

## 5-YEAR REVIEW

### Short Form Summary

**Species Reviewed:** *Silene hawaiiensis* (no common name)

**Current Classification:** Threatened

#### **Federal Register Notice announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2013. Endangered and threatened wildlife and plants; Initiation of 5-year status reviews of 44 species in Oregon, Hawaii, Guam, and the Northern Mariana Islands. Federal Register 78(24):8185-8187.

#### **Lead Region/Field Office:**

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

#### **Name of Reviewer(s):**

Chelsie Javar-Salas, Plant Biologist, PIFWO

Marie Bruegmann, Plant Recovery Coordinator, 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 March 4, 2013. The review was based on a review of current, available information since the last 5-year review for *Silene hawaiiensis* (USFWS 2010). The evaluation by Chelsie Javar-Salas, Plant Biologist, was reviewed by the Plant Recovery Coordinator. It was subsequently reviewed and approved by the Programmatic Deputy Field Supervisor.

#### **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 at: [http://ecos.fws.gov/tess\\_public](http://ecos.fws.gov/tess_public).

#### **Review Analysis:**

Please refer to the previous 5-year review for *Silene hawaiiensis* published on August 27, 2010 (available at: [http://ecos.fws.gov/docs/five\\_year\\_review/doc3348.pdf](http://ecos.fws.gov/docs/five_year_review/doc3348.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 *S. hawaiiensis*.

This short-lived perennial shrub in the pink family (Caryophyllaceae) is threatened and is endemic to Hawaii Island (Wagner *et al.* 1999; USFWS 1996). The status and trends for *Silene hawaiiensis* are provided in the tables below.

#### **New status information:**

- In 2012, a single individual of *Silene hawaiiensis* was discovered in the Hawaii Volcanoes National Park Kahuku Unit (Hawaii Volcanoes National Park 2013). This

was a new record for Kahuku and the only known plant in this area (Hawaii Volcanoes National Park 2013). Two populations of *S. hawaiiensis* were monitored on Mauna Loa Strip (200 plants plus an additional 50 plants were added in the final year of the study in 2008) and at Kilauea Crater Rim (200 plants) (Pratt *et al.* 2012). *Silene hawaiiensis* had a stable population structure at the Mauna Loa study area, but its population structure at the Kilauea study site was flat to declining. Mortality of mature plants was low on Mauna Loa (6.5 percent), but was greater than 30 percent at the Kilauea Crater Rim site. Among regularly monitored plants at the Kilauea site, losses were observed in all size classes between 2006 and 2008.

- In 2010, a total of 648 individuals of *Silene hawaiiensis* were monitored of which 368 (43 percent) were classified as mature individuals (U.S. Army Garrison [U.S. Army] 2010). This compares to 798 total individuals monitored in 2009, of which 468 (41 percent) were mature. In 2012, there were 1,791 to 2,760 individuals of *S. hawaiiensis* currently found at Pohakuloa Training Area (PTA) (U.S. Army 2012).
- Overall, the numbers of individuals have declined from the approximately 8,360 wild individuals reported in the previous 5-year review to approximately 2,100 to 4,870 wild individuals in 2015 (Pratt *et al.* 2012; Hawaii Volcanoes National Park 2013; U.S. Army 2012). This decline is due to lack of information from the populations located in the Kau Desert, Hualalai, and Puu Keanui.

#### New threats:

- Collecting impacts – Illegal collection for scientific, horticultural or other purposes threatens the populations of *S. hawaiiensis*, as well as possible excessive visitation. For instance, in 2013, two reintroduced individuals of *S. hawaiiensis* were uprooted in the Mauna Kea area and those two plants were stolen along with other common and federally listed plants (P. Peshut and S. Evans, U.S. Army, pers. comm. 2013). This incident was reported to the State of Hawaii’s Division of Conservation and Resource Enforcement (DOCARE) and the U.S. Fish and Wildlife Service’s Office of Law Enforcement (OLE) (P. Peshut and S. Evans, pers. comm. 2013).

#### New management actions:

- Surveys / inventories
  - In 2012, surveys were conducted in the vicinity and along the edge of Kilauea Crater at Hawaii Volcanoes National Park (2013). All locations of these individuals were added to the rare plant geo-database.
  - In 2013, a single individual of *S. hawaiiensis* was discovered in the Kahuku east unit (Hawaii Volcanoes National Park 2013). This is the only known plant at Kahuku.
  - In 2010, a single individual was discovered outside of Kipuka Alala fence units (U.S. Army 2010).
  - During 2011 to 2012, approximately 18.25 square kilometers (7.05 square miles) were surveyed at PTA (U.S. Army 2013). Surveys were completed within the following fence units: *Haplostachys haplostachya* (66 hectares [165 acres]), *Kadua coriacea* (392 hectares [969 acres]), Kipuka Alala North (407 hectares [1,066 acres]), Puu Nohona O Hae (79 hectares [195 acres]), Puu Papapa (28 hectares [68 acres]), and *Silene hawaiiensis* (18 hectares [44 acres]). During that

- survey, approximately 494 locations were recorded of *Silene hawaiiensis* (U.S. Army 2013).
- Approximately 767 locations of *S. hawaiiensis* were recorded within the installation wide survey area in 2012 to 2013 (U.S. Army 2014). The greatest change in the recorded distribution was in the Kipuku Alala south fence unit where a large number of locations were recorded along the northern fence line and southern portion of the fence unit (U.S. Army 2014). Additionally, new locations were found in the Puu Koli Fence Unit which helped to clarify the abundance within this fence unit (U.S. Army 2014).
  - In 2014, surveys conducted in previously un-surveyed areas and previously surveyed areas discovered approximately 517 locations of *S. hawaiiensis* (U.S. Army 2015).
  - Ungulate monitoring and control
    - A new 4-hectare [10-acre] fenced enclosure was constructed in the Mauna Kea Ice Age Natural Area Reserve System (PEPP 2009). The enclosure will be used for future outplantings of the following species: *Argyroxiphium sandwicense subsp. sandwicense*, *Ranunculus hawaiiensis*, *Silene hawaiiensis*, *Dubautia arborea*, and *Sanicula sandwicensis* (PEPP 2009).
    - A temporary cage was constructed to protect the single plant at Kahuku from mouflon (Hawaii Volcanoes National Park 2013).
    - As of 2010, plants within Area of Species Recovery [ASRs] 3 and 19 are currently protected within large-scale fence units (U.S. Army 2010). The *Kadua coriacea* fence unit was completed in 2010 and protects a group of *S. hawaiiensis*. Nearly all known *S. hawaiiensis* on the west side of PTA are protected within large-scale fence units (U.S. Army 2010).
    - The Puu Koli fence unit was completed in 2013 and is pending ungulate removal (U.S. Army 2014).
  - Invasive plant monitoring and control
    - Active weed control is conducted in ASRs 3 and 19 at PTA (U.S. Army 2010, 2014). Weed densities in other ASRs and unmanaged areas are very low and have not necessitated weed control.
  - Captive propagation for genetic storage and reintroduction
    - There are 30 individuals of *S. hawaiiensis* in the nursery at Hawaii Volcanoes National Park (2014).
    - The National Tropical Botanical Garden (2015) has approximately 537 seeds in storage.
    - During 2012 to 2013, more than 1,190 seeds from 3 accessions representing 3 groups and 3 founders of *S. hawaiiensis* were collected and placed in long-term storage at PTA (U.S. Army 2014). There are now more than 21,300 seeds in storage from 23 accessions representing 3 groups and 20 founders in long-term storage at PTA (U.S. Army 2014). Now that the Puu Koli fence unit is complete, the population will be monitored for seed collection. Seeds collected in 2004 from that fence unit were propagated during 2012 to 2013 and 2 individuals germinated and will be kept in the greenhouse for seed collection purposes (U.S. Army 2014).

- In 2014, 101 seeds were collected from a single founder within ASR 29 at PTA (U.S. Army 2015).
- Captive propagation protocol development
  - Propagation trials were conducted at PTA to determine appropriate storage and propagation techniques for *S. hawaiiensis*. The trials indicated that seeds of *S. hawaiiensis* germinate readily at a rate of more than 50 percent (U.S. Army 2015). Seed longevity for *S. lanceolata* is greater than 10 years (U.S. Army 2015).
  - *Silene hawaiiensis* was identified, along with another 196 (27 percent) taxa, of being unsecured with inadequate or non-existent *ex situ* representation at any of the surveyed statewide system of *ex situ* facilities in Hawaii (Weisenberger and Keir 2012).
  - A seed dispersal experiment at the Kilauea Crater Rim site demonstrated that wind dispersed seeds of *S. hawaiiensis* could travel at least 40 meters (130 feet) from plants with mature open capsules (Pratt *et al.* 2012). Seed germination rates varied from 7.0 to 73.0 percent in greenhouse trials.
  - Germination rates of *S. hawaiiensis* in the greenhouse were high in three trials and relatively low in two others. Seeds used in the trials varied from fresh to 10 months old; when not used immediately the seeds were air-dried and stored in a refrigerator (Pratt *et al.* 2012). No special treatment was given to seeds before sowing. The first trial sown in May 2006 had a mean germination rate of 73.0 percent. This was followed in August 2006 by a second trial with a mean of only 7.0 percent germination in six replicated pots. The third and fourth trials were sown in June and July 2007 and differed greatly in mean germination rates; the third trial had 60.7 percent germination and the fourth only 13.3 percent. In the final fifth trial, seeds were sown in January 2008 and had 62.4 percent germination rate. The source of the seeds was the from the Mauna Loa site, except for the third trial, in which seeds were collected at the population south of Halemaumau.
- Population viability monitoring and analysis
  - In 2010, mean adult height across all ASRs at PTA was 19 centimeters, a notable decrease of 7 centimeters measured in 2009 (U.S. Army 2010). The fluctuation between monitoring cycles in height may be due to drought, natural dieback, and ungulate herbivory in unprotected areas (U.S. Army 2010). The percentage of mature individuals that were reproductively active at the time of monitoring in 2010 was 23 percent compared to 56 percent in 2009. This could be attributed to drought conditions altering the timing and/or the magnitude of reproductive activity (U.S. Army 2010). The percentage of individuals for which herbivory were recorded increased from 6 percent in 2009 to 30 percent in 2010. The majority of herbivory was from ungulate browse with a substantial number of individuals exhibiting signs of insect browse as well (46 percent and 34 percent, respectively) (U.S. Army 2010).
  - During the installation-wide surveys at PTA, *S. hawaiiensis* was frequently observed browsed down to the ground in the presence of ungulates but was observed to reach heights of 0.6 m in the Kipuka Alala South Fence Unit (U.S. Army 2014).

- At Hawaii Volcanoes National Park, most individuals of *S. hawaiiensis* on Mauna Loa were older than eight years, and a few plants at the Kilauea site south of Halemaumau still had numbered tags dating from 1994, indicating an age greater than 14 years (Pratt *et al.* 2012).
- Reintroduction / translocation
  - During 2002 to 2012 at site 214 within the Kipuka Alala south fence unit, three individuals were reintroduced to the site (U.S. Army 2015). In 2014, five individuals of *S. hawaiiensis* were outplanted at the site (U.S. Army 2015).
  - In 2014 at site 219 within the Kipuka Alala south fence unit, two individuals were reintroduced to the site (U.S. Army 2015).
  - Near Saddle Road on State-owned lands, 26 individuals were reintroduced during 2002 to 2012, 5 individuals were added in 2014, and 17 plants remained in 2014 (U.S. Army 2015).
  - At Puu Waawaa Cone Unit on State-owned lands, 22 individuals were reintroduced during 2010 to 2012 (U.S. Army 2015). In 2014, 8 reintroduced individuals remained.
  - On County-owned lands in North Kona, 18 individuals were reintroduced during 2008 to 2012 and no outplants remained in 2014 (U.S. Army 2015).
- Reintroduced / translocated population management and monitoring
  - Reintroductions of *S. hawaiiensis* were conducted over three years within the Kahuku silversword exclosure of Hawaii Volcanoes National Park (54 individuals reintroduced in 2007, 65 in 2008, and 225 in 2009) (Hawaii Volcanoes National Park 2011). In 2010, 47 percent of the reintroduced individuals were alive with 10.2 percent of the individuals flowering or fruiting following 21 to 30 months of post-planting (Hawaii Volcanoes National Park 2011). Monitoring of the reintroduced individuals in September 2011 reported a decline in survival to approximately 37 percent of the individuals remaining and 6 percent were reproductive (Hawaii Volcanoes National Park 2011). No monitoring was conducted in 2012 or 2013.
  - At site 214 within the Kipuka Alala South fence unit, monitoring of the site in 2014 tallied 8 reintroduced individuals and approximately 2 naturally recruited immature individuals (U.S. Army 2015).
  - At site 214 within the Kipuka Alala South fence unit, monitoring of the site in 2014 tallied five reintroduced individuals (U.S. Army 2015).
  - Near Saddle Road on State-owned lands, natural recruitment of approximately 25 seedlings was observed in 2014 (U.S. Army 2015).
  - At Puu Waawaa Cone Unit on State-owned lands monitoring conducted in 2014 recorded natural recruitment of three immature individuals of *S. hawaiiensis* (U.S. Army 2015).
- Population biology research
  - At Hawaii Volcanoes National Park, individuals of *S. hawaiiensis* were studied for more than two years (2006 to 2008) to determine the stand structure, short-term mortality rates, patterns of reproductive phenology, success of fruit production, floral visitor composition, seed germination rates in the greenhouse, and survival of both natural and outplanted seedlings (Pratt *et al.* 2012). Two populations of *S. hawaiiensis* were monitored on Mauna Loa Strip (200 plants

- plus an additional 50 plants were added in the final year of the study in 2008) and at Kilauea Crater Rim (200 plants). *Silene hawaiiensis* had a stable population structure at the Mauna Loa study area, but its population structure at the Kilauea study site was flat to declining. Mortality of mature plants was low on Mauna Loa (6.5 percent), but was greater than 30 percent at the Kilauea Crater Rim site. Among regularly monitored plants at the Kilauea site, losses were observed in all size classes between 2006 and 2008. Natural seedling recruitment was observed in stand structure plots at both sites between 2006 and 2007, but numbers of seedlings were low and did not compensate for losses of mature plants. Reproductive phenology was annual with buds and flowers observed in summer and fall, and fruit formed in the fall and winter. The production of immature fruit capsules from buds and flowers was high (51.2 percent) and tagged immature fruit became mature fruit at a high rate of 66.7 percent (Pratt *et al.* 2012).
- Pollinators – Pollination studies for *S. hawaiiensis* at Mauna Loa and Kilauea Crater Rim sites revealed that floral visitation rates were very low in timed observations and only three insect species were identified visiting the flowers: native yellow-faced bees, *Hylaeus difficilis* and *H. volcanicus*, and *Allograpta exotica* (alien hover fly) (Pratt *et al.* 2012). Pollination observations on *S. hawaiiensis* were halted by the Kilauea summit eruption, thus further investigation of potential pollinators is warranted for this species. Floral visitor observations at the Mauna Loa population of *S. hawaiiensis* might identify additional potential pollinators (Pratt *et al.* 2012).
  - Threats - ungulate control research
    - Mortality of outplanted seedlings of *S. hawaiiensis* at Kahuku was not significantly greater outside ungulate exclosures than inside, but growth in height and production of reproductive structures was significantly greater in protected areas inside exclosures (Pratt *et al.* 2012). Seedlings planted within exclosures in 2006 had a mortality rate of 48 percent (n = 25) 2.5 years after planting, and a similar number of unprotected seedlings planted outside the same exclosures had a mortality rate of 54.2 percent (n = 24). A second group of seedlings planted in equal numbers inside (n = 9) and outside (n = 9) the same exclosures in May 2007 had a mortality rate of 88.9 percent after two years in both protected exclosures and immediately outside. All seedlings planted outside exclosures in November 2006 showed evidence of animal browsing within four months of planting; no plants inside exclosures were browsed. All unprotected seedlings planted in May 2007 showed browsing damage within six months of planting, and protected seedlings inside exclosures were unaffected (Pratt *et al.* 2012).
    - Additionally, the seedling stage was the most vulnerable part of the life cycle for *S. hawaiiensis*, and low seedling recruitment appeared to be the most important limiting factor for this species (Pratt *et al.* 2012).
    - The results of the Kahuku outplantings inside and outside exclosures, indicate that exposure to browsing ungulates reduces the size of *S. hawaiiensis* plants and prevents them from flowering and reproducing by seeds (Pratt *et al.* 2012). While the plants appear to be able to survive repeated browsing events and persist, at least in the short term, the ultimate impact of continuous ungulate pressure on

- populations of *S. hawaiiensis* is likely reduction and eventual loss, as old plants succumb and are not replaced by recruited seedlings (Pratt *et al.* 2012).
- Human interaction monitoring and management
    - Increased eruptive activity in 2012 lead to an increase in the number of visitors to the edge of the Kilauea Crater for viewing (Hawaii Volcanoes National Park 2013). Unfortunately individuals of *S. hawaiiensis* were being trampled. Cages were placed over the most vulnerable individuals to prevent visitors from trampling the plants (Hawaii Volcanoes National Park 2013).
    - In 2013, a formal consultation was completed for *Asplenium peruvianum* var. *insulare*, *Kadua coriacea*, *Silene hawaiiensis*, *Spermolepis hawaiiensis*, and *Zanthoxylum hawaiiense*. The 2013 biological opinion lists the following avoidance and minimization measures for these species: locating infrastructure to avoid listed species whenever possible; invasive plant surveys and control in construction areas and along roads; and creating buffer zones around federally-listed plants and fencing them to reduce the potential for mechanical damage (U.S. Army 2014).
  - Fire monitoring and control – In November 2012, a wildland fire was ignited as a result of detonating an unexploded ordnance within the Kipuka Kalawamauna East Fence Unit and burned approximately 188 hectares (465 acres) (U.S. Army 2014). A post-fire survey was conducted from December 2012 to March 2013 to assess the impacts of the fire on federal-listed plant species. *Silene hawaiiensis* was located within and surrounding the burned area and may have been impacted by the fire but there was little to no impact on the distribution of the species (U.S. Army 2014). The specific impacts to the distribution of *S. hawaiiensis* were not described in the report.
  - Climate change adaptation strategy – Fortini *et al.* (2013) conducted a landscape-based assessment of climate change vulnerability for native plants of Hawaii 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 by Fortini *et al.* (2013) concluded that *S. hawaiiensis* has a low vulnerability to the impacts of climate change.

### **Synthesis:**

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.

The delisting goals for this species have not been met, as only two of the known populations contain more than 300 mature individuals (Table 1). In addition, not all

threats are being sufficiently managed throughout all of the populations (Table 2). This species is likely to become endangered in the foreseeable future throughout all or a significant portion of its range, and therefore, continues to meet the definition of threatened.

**Recommendations for Future Actions:**

- Surveys / inventories – Survey geographical and historical range for a current assessment of the species’ status.
- Captive propagation for genetic storage and reintroduction – Continue collection of genetic resources for storage, propagation, and reintroduction into protected suitable habitat within historical range.
- Ungulate monitoring and control – Maintain existing exclosures and monitor for potential incursions.
- Invasive plant monitoring and control – Eradicate invasive introduced plants within ungulate exclosures and maintain exclosures free of invasive plants.
- Population viability monitoring and analysis – Continue monitoring wild and reintroduced individuals.
- Fire monitoring and control – Develop and implement a fire management plan at the existing exclosures.
- Climate change adaptation strategy – Research the suitability of habitat for reintroducing this species in the future due to the impacts of climate change.
- Alliance and partnership development – Initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this taxon.

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

<b>Date</b>	<b>No. wild indivs</b>	<b>No. outplanted</b>	<b>Delisting Criteria identified in Recovery Plan</b>	<b>Downlisting Criteria Completed?</b>
1994 (listing)	~3,000	0	All threats managed in the 5 largest populations	Partially
			Complete genetic storage	No
			8-10 populations with 300 mature individuals each	No
			Naturally reproducing, stable, & increasing in number	Unknown
			Stable for 5 consecutive 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, & increasing in number	Unknown
			Stable for 5 consecutive 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	No
			Naturally reproducing, stable, & increasing in number	Unknown
			Stable for 5 consecutive years	Unknown
2010 (5-yr 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	Partially
			Naturally reproducing, stable, & increasing in number	Unknown
			Stable for 5 consecutive years	Unknown
2015 (5-yr review)	~2,100-4,870	~162 (30 natural recruits)	All threats managed in the 5 largest populations	Partially
			Complete genetic storage	Partially
			8-10 populations with 300 mature individuals each	Partially
			Naturally reproducing, stable,	No

Date	No. wild indivs	No. outplanted	Delisting Criteria identified in Recovery Plan	Downlisting Criteria Completed?
			& increasing in number	
			Stable for 5 consecutive years	No

**Table 2. Threats to *Silene hawaiiensis* and ongoing conservation efforts.**

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulates – degradation of habitat and herbivory	A, C, D, E	Ongoing	Partially, PTA is fenced
Invasive introduced plants	A, E	Ongoing	Partially, weed control ongoing at PTA
Lava flow loss or degradation of habitat	A	Ongoing	None
Collecting impacts	B	Ongoing	Partially, case opened with DOCARE and OLE
Invertebrate predation or herbivory –	C	Ongoing	None
Drought	E	Ongoing	None
Fire	E	Ongoing	Partially, tied to weed control efforts at PTA
Military activities	E	Ongoing	Partially, ESA consultations at PTA
Climate change	A, E	Increasing	None

**References:**

See previous 5-year review for a full list of references (USFWS 2010). Only references for new information are provided below.

Fortini, L., J. Price, J. Jacobi, A. Vorsino, J. Burgett, K. Brinck, F. Amidon, S. Miller, S. Gon II, G. Koob, and E. Paxton. 2013. A landscape-based assessment of climate change vulnerability for all native Hawaiian plants. Technical report HCSU-044. Hawaii Cooperative Studies Unit, University of Hawaii at Hilo, Hawaii. 141 pages.

Hawaii Volcanoes National Park. 2011. Annual permit report on threatened and endangered plants. Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii.

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- [PEPP] Plant Extinction Prevention Program. 2009. Plant Extinction Prevention Program annual report, fiscal year 2009 (July 1, 2008-June 30, 2009). Unpublished report submitted to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii.
- Pratt, L.W., J.R. VanDeMark, M. Euaparadorn. 2012. Status and limiting factors of two rare plant species in montane dry communities of Hawaii Volcanoes National Park. Technical Report HCSU-030, Hawaii Cooperative Studies Unit, University of Hawaii at Hilo, Hawaii.
- [U.S. Army] U.S. Army Garrison Pohakuloa. 2010. Natural Resources Program, annual report, Pohakuloa Training Area, Island of Hawaii. 01 October 2009 to 30 September 2010. U.S. Army Garrison Pohakuloa LTC Rolland C. Niles, Commanding December 2010. Prepared in cooperation with the Center for Environmental Management of Military Lands, Colorado State University.
- [U.S. Army] U.S. Army Garrison Pohakuloa. 2012. Final programmatic biological assessment for (1) construction, maintenance, and operation of an infantry platoon battle area; and (2) *Branta sandvicensis* at Pohakuloa Training Area, Island of Hawaii. Prepared by the Natural Resources Office, Directorate of Public Works, United States Army Garrison – Pohakuloa Training Area. March 2012.
- [U.S. Army] U.S. Army Garrison Pohakuloa. 2013. FY 2012 annual report for the Natural Resources Office, Pohakuloa Training Area, Island of Hawaii. 01 October 2011 to 30 September 2012. Prepared in cooperation with the Center for Environmental Management of Military Lands, Colorado State University.
- [U.S. Army] U.S. Army Garrison Pohakuloa. 2014. Natural Resources Office, biennial report, Pohakuloa Training Area, Island of Hawaii. 01 October 2011 to 30 September 2013. Prepared in cooperation with the Center for Environmental Management of Military Lands, Colorado State University.
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- [USFWS] U.S. Fish and Wildlife Service. 1996. Recovery plan for Big Island plant cluster. U.S. Fish and Wildlife Service, Portland, Oregon. 252 pages.

[USFWS] U.S. Fish and Wildlife Service. 2010. *Silene hawaiiensis* 5-year review summary and evaluation. Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii. 17 pages.

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

Weisenberger, L. and M.J. Keir. 2012. A statewide assessment of ex situ status, capacity and needs for the conservation of Hawaiian plants. A project for The National Tropical Botanical Garden, Harold L. Lyon Arboretum, U.S. Fish and Wildlife Service. Sponsored by Hau'oli Mau Loa Foundation.

**Personal communication:**

Peshut, Peter J. and Steven A. Evans. 2013. Manager, Natural Resources Office, US Army Garrison-Pohakuloa and Botanical Program Manager, Center for Environmental Management Military Lands. Letter to Tim Langer, Pacific Islands Fish and Wildlife Office, dated December 23, 2013. Subject: theft of listed plants.

**U.S. FISH AND WILDLIFE SERVICE**  
**SIGNATURE PAGE for 5-YEAR REVIEW of *Silene hawaiiensis* (Hawaiian catch-  
fly)**

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

Appropriate Listing/Reclassification Priority Number, if applicable: \_\_\_\_\_

*for* Programmatic Deputy Field Supervisor, Pacific Islands Fish and Wildlife Office

Maria M. Buegnara

Date 2015-08-25