

## 5-YEAR REVIEW

### Short Form Summary

**Species Reviewed:** *Argyroxiphium sandwicense* subsp. *macrocephalum*  
(‘āhinahina; Haleakalā silversword)

**Current Classification:** Threatened

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

[USFWS] U.S. Fish and Wildlife Service. 2016. Endangered and threatened wildlife and plants; initiation of 5-year status reviews of 76 species in Hawaii, Oregon, Washington, Montana, and Idaho. Federal Register 81(29): 7571–7573.

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

Region 1/Pacific Islands Fish and Wildlife Office (PIFWO), Honolulu, Hawai‘i

#### **Name of Reviewers:**

Cheryl Phillipson, Biologist, PIFWO

Lauren Weisenberger, Plant Recovery Coordinator, PIFWO

Gregory Koob, 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 August 2017. The review was based on a review of current, available information since the last 5-year review for *Argyroxiphium sandwicense* subsp. *macrocephalum* (USFWS 2011). The evaluation by Cheryl Phillipson, Biologist, was reviewed by Lauren Weisenberger, Plant Recovery Coordinator, and Gregory Koob, 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](http://ecos.fws.gov/tess_public)).

#### **Review Analysis:**

Please refer to the previous 5-year review for *Argyroxiphium sandwicense* subsp. *macrocephalum* published in the Federal Register on August 2, 2011 (available at [https://ecos.fws.gov/docs/five\\_year\\_review/doc3801.pdf](https://ecos.fws.gov/docs/five_year_review/doc3801.pdf)) for a complete review of the species’ status, threats, and management efforts. 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 *A. sandwicense* subsp. *macrocephalum*.

This long-lived monocarpic rosette shrub in the Asteraceae (sunflower) family is threatened and endemic to Maui. The current status and trends for *Argyroxiphium sandwicense* subsp. *macrocephalum* are provided in the tables below.

#### New Status Information:

- Occurrences and numbers of individuals have been observed to be in steep decline at their only location in Haleakalā Crater (Krushelnycky *et al.* 2013). The research group counted approximately 29,000 individuals in 31 subpopulations (out of an approximate 100 subpopulations), and data from the study plots indicate that the previous estimate of 50,000 or more plants is no longer justified.
- Research by Perez (2015a) found that *Argyroxiphium sandwicense* subsp. *macrocephalum* has strong substrate preferences. This subspecies prefers (1) rock outcrops, (2) shallow soils, (3) areas with surface stones, and (4) organic litter. These soil types have higher moisture levels and retain moisture longer, stay cooler, and provide protection from falling debris (Perez 2015b). Overall, this subspecies avoids “barren, deep-soil areas.”
- In 2014, Haleakalā National Park (HNP) reported mapping one new individual at 9,700 ft at the summit of Haleakalā (HNP 2015).
- In 2016, the Service revised critical habitat for *Argyroxiphium sandwicense* subsp. *macrocephalum*, and the final rule designated four critical habitat units in four ecosystem types (montane mesic, subalpine, alpine, and dry cliff) on east Maui (23,410 ac, 11,937 ha) (81 FR 17790, March 30, 2016).

#### New Threats:

- Habitat modification and destruction and competition with nonnative *Pinus* species are noted as threats to *Argyroxiphium sandwicense* subsp. *macrocephalum* (Robertson 2016, in litt.). *Pinus* species (pine trees) are tall, evergreen trees or shrubs native to all continents and some oceanic islands, but are not native to any of the Hawaiian islands. *Pinus caribaea* (Caribbean pine), *P. elliottii* (slash pine), *P. patula* (jelecote pine), *P. pinaster* (maritime pine), *P. radiata* (Monterey pine), and *P. taeda* (loblolly pine) are found on Moloka‘i, Lāna‘i, and Maui (Little and Skolmen 1989; Oppenheimer 2003; PIER 2011; IUCN 2017a–f) and were primarily planted by Hawai‘i State foresters for reforestation and erosion control (Little and Skolmen 1989; Oppenheimer 2003; PIER 2010). *Pinus* species are known to establish readily, create dense stands that shade out native plants and prevent regeneration, outcompete native plants for soil water and nutrients, change soil chemistry, promote growth of weed seeds dropped by perching birds, and are highly flammable (Oppenheimer 2010, in litt.; PIER 2010). On east Maui, *Pinus* species are a threat at higher elevations because they are invading native subalpine shrublands (Oppenheimer 2002; Oppenheimer 2010, in litt.).
- Invasive species—Established invasive plant species competition—Another nonnative plant, *Cortaderia jubata* (pampas grass), is noted as a new threat to *Argyroxiphium sandwicense* subsp. *macrocephalum* (Robertson 2016, in litt.). One of the most detrimental nonnative plant species in the area, along with *Pinus* species, pampas grass, a large, clump-forming, perennial herb, was first discovered in 1987 on east Maui, where it has escaped cultivation and is becoming invasive inside and on the outer slopes of Haleakalā Crater (Robertson 2016, in litt.). This species is a serious pest in California, and is on the Hawai‘i State noxious weed list (Staples and Herbst 2005). Pampas grass produces abundant seed and spreads readily (Staples and Herbst 2005).

- Climate change loss or degradation of habitat—
  - Climate change may pose a threat to this subspecies. 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 by Fortini *et al.* (2013) concluded that at the species level, *Argyroxiphium sandwicense* is highly vulnerable to the impacts of climate change, with a vulnerability score of 0.536 (on a scale of 0 being not vulnerable to 1 being extremely vulnerable to climate change). However, *Argyroxiphium sandwicense* subsp. *macrocephalum* occurs at the highest elevations on Maui. There is no area above its current range that it could occupy. Therefore, additional management actions, including possible translocations to other islands outside of its historic range, are needed to conserve this taxon into the future.
  - Recent trends in drought associated with climate change are implicated in the population decline of this subspecies. Current research indicates that annual population growth rates of *Argyroxiphium sandwicense* subsp. *macrocephalum* are strongly tied to rainfall patterns, and that plants at lower-elevations are declining in numbers at a more rapid rate than higher-elevation plants (Krushelnycky *et al.* 2013; Robertson 2016, in litt.). Researchers suspect that unusually warm and dry conditions may create negative carbon balances leading to mortality through carbon starvation from depletion of carbon stores or interruption of carbon transport. Severe water stress may induce hydraulic failure, compounding the effect of carbon starvation.
- Landslides and flooding destruction or degradation of habitat—A study by Krushelnycky *et al.* (2013) suggests that high rainfall events (greater than 15mm per day) may be deleterious to *Argyroxiphium sandwicense* subsp. *macrocephalum* by causing erosion of the substrate that this subspecies requires (Perez 2015a). Although there is currently a decline in rainfall resulting from the warming and drying climate, there is also a trend towards more extreme rainfall events (especially during La Niña years) on Hawai‘i island as described in Chu *et al.* (2010); however, current modeling data does not yet reflect increased extreme rainfall events for the islands of O‘ahu and Maui (Chen and Chu 2014).
- Lack of adequate biosecurity legislation—Invasion of the State of Hawai‘i by invasive nonnative plant species, and destruction of habitat and competition by nonnative plants are threats to *Argyroxiphium sandwicense* subsp. *macrocephalum*. The U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, is authorized to prevent the introduction or dissemination of animal and plant pests on all ships, aircraft, and their cargo and baggage arriving in the U.S. and its territories; however, pest species continue to enter the State. In addition, Federal import regulations do not

address many species that could be pests in Hawai‘i (CGAPS 2009; Ikuma *et al.* 2002).

#### New Management Actions:

- Captive propagation for genetic storage and reintroduction—Lyon Arboretum continues to store propagules of *Argyroxiphium sandwicense* subsp. *macrocephalum* (Lyon Arboretum 2017). Olinda Rare Plant Facility has five potted plants in storage (ORPF 2016). The Plant Extinction Prevention program co-manages this subspecies, and records indicate that 32 individuals were recently outplanted (PEPP 2017).
- In 2014, HNP reported collection of 900 seeds from four individuals at the summit, outplanting of 165 individuals at four locations at the summit, Kahikinui, and the crater (HNP 2014). In 2015, HNP reported 3,512 plants in storage representing 20 wild individuals, and 12,000 seeds collected from 57 individuals. Also, 313 individuals were outplanted at the summit and in the State enclosure in the summit crater (HNP 2015). In 2016, HNP reported 961 plants representing about 30 wild individuals from the HNP summit in the nursery, and 8,000 seeds collected from the HNP summit from 130 wild individuals. There were 1,062 individuals outplanted in the State enclosure in the summit crater (HNP 2017). In 2017, HNP reported collections of 500 seeds representing one founder from one location in the Park. HNP also outplanted 637 individuals at the summit, and 420 individuals at various elevations within Haleakalā Crater (HNP 2018).

#### Synthesis:

Studies conducted since completion of the last 5-year review for this subspecies confirm the steady decline of individuals in Haleakalā Crater. Currently, there is one occurrence extending over 1,600 ha (4,000 ac). A landscape-based assessment of climate change vulnerability for native plants of Hawai‘i using high resolution climate change projections was made by Fortini *et al.* (2013) and their analysis showed that *Argyroxiphium sandwicense* subsp. *macrocephalum* is highly vulnerable to the effects of climate change. Reintroductions and seed collections from wild, outplanted or greenhouse material are ongoing. Seeds and propagules are in storage; and it is estimated that over 300 individuals are represented in seed storage.

Stabilizing (interim), downlisting, and delisting objectives were provided in the Recovery Plan for the Maui Plant Cluster (USFWS 1997), and have been updated according to the draft revised recovery objective guidelines developed by the Hawai‘i 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.

*Argyroxiphium sandwicense* subsp. *macrocephalum* is a long-lived monocarpic rosette shrub, and an obligate outcrosser. To prevent extinction, which is the first step 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 an *ex situ* (secured off-site, such as a nursery or seed bank) collection. In addition, a minimum of three populations should be documented on Maui. Each of these populations must be naturally reproducing (*i.e.*, viable seeds, seedlings, saplings) and increasing in number, with a minimum of 50 mature, reproducing individuals per population.

The preventing extinction goals for this subspecies have not been met (Table 1), although there are at least three subpopulations with greater than 50 individuals, it is uncertain how many individuals matured, this population is observed to be declining in numbers, all threats are not being managed, and genetic storage is incomplete (Table 2). Therefore, *Argyroxiphium sandwicense* subsp. *macrocephalum* meets the definition of Threatened as it is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

#### **Recommendations for Future Actions:**

Habitat destruction and modification, and direct competition, by the nonnative plants pampas grass and *Pinus* species, are noted as new threats to this subspecies. In addition, erosion and substrate modification by high rainfall events is a threat to this subspecies. However, this information does not change the species' biological status since the last 5-year review in 2011. Thus, the following recommendations for future actions are added or reiterated for the 5-year review for 2018.

- Ungulate monitoring and control—Continue to maintain large-scale fenced enclosures to protect individuals from the negative impacts of feral ungulates. Protect all occurrences against browsing and habitat disturbances from feral ungulates.
- Invasive plant monitoring and control—
  - Control established ecosystem-altering nonnative invasive plant species around all populations.
  - Control invasive nonnative species that compete with the species around all populations.
- Captive propagation for genetic storage and reintroduction—
  - Continue to conduct research on outcrossing success, and collect seeds from outplanted individuals for adequate genetic representation.
  - Continue propagation efforts for maintenance of genetic stock.
- Reintroduction and translocation—Continue to reintroduce individuals into suitable habitat within historic range that is being managed for known threats to this subspecies.
- Climate change adaptation strategy—Assess the modeled effects of climate change on this subspecies, and determine future landscape needed for the recovery of the subspecies.
- Predator monitoring and control—

- Continue to study pollinators and other insects visiting flowers and their relationship to the nonnative Argentine ant.
  - Continue to determine which pollinators are most critical to seed set and to the long-term survival of the species.
- Stochastic events—Build resilience and redundancy—Increase numbers of populations and individuals scattered through historic range to reduce impacts from drought.
- Habitat and natural process management and restoration—Strategic planning—Work with the National Park Service, the Hawai‘i Division of Forestry and Wildlife, and other land managers to continue implementation of ecosystem-level restoration and management to benefit this subspecies.
- Population biology research—Continue to study population dynamics over the entire population with accurate mapping so that factors such as blooming and seed set can be correlated with abiotic factors such as climate change.

**Table 1. Status and trends of *Argyroxiphium sandwicense* subsp. *macrocephalum* from listing through current 5-year review.**

<b>Date</b>	<b>No. wild individuals</b>	<b>No. outplanted</b>	<b>Stability Criteria identified in Recovery Plan</b>	<b>Stability Criteria Completed?</b>
1992 (listing)	ca 50,000	0	All threats managed in one population	No
			Complete genetic storage	No
			One population with 50,000 mature individuals	No
1997 (recovery plan)	>64,000	0	All threats managed in one population	No
			Complete genetic storage	Partially
			One population with 50,000 mature individuals	Yes
2003 (critical habitat)	39,025–44,025	0	All threats managed in one population	No
			Complete genetic storage	Partially
			One population with 50,000 mature individuals	No
2011 (5-year review)	ca 50,000	16,279	All threats managed in one population	No
			Complete genetic storage	Partially
			One population with 50,000 mature individuals	Yes
2016 (critical habitat)	ca 50,000	1,540	All threats managed in one population	No
			Complete genetic storage	Partially

			One population with 50,000 mature individuals	Yes
<b>Date</b>	<b>No. wild individuals</b>	<b>No. outplanted</b>	<b>*Preventing Extinction Criteria identified by HPPRCC</b>	<b>*Preventing Extinction Criteria Completed?</b>
2018 (5-year review)	< 50,000	1,057	All threats managed in all three populations	No
			Complete genetic storage	Partially
			Reproduction ( <i>i.e.</i> viable seeds, seedlings) at all three populations	No
			Three 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 after Preventing Extinction).

**Table 2. Threats to *Argyroxiphium sandwicense* subsp. *macrocephalum* and ongoing conservation efforts.**

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulate degradation of habitat	A	Ongoing	None
Established ecosystem altering invasive plant species degradation of habitat	A	Ongoing	Partial, Haleakalā National Park conducts weed control
Landslides and flooding destruction or degradation of habitat	A	Ongoing	None
Climate change degradation or loss of habitat	A	Ongoing	Partial, research on impacts ongoing
Ungulate predation or herbivory	C	Ongoing	Partial, fence monitoring ongoing
Rodent predation or herbivory	C	Ongoing	Partial
Ant predation of pollinators	C	Ongoing	Partial, testing effective and efficient control methods
Lack of adequate hunting regulations	D	Ongoing	None
Lack of adequate biosecurity legislation	D	Ongoing	None
Invasive species—Established invasive plant species competition	E	Ongoing	Partial, Haleakalā National Park conducts weed control
Stochastic events—Drought mortality and reduced viability	E	Ongoing	Partial, monitoring of study plots
Reduced viability due to loss of pollinators	E	Ongoing	Partial, propagation efforts are ongoing

**References:**

See previous 5-year review for a full list of references (USFWS 2011). Only references for new information are provided below.

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**U.S. FISH AND WILDLIFE SERVICE**

SIGNATURE PAGE for 5-YEAR REVIEW of *Argyroxiphium sandwicense* subsp.  
*macrocephalum* (‘āhinahina; Haleakalā silversword)

**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

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