from 1997 (U.S. Army Garrison 2005). A total of 1,913 and 2,871 individuals were reported in 2005 for all management units located in Pohakuloa Training Area. Only four of fifteen occurrences contained more than 300 individuals (U.S. Army Garrison 2005). In 2007, 1,844 individuals were observed and only one management unit contained more than 300 individuals. These 15 occurrences of *Silene hawaiiensis* lie primarily in areas to the east of the military training impact area (U.S. Army Garrison 2007).

The Center for Environmental Management of Military Lands conducted surveys for *Silene hawaiiensis* outside of the Pohakuloa Training Area in 2003 and 2005. Study areas included Mauna Loa, Hualalai, lands north and south of Puu Keanui, and the Kau Desert. The focus of the surveys was to determine the extent of the species outside the boundaries of Pohakuloa Training Area. A total of 6,416 individuals were located, identified, and recorded during the survey period. During the 2003 survey

there were 1,564 plants recorded on the north slope of Mauna Loa, 1,886 plants in the Kau Desert, and 15 plants on the east slope of Mauna Loa. In 2005, 641 plants were recorded on the summit of Hualalai, 1,884 plants on the south-southeast slopes of Hualalai, and 425 plants near Puu Keanui (Center for Environmental Management of Military Lands 2006).

Currently, the statewide number of *Silene hawaiiensis* populations is 22, containing a total of approximately 8,360 individuals, all on the island of Hawaii: one population of 100 individuals at Crater Rim in Hawaii Volcanoes National Park, 15 populations of 1,844 individuals at Pohakuloa Training Area, and six populations outside Pohakuloa at Mauna Loa (two populations), Kau Desert, Hualalei (two populations), and Puu Keanui, containing 6,416 individuals. Of these populations, only six were reported to contain more than 300 individuals since 2003.

A recent study of the genetics of the genus *Silene* indicates a single introduction from North America as the most likely origin of all Hawaiian species of *Silene* (Eggens *et al.* 2007).

Silene hawaiiensis is endemic to the island of Hawaii and grows in mountainous to subalpine terrain on lava flows varying in age from 200 to over 5,000 years old, and on flows greater than 10,000 years old on the western slopes of Mauna Kea. Substrates associated with the taxon include weathered lava, ash, and cinder. *Silene hawaiiensis* is found between 900 to 3,000 meters (2,953 to 9,843 feet) elevation. Associated species include *Metrosideros polymorpha* (ohia), *Sophora chrysophylla* (mamane), *Vaccinium reticulatum* (ohelo), and *Dodonaea viscosa* (aalii) (Center for Environmental Management of Military Lands 2006).

The Southwest Rift Zone of Kilauea Crater is a harsh environment where only a few plant species are found such as *Coprosma ernodeoides* (pilo), *Dubautia ciliolata* (naenae), *Leptecophylla tameiameia* (pukiawe), *Metrosideros polymorpha*, *Nephrolepis exaltata* (nianiau, ikupukupu), *Sadleria* sp. (amau), and *Vaccinium reticulatum* (Wood 2009). The active zone of the Halemaumau Crater emits hydrogen sulfide which combines with water making the rainfall in this region very acidic. Rainwater measurements as low as pH 2 have been made. Protection from extreme wind exists only in the depressions created by the rift-zone cracks. A vegetated area several hectares in size adjacent to Halemaumau Crater hosts another population of *Silene hawaiiensis*. This area is more varied, with large cracks that provide a refuge for species that might otherwise have difficulty growing in such an environment. A variety of robust plants form a closed canopy of shrubs, grasses, and ferns including *Dicranopteris linearis* (uluhe), *Coprosma menziesii* (pilo), *Metrosideros polymorpha* (ohia), and *Dodonaea viscosa* (aalii). This area is comprised of a denser vegetation community than those found in the nearby shrublands (Bridges and Huddleston 1999; National Tropical Botanical Garden 2009).

Fire (Factor E) is a potential threat to *Silene hawaiiensis*. In a 2002 fire study at Pohakuloa Training Area of endangered and threatened species, it was shown that a few native woody plants were able to recover, re-sprout, or reestablish by seed soon after fire. The study found that *S. hawaiiensis* is fire tolerant and able to re-sprout due to its development of large fusiform roots that also allows it to withstand frequent browsing. However, fire is still a threat to *S. hawaiiensis* in areas where vegetation is dense and/or where introduced fire resistant species are present, such as near Puu Keanui, in some areas on Hualalai, and on Pohakuloa Training Area. Fire does not pose a threat to populations of *S. hawaiiensis* in Hawaii Volcanoes National Park and is a minimal threat in the sparsely vegetated habitat on the high slopes of Mauna Loa (Beavers and Burgan 2002).

The relationship of fire with the invasion of introduced plants (Factor E) such as *Pennisetum setaceum* (fountain grass) is well established. *Pennisetum setaceum* is a robust, highly combustible grass species with a life cycle that is very responsive to fire. Once established, it rapidly invades where native vegetation has been displaced by fire, eventually leading to near total displacement of native plant communities. Native plant species that are tolerant to fire are still not able to withstand the self-perpetuating fire regime that *P. setaceum* feeds. Large quantities of *P. setaceum* seeds have been inadvertently spread throughout Pohakuloa Training Area by vehicles, clothing, and other equipment used during training, although dispersal via wind is probably the most common vector of seed dispersal. Dense stands of *P. setaceum* located in areas supporting *Silene hawaiiensis* have been removed by staff at Pohakuloa Training Area to minimize the threat of fire (Center for Environmental Management of Military Lands 2006).

A decision by the state Board of Land and Natural Resources to grant a Conservation District Use Permit (CDUP) for a project to upgrade State Highway 200, also known as the Saddle Road, to a two-lane highway (Factor E) through the Pohakuloa Training Area would have impacted a population of 70 individuals of *Silene hawaiiensis*. An Environmental Impact Statement was completed and a Biological Opinion was issued by the USFWS, after which the proposed alignment path was moved south to avoid this population of *S. hawaiiensis*. The decision was upheld by an appeal (Supreme Court of the State of Hawaii 2005). The possibility of potential impacts to *S. hawaiiensis* was also considered in the construction of an additional telescope at Mauna Kea (Factor A) (University of Hawaii at Hilo 2008).

Proposed construction activities and training (Factor A) at Pohakuloa Training Area could extirpate 1,251 individuals of *Silene hawaiiensis*. Actions that would affect these populations include on- and off-road mounted maneuvers, dismounted maneuvers, reconnaissance, live-fire training, bivouac, and construction. Off-road maneuvers in the northern portion of Pohakuloa Training Area have the potential to destroy plants by the prolonged use of Stryker vehicles, and cause large-scale habitat loss and degradation. On-road maneuvers were reported to affect *S. hawaiiensis* by increasing dust circulation and allowing herbicide to drift away from the roadside when used in weed control operations. These actions have the potential to reduce

photosynthetic rates and inhibit pollinators from using the disturbed areas. Bivouac, dismantled maneuvers, and live-fire training were reported to impact plants by compacting soil, breaking plant stems, fragmenting *S. hawaiiensis* habitat, and increasing the dispersal of invasive plants (USFWS 2003b).

Mouflon sheep (*Ovis gmelini musimon*) (Factors A and C) were introduced to the former Kahuku Ranch, now part of Hawaii Volcanoes National Park, to start a game herd. Eight mouflon were introduced to Kahuku in 1968 and an additional three mouflon were brought in 1974. These individuals multiplied to several hundred prior to 1986 and now appear to be increasing in both range and abundance. They have the potential of invading other areas of Hawaii Volcanoes National Park which have already been cleared of large mammals. Currently, two large populations exist on the island of Hawaii: hybrid mouflon that surround Mauna Kea and extend across the saddle to the northern boundaries of Hawaii Volcanoes National Park and wild-type mouflon that inhabit the southern part of Mauna Loa in and outside of the Kahuku Unit. Agile jumpers, mouflon invaded fenced areas in the Mauna Loa Strip of the Park, where they destroyed outplanted Kau silverswords (*Argyroxiphium kauense*), damaged *Silene hawaiiensis*, and stripped the bark of important forest trees such as *Acacia koa* (koa) and *Sophora chrysophylla* (Hess *et al.* 2006).

Overall, 7 percent of the populations of *Silene hawaiiensis* located in areas of Pohakuloa Training Area that are unprotected by ungulate proof fences, displayed some evidence of ungulate herbivory. No plants were impacted by ungulates in protected areas. Plant height increased after wire cages were constructed around individual plants protected from mouflon and feral sheep (*Ovis aries*) (Hess *et al.* 2006; U.S. Army Garrison 2005). Eighteen percent of *S. hawaiiensis* found in Pohakuloa Training Area are fenced and species-specific weed control is being conducted (U.S. Army Garrison 2007).

Since the time of listing, measures have been taken to provide protection of a few large populations of *Silene hawaiiensis*. The U.S. Army, the State of Hawaii, and Hawaii Volcanoes National Park have or are currently constructing fences that will protect large areas of native habitat where *S. hawaiiensis* is found. The Army is currently constructing ungulate-proof fencing on over 24,000 acres of habitat at Pohakuloa Training Area that includes *S. hawaiiensis*. Construction of the five proposed fence units on State of Hawaii and Kamehameha Schools lands would protect 1,900 plants concentrated in relatively small areas. However, most populations of this species remain unprotected, yet continue to survive in areas where evidence of browsing by feral ungulates is ubiquitous (Center for Environmental Management of Military Lands 2006). It is unclear whether survival is only occurring within mature individuals of *S. hawaiiensis* or if reproduction is actually occurring in these grazed populations.

Insects (Factor C) were responsible for the remainder of recorded herbivory in all areas (U.S. Army Garrison 2007). Climate change may also pose a threat to *Silene hawaiiensis* (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.

Silene hawaiiensis seeds are in storage at Pohakuloa Training Area, representing germplasm from several natural sites. In 2009, approximately 892 seeds from 14 founders were in storage. No reintroductions have been conducted for this species due to its relative abundance at Pohakuloa Training Area (U.S. Army Garrison 2005; U.S. Army 2009). Monitoring for *Silene hawaiiensis* at Pohakuloa Training Area is ongoing (U.S. Army Garrison 2007). At Hawaii Volcanoes National Park, 225 plants were propagated from less than 20 wild individuals collected from Kipuka Maunaiu and Halemaumau. These plants were reintroduced to Kahuku (Hawaii Volcanoes National Park 2008, 2009).

In 1994, the known total population of *Silene hawaiiensis* was estimated at 3,000 (USFWS 1994). Through 2005, an estimated 25,000 individuals of this species were thought to exist, with a distribution encompassing nearly 20 percent of the island's land area (Center for Environmental Management of Military Lands 2006). However, this number appears to be cumulative and, therefore, previously known sites were potentially recounted multiple times instead of updated each year. Based on surveys done since 2003, including the Center for Environmental Management of Military Lands', the United States Army, and the last known observations at Hawaii Volcanoes National Park, the current total number of individuals is closer to 8,000. Management of ungulates at both the Pohakuloa Training Area and Hawaii Volcanoes National Park are ongoing. Other threats to *S. hawaiiensis* are not being adequately addressed.

The delisting goals for this species have not been met as there are only six populations containing more than 300 individuals, and not all threats are being managed (see Table 1). Therefore, *Silene hawaiiensis* meets the definition of endangered as it remains in danger of extinction throughout its range.

3.0 RESULTS

3.3 Recommended Classification:

Downlist to Threatened

Uplist to Endangered

Delist

Extinction

Recovery

Original data for classification in error

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

- Conduct an accurate assessment of the number of individuals, level of threats, and threat management for each population over a period of five years, to determine if species continues to warrant listing.
- Determine which additional populations require management to reach delisting.
- Collect seed for genetic storage.
- Work with U.S. Army, National Park Service, and other landowners to continue management and contribute to implementation of ecosystem-level restoration and management to benefit this species.

5.0 REFERENCES

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Signature Page
U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Silene hawaiiensis* / (Hawaiian catch-fly)

Current Classification: _____ E _____

Recommendation resulting from the 5-Year Review:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: _____

Review Conducted By:

Marie Bruegmann, Plant Recovery Coordinator
Marilet A. Zablan, Assistant Field Supervisor for Endangered Species
Jeff Newman, Acting Deputy Field Supervisor

Approved  Date **AUG 27 2010**
_{po3} **Field Supervisor, Pacific Islands Fish and Wildlife Office**