

*Arabis [Boechera] hoffmannii*  
(Hoffmann's rock-cress)

**5-Year Review:  
Summary and Evaluation**



**U.S. Fish and Wildlife Service  
Ventura Fish and Wildlife Office  
Ventura, California**

**November 2011**

## 5-YEAR REVIEW

### *Arabis [Boechea] hoffmannii* (Hoffmann's rock-cress)

#### I. GENERAL INFORMATION

##### **Purpose of 5-Year Reviews:**

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing of a species as endangered or threatened is based on the existence of threats attributable to one or more of the five threat factors described in section 4(a)(1) of the Act, and we must consider these same five factors in any subsequent consideration of reclassification or delisting of a species. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process defined in the Act that includes public review and comment.

##### **Species Overview:**

Hoffmann's rock-cress (*Arabis [Boechea] hoffmannii*) is a short-lived, perennial herb in the mustard (Brassicaceae) family. *Arabis [Boechea] hoffmannii* was formerly known as *Arabis hoffmannii* until recent taxonomic revisions placed it in the genus *Boechea*. The plant grows from a vegetative rosette with stems sometimes reaching 0.5 meter (m) (1.6 feet (ft)) in height. It is endemic to Santa Rosa, Santa Cruz, and Anacapa Islands in the Channel Islands National Park located off the coast of southern California, although it has not been seen on Anacapa Island since 1941. Hoffmann's rock-cress was listed as a federally endangered species in 1997. The plant is currently threatened by soil damage and habitat alteration resulting from decades of herbivory by sheep, horses, cattle, elk and deer, competition from nonnative grasses, small population size, and climate change. Since the last 5-year review was prepared, the number of known populations has increased from 6 to 10.

##### **Methodology Used to Complete This Review:**

This review was prepared by the Ventura Fish and Wildlife Office, following the Region 8 guidance issued in March 2008. We used information from the recovery plan, survey information from experts who have been monitoring various localities of this species, and the California Natural Diversity Database (CNDDDB) maintained by the California Department of Fish and Game. The Recovery Plan and personal communications with experts, particularly staff of the National Park Service (NPS) at Channel Islands National Park, U.S. Geological Survey Biological Resources Division (USGS-BRD), and The Nature Conservancy (TNC), were our primary sources of information used to update the species' status and threats. This 5-year review

contains updated information on the species' biology and threats, and an assessment of that information compared to that known at the time of listing or since the last 5-year review. We focus on current threats to the species that are attributable to the Act's five listing factors. The review synthesizes all this information to evaluate the listing status of the species and provide an indication of its progress towards recovery. Finally, based on this synthesis and the threats identified in the five-factor analysis, we recommend a prioritized list of conservation actions to be completed or initiated within the next 5 years.

**Contact Information:**

**Lead Regional Office:** Larry Rabin, Deputy Division Chief for Listing, Recovery, and Environmental Contaminants, Region 8, Pacific Southwest, (916) 414-6464

**Lead Field Office:** Ventura Fish and Wildlife Office  
Lauren Kehiayan, Fish and Wildlife Biologist, (805) 644-1766;  
Della Snyder-Velto, Fish and Wildlife Biologist, (626) 574-5254;  
Connie Rutherford, Listing and Recovery Program Coordinator for Plants, (805) 644-1766, extension 306

**Federal Register Notice Citation Announcing Initiation of This Review:** A notice announcing initiation of the 5-year review of this taxon and the opening of a 60-day period to receive information from the public was published in the Federal Register (FR) on May 25, 2011 (76 FR 30377). No information was received in relation to this species.

**Listing history:**

Original Listing  
FR notice: 62 FR 40954-40974  
Date listed: July 31, 1997  
Entity listed: *Arabis hoffmannii* (species)  
Classification: Endangered

**Associated Rulemaking:** None

**Review History:** 40 FR 27924 (July 1, 1975). Review of Status of Vascular Plants  
73 FR 11950 (March 5, 2008). Availability of Completed 5-Year  
Reviews in California, Nevada, and Southern Oregon

**Species' Recovery Priority Number at Start of Review: 5.** This is based on a 1-18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 FR 43098, September 21, 1983). The Recovery Priority number 5 denotes a full species with a high degree of threat and a low potential for recovery.

**Recovery Plan or Outline**

Name of Plan: Thirteen Plant Taxa from the Northern Channel Islands Recovery Plan.

Date Issued: September 26, 2000.

Previous revisions: None.

## II. REVIEW ANALYSIS

### **Application of the 1996 Distinct Population Segment (DPS) policy**

The Endangered Species Act defines “species” as including any subspecies of fish or wildlife or plants, and any distinct population segment (DPS) of any species of vertebrate wildlife. This definition of species under the Act limits listings as distinct population segments to species of vertebrate fish or wildlife. Because the species under review is a plant, the DPS policy is not applicable, and the application of the DPS policy to the species listing is not addressed further in this review.

### **Information on the Species and its Status**

#### Species Description and Life History

Hoffmann’s rock-cress is a short-lived, perennial herb in the mustard (Brassicaceae) family. The plant grows from a vegetative rosette with stems sometimes reaching 0.5 m (1.6 ft) in height. Upon maturity, it develops one or more flower stalks producing white to lavender flowers with four petals about 1 cm long. The plant is believed to be monocarpic (bearing fruit only once, then dying); however, the plant has been observed to live for up to 5 years if two or more vegetative and reproductive rosettes are present on the plant (Wilken 2006). Hoffmann’s rock-cress can produce tens to hundreds of slightly curved fruits (siliques) borne on long stalks with thousands of seeds. Hoffmann’s rock-cress does not appear to be dependent upon pollinators for seed set, and individual plants may produce as many as 3,000 to 4,000 seeds. The small sizes of natural populations indicate that establishment success of new plants is low despite the large number of seeds produced per plant. Surviving plants tend to be found in the shade of shrubs where the cover of annual species is low, suggesting that Hoffmann’s rock-cress cannot tolerate competition with a high cover of annual species (Service 2000).

#### Changes in Taxonomic Classification or Nomenclature

Recent taxonomic changes reassigned Hoffmann’s rock-cress from the genus *Arabis* to the genus *Boechea* (Windham and Al-Shehbaz 2007, Al-Shehbaz and Windham 2011). The genus *Boechea* was separated from *Arabis* in 1976 on the basis of chromosome number; genetic studies clarified that *Boechea* had a base chromosome number of  $x=7$ , while the genus *Arabis* has a base chromosome number of  $x=8$ . Since then, several phylogenetic studies were done that reconfirm the distinction between *Boechea* and *Arabis* (Al-Shehbaz 2003). The Service will formally recognize *Boechea* as the genus for the taxon once it is published in the Federal Register.

#### Genetics

While recent genetic work has focused on the distinction between genera within the family Brassicaceae (see above), no new studies concerning the genetics of this specific taxon have been conducted since the time of listing.

### Distribution

Hoffmann's rock-cress has historically been reported to occur on Anacapa Island, Santa Rosa Island, and Santa Cruz Island (Figure 1). All of Anacapa and Santa Rosa and portions of Santa Cruz Island are owned and managed by NPS. The remaining portion of Santa Cruz Island is owned by TNC; a portion of the TNC lands are managed by NPS through an agreement. At the time the recovery plan was published, four populations of Hoffmann's rock-cress were known: three on Santa Cruz Island that collectively covered less than 0.4 hectare (1 acre), and one population on Santa Rosa Island.

Regarding the one historically known Santa Rosa Island population, no plants have been seen there since 2000, despite annual surveys; however, the USGS believes this population still exists. With the discovery of two more populations of Hoffmann's rock-cress on Santa Rosa Island, there are now three known populations on Santa Rosa Island. For Santa Cruz Island, in addition to the three historically known populations, another population was discovered at Trident Lady's Ridge, so at present, four populations are known to exist on Santa Cruz Island. Adding the 3 outplanting trials on Santa Cruz Island to these 7 natural populations, there are currently 10 populations of Hoffmann's rock-cress that exist to date.

The Anacapa Island population (known as the Frenchy's Cove population) is based on a 1941 field collection by Reid Moran. It is possible that the plant was misidentified as Hoffmann's rock-cress in this field collection and may not have occurred on Anacapa Island at all. According to Moran's field notes, he collected Hoffmann's rock-cress from Anacapa Island "on the slopes above Frenchy's Cove" (S. Junak, pers. comm. 1993 in Service 1997). However, no specimens from this collection have been found in herbaria with known collections of island species, and despite repeated surveys, no populations of Hoffmann's rock-cress on Anacapa Island have ever been located to date (D. Rodriguez and K. Niessen, National Park Service, pers. comm. 2011).

### Abundance

Results from demographic monitoring suggest that approximately 10 to 15 percent of Hoffmann's rock-cress plants within a population flower each year (McEachern and Chess 2006). Currently there are seven known natural Hoffmann's rock-cress populations on the Channel Islands.

### **Santa Cruz Island Populations**

Four Santa Cruz Island population sites of Hoffmann's rock-cress were known in 2003 (Figure 2): two on the north side of the island (Platt's Canyon and Platt's Harbor); and two in the Central Valley (Centinela and Stanton Ranch). In 2004-2005, the USGS-BRD revisited and censused plants at Centinela and Stanton Ranch but were prevented from visiting the Platt's Canyon and Platt's Harbor sites due to the remoteness of those locations. The Central Valley sites, Centinela and Stanton Ranch, have been visited semi-regularly by various botanists over the years.

Although the Platt's Canyon and Platt's Harbor sites had not been visited in 16 to 21 years, surveys of those locations were planned for 2006 (McEachern and Chess 2006). In June 2006, these populations were revisited and 19 individual plants were found at the Platt's Harbor site (McEachern et al. 2010). However, no plants were found within 200 m of the estimated location

of the Platt’s Canyon site; the USGS-BRD believes a larger area needs to be searched to find this population. Based on the results of these surveys, only the population at Platt’s Harbor is considered extant at present.

During the 2004-2005 surveys, the USGS-BRD discovered another population that is called the “Trident Lady’s Ridge” site and is located on the north side of the island as well. The Trident Lady’s Ridge population was visited annually from 2004 to 2008; seeds were collected in 2004, 2005, and 2006, and a voucher specimen was collected in 2004. The plants in this population were found to be more robust than plants seen in the Stanton Ranch population. The most recent survey conducted of this population in 2008 estimated the plant numbers to be slightly higher at that time than in previous years (McEachern and Rodriguez 2008, McEachern et al. 2010, McEachern 2011).

The Centinela population occurs on thin soil in crevices or on ledges of volcanic cliff face, beneath giant coreopsis (*Coreopsis gigantea*), buckwheat (*Eriogonum arboreum*), island bristleweed (*Hazardia detonsa*), and scattered California sagebrush (*Artemisia californica*) (Wilken 2006). The Centinela population has not been sampled since 2006; however, the most recent survey reported 485 adult plants. Visits since 2006 indicate that there has been little change in the number of plants in this population (McEachern and Rodriguez 2008).

The Stanton Ranch population is located southwest of the Main Ranch Airfield and occurs on thin soil or bare, moderately friable (crumbly) bedrock in the shade of chamise (*Adenostoma fasciculatum*), island scrub oak (*Quercus pacifica*), and scattered island manzanita (*Arctostaphylos insularis*) (Wilken 2006). A demographic survey of the Stanton Ranch location was conducted in June of 2008 and a much higher number of plants were reported. Data from the 2005 demographic surveys showed that plants at Stanton Ranch are smaller and have fewer fruits than plants at Centinela and Trident Lady’s Ridge. These data are consistent with Wilken’s 2006 monitoring results that also showed Hoffmann’s rock-cress fruits at Stanton Ranch were smaller than at Centinela.

**Table 1: Known natural occurrences of Hoffmann’s rock-cress on Santa Cruz Island**

Site No.	Year Discovered	Site Name	Area (m <sup>2</sup> )	Census			
				2004	2005	2006	2008
1	1932	Platt’s Harbor	200	no survey	no survey	19	no survey
2	1950	Stanton Ranch	6	33	81	138	138++
3	1985	Centinela	450	no survey	485	no survey	no survey
4	2004	Trident Lady’s Ridge	2,400	13	18	15	15+

### Santa Rosa Island Populations

Until 2008, the Lobos Canyon population was the only known population of Hoffmann’s rock-cress on Santa Rosa Island. Today, three populations are known to exist on Santa Rosa Island: Lobos Canyon, Sierra Pablo Chaparral, and South Point Chaparral (Figure 3).

The Lobos Canyon population occurs on thin, sandy soil on a sandstone ledge, on open sites or beneath giant coreopsis (Wilken 2006). When the Lobos Canyon population was discovered in 1996, it was believed to be too small for long-term persistence, as its seeds fall on inhospitable

ground below the ledge and the rock ledge itself has a high erosion risk (Wilken 2006). As of 2004, the plants at the Lobos Canyon site had produced fruits only 3 of the 9 years since they were discovered. From 1996 to 2004, the USGS-BRD did not collect or propagate seeds from the Lobos Canyon plants because recovery permits and a restoration plan for the Santa Rosa Island genotypes were lacking at that time (McEachern et al. 2004). The population has continued to be inspected annually. As the site is on a rock ledge perched about 10 m above the canyon bottom, the USGS used a ladder to climb up and visually inspect the ledge and canyon floor beneath during the flowering seasons of 2003-2008; however, no plants have been seen at this location since 2002 (McEachern and Rodriguez 2008; McEachern et al. 2009).

Demographic studies of the native rock cress populations on Santa Cruz Island indicate that the species lives 2-3 years, flowering at 2-3 years of age and rarely persists for 4 years. Based on this, any plants that had germinated at the Lobos Canyon site would have been detected during the visual surveys from 2003 to 2008. However, Hoffmann's rock-cress may also have a long-lived seed bank and therefore, the population at this site is not yet considered extirpated (Rodriguez and Niessen, pers. comm. 2011).

The population at the Sierra Pablo Chaparral location was discovered in 2008 by staff from the NPS. At the time it was discovered, there were about 35 adult individuals distributed among 6 colonies. The site was revisited in 2009 and fencing was placed around existing plants to protect against herbivory and trampling by deer. The site was visited again in 2010 and no substantial changes were seen at the location (Christian, unpubl. data 2008; McEachern et al. 2009).

The population at the South Point Chaparral location was discovered in 2010 by staff from NPS. At the time of discovery, 21 adult plants were counted along with other individuals that had fruited and died. No change is presumed to have occurred at the site since it was visited in 2010 (Niessen, unpubl. data 2010).

**Table 2: Known natural occurrences of Hoffmann's rock-cress on Santa Rosa Island.**

Site No.	Year Discovered	Site Name	Area (m <sup>2</sup> )	Census			
				1996	2008	2009	2010
1	1996	Lobos Canyon	5,600	3-8	0	no survey	no survey
2	2008	Sierra Pablo Chaparral	unknown	N/A	35	35	35
3	2010	South Point Chaparral	30	N/A	NA/	N/A	21

**Seed Collection and Storage:**

On Santa Cruz Island, the USGS-BRD visited the Trident Lady's Ridge population and collected 13 mature fruits yielding 2,093 seeds and collected 1 voucher specimen in June, 2004 (McEachern and Chess 2006; McEachern et al. 2010). In June 2005, USGS-BRD collected 20 fruits from the Centinela population and 18 fruits from the Trident Lady's Ridge population, yielding 2,565 and 3,173 seeds respectively. Fruits were not collected from the Stanton Ranch site at that time because USGS-BRD considered the population too small. In 2006, the USGS-BRD collected seeds from Stanton Ranch, Centinela, and Trident Lady's Ridge populations, resulting in 10 fruits yielding 1,200 seeds from Stanton Ranch, 10 fruits yielding 1,363 seeds from Centinela, and 15 fruits yielding 2,090 seeds from Trident Lady's Ridge (McEachern et al. 2010 and McEachern 2011). One thousand of the seeds that were collected between 2005 and 2006 each from Centinela and Trident Lady's Ridge were deposited at the Santa Barbara Botanic Garden (SBBG) seed bank in 2006 (McEachern and Chess 2006). In addition, a small number of

seeds were planted outside the Channel Islands National Park Visitor Center in the native plant garden; the resulting plants are accessible to the general public for viewing.

**Table 3: Seed collections taken from natural populations of Hoffmann’s rock-crec on Santa Cruz Island.**

Site No.	Year Discovered	Site Name	Area (m <sup>2</sup> )	Seed Collection		
				2004	2005	2006
1	1932	Platt’s Harbor	200	0	0	0
2	1950	Stanton Ranch	6	0	0	1,200
3	1985	Centinela	450	0	2,565	1,363
4	2004	Trident Lady’s Ridge	2,400	2,093	3,173	2,090

On Santa Rosa Island, seeds were also collected from the newly discovered Sierra Pablo Chaparral population in 2008. Five fruits were collected by NPS that yielded 150 seeds (Christian, unpubl. data 2008). These seeds will be used for future outplanting trials on Santa Rosa Island (McEachern et al. 2009).

**Table 4: Seed collections taken from natural populations of Hoffmann’s rock-crec on Santa Rosa Island.**

Site No.	Year Discovered	Site Name	Area (m <sup>2</sup> )	Seed Collection	
				2004	2008
1	1996	Lobos Canyon	5,600	0	0
2	2008	Sierra Pablo Chaparral	unknown	N/A	150
3	2010	South Point Chaparral	30	N/A	N/A

Outplanting Trials:

Outplanting activities have been undertaken by both the NPS and USGS-BRD. At the time of the first 5-year review (2007-2008), NPS goals for Hoffmann’s rock-crec were to use overflow stock from SBBG to increase the number of plants on Santa Cruz Island and to establish a seed bank. The USGS-BRD goals included these, as well as testing whether seeds or seedlings are better for successful restoration out-planting projects. Out-planting projects were conducted at five sites in 2004 and 2005; only two (Centinela and Pelican) of the five sites still had live plants as of March 2006 (McEachern and Chess 2006). The Centinela and Pelican outplantings were visited again in 2007 and no Hoffmann’s rock-crec plants were present in the exclosures (McEachern et al. 2010).

Three more outplanting sites were established by NPS and USGS-BRD on Santa Cruz Island in the winter of 2005-2006. The sites were chosen based on criteria for suitable habitat (north-facing slopes with fog in the summer and without a dominant understory of invasive grasses and out of the way of feral pig trampling). They used seeds from SBBG as well as from collections taken from two natural Santa Cruz populations. The sites were named “Lagunitas Secas Road North,” “Lagunitas Secas Road South,” and “Alberts Road” (McEachern et al. 2009). When the sites were revisited in 2008, a minimum of 50 percent survivorship was reported among all three sites. A total of 137, 231, and 187 plants were found respectively. About 30 percent of the plants had flowered and set seed. As of 2008, none of the plants that were started as seed had flowered yet (McEachern and Rodriguez 2008).



No outplanting activities have been conducted on Santa Rosa Island, but preliminary outplanting trials that are underway on Santa Cruz Island will help guide restoration plans for Santa Rosa Island.

#### Research on Reproduction Characteristics:

The SBBG initiated a research program in 2006 to investigate the reproductive strategies of four plants restricted to the northern Channel Islands, one of which was Hoffmann's rock-cress. The objectives of the program were to understand the biology of rarity and to provide basic information for wise management and conservation. At the time the study was undertaken, soil erosion, habitat degradation, and feral pig rooting were all potential threats to Hoffmann's rock-cress. Today, feral pig rooting is not a threat, although soil erosion and habitat degradation continue to threaten the existence of Hoffmann's rock-cress as well as other factors discussed throughout this review. The Stanton Ranch, Centinela, and Lobos Canyon populations were included in the study (Wilken 2006).

Based on the results of the study, Hoffmann's rock-cress plants with solitary rosettes die after fruiting, while plants with two or more rosettes generally persist after fruiting and can live up to 5 years. In studies conducted on plants germinated at SBBG, it was found that plants can reproduce as early as 2 years after germination. The study found that anthesis (flower is fully open) lasts between 18 and 24 hours. Anther dehiscence (dropping of the seeds) occurs a few hours before the unfolding of the petals (Wilken 2006).

Hoffmann's rock-cress was found to be self-compatible and can produce more than 30 fruits per plant and 3,000 to 4,000 seeds per plant. It is unknown at this time whether or not the breeding system is autogamous (self-fertilizing). However, high proportions of fruit set and many seeds per fruit under insect-free conditions suggest that Hoffmann's rock-cress does not need pollinators to set seed. If the plants are self-fertilizing, a very low level of genetic variability would be expected. Overall seed germination rates ranged from 59 to 89 percent and most seeds germinated within 9 to 14 days of planting (Wilken 2006).

#### Habitat or Ecosystem

Hoffmann's rock-cress occurs in coastal bluff scrub and on volcanic cliff edges (CNDDDB 2009). An island-wide habitat model for Santa Rosa Island was developed by the USGS-BRD and NPS in 2005 in order to create a search area for Hoffmann's rock-cress on the island. The parameters included in the model were slopes facing northwest to northeast with afternoon shading, island areas with summer fog, and sites inaccessible to ungulates such as steep to vertical or isolated ledges (McEachern et al. 2009).

Plants in the Sierra Pablo Chaparral population were originally found only under the protection of scrub oak (*Quercus pacifica*). However, when plants were fenced in and protected from trampling and rooting by deer and elk, they persisted in an open field away from the protection of the scrub oak areas (Rodriguez and Niessen, pers. comm. 2011). This is the only instance where Hoffmann's rock-cress persists without the protection of a steep cliff or located in an isolated area.

### Species-specific Research and/or Grant-supported Activities

In 2003, NPS, in collaboration with the USGS-BRD and the Service, developed a conservation strategy to help guide landscape-level actions that would indirectly aid in recovery of Hoffmann's rock-cress and eight other threatened and endangered species on the northern Channel Islands (Coonan et al. 1996). Included in this program is a compilation of herbarium records, annual field surveys, and demographic monitoring to determine population status and trends.

The NPS, USGS-BRD, and SBBG have also developed the National Park Service Natural Resource Preservation Plan. Its goal is to implement actions that will contribute to the recovery of 15 federally listed plant taxa on the Channel Islands National Park over a 3-year period. One of the taxa included in this program is Hoffmann's rock-cress. The overarching objective of this plan is to increase long-term resiliency and persistence of those listed taxa. The project's species-specific goals for the recovery of Hoffmann's rock-cress are to:

- 1) add seeds and seedlings to the three new out-planted populations of Hoffmann's rock-cress on Santa Cruz Island,
- 2) collect data on recruitment, plant size, survival, and fecundity of the out-planted populations,
- 3) collect data on recruitment, plant size, survival, and fecundity on the native populations,
- 4) establish new Hoffmann's rock-cress populations on Santa Rosa Island using techniques developed on Santa Cruz Island and seeds collected from each of the three sites on Santa Rosa Island,
- 5) add to seed banks at SBBG,
- 6) search for new occurrences on Santa Rosa Island, and
- 7) inform island visitors of declining populations of endangered, endemic plant species on the Channel Islands in part by developing a photo gallery of the listed plants for display at the mainland Visitor Center (McEachern et al. 2011).

Research is conducted collaboratively by the USGS Channel Islands Field Station (Research Ecologist, Dr. Kathryn McEachern), the Santa Barbara Botanic Garden (Director of Conservation, Dr. Dieter Wilken), and the NPS (Restoration Botanist, Ms. Sarah Chaney) (McEachern et al. 2011). The work has been funded by USGS, grants from NPS and TNC, in-kind salary contributions from the SBBG, and in-kind logistical support from the University of California Santa Cruz Island Reserve (McEachern et al. 2010). The USGS is currently conducting parallel research funded by the National Science Foundation to develop population models and evaluate the long-term effects of the proposed management actions on population growth under various scenarios of post-grazing succession and climate change through 2012 (McEachern et al. 2011).

### **Five-Factor Analysis**

The following five-factor analysis describes and evaluates the threats attributable to one or more of the five listing factors outlined in section 4(a)(1) of the Act.

## **FACTOR A: Present or Threatened Destruction, Modification or Curtailment of its Habitat or Range**

At the time of listing, the primary threats to the species were the ongoing loss of soils and shrub canopy cover, and trampling of potential seed germination sites by nonnative sheep and pigs on Santa Cruz Island, and by nonnative sheep, cattle, deer and elk on Santa Rosa Island.

In 2002-2003, the USGS-BRD conducted a baseline study on Santa Cruz Island designed to gather information on the condition of plant communities after sheep removal but before pig eradication. Results indicated there were signs of new understory growth in sites where shrub canopies had reconnected, particularly on north-facing slopes where soils were deepest and could retain moisture (McEachern and Chess 2006). The baseline study showed that recovery was beginning, but was slowed by the continued presence of pigs. At the time of the last 5-year review, all areas on the island were invaded by nonnative plants, pig disturbance occurred nearly everywhere, soils were exposed with little seed bed development on steep southern slopes, fragmentation had reduced stands of native vegetation to an average size of less than 2 acres (0.8 ha), and many communities lacked the internal undergrowth and branching structure of undisturbed native stands (McEachern and Chess 2006). Active disturbance by feral pigs is no longer a threat, as the last pig was removed from Santa Cruz Island by 2007 (Parkes et al. 2009). Feral sheep were removed from Santa Cruz Island in the 1980s (TNC 2011). While the threat of rooting from feral pig populations is gone, subsequent trampling by elk and deer of potential seed germination sites adds to the already low establishment success of new plants compounding the effects and vulnerability of small population size.

On Santa Rosa Island, nonnative sheep and cattle have been absent since 1999; deer and elk have remained, though in reduced numbers (Rutherford and Chaney 1999). It is estimated that no more than 60 nonnative ungulates are present on the island at this time and plans to remove the deer and elk are underway with a projected removal deadline of the end of 2011 (K. Niessen, C. Cory, and P. Power, TNC and NPS, pers. comm. 2011; Environmental Defense Center (EDC) 1998; K. Faulkner, NPS, in litt. 2011).

In summary, trampling and grazing by remaining deer and elk continues to be the biggest threat to all Santa Rosa Island populations of Hoffmann's rock-cress (Rodriguez and Niessen, pers. comm. 2011). For populations on Santa Cruz Island, residual habitat degradation from nonnative ungulates and competition with nonnative annual plants are the biggest threats.

## **FACTOR B: Overutilization for Commercial, Recreational, Scientific, or Educational purposes**

Not a factor at the time of listing and not currently a factor.

## **FACTOR C: Disease or Predation**

At the time of listing, predation resulting from feral pig rooting was considered a major threat to the species on Santa Cruz Island. In October 2005, TNC and NPS began a feral pig eradication program that was completed in 2007. On Santa Rosa Island, pig eradication was completed in 1993. Because no direct predation currently occurs from feral pig rooting, predation is less of a

threat than we considered at the time of listing; however, residual effects from habitat degradation remain (see discussion under Factor A).

#### **FACTOR D: Inadequacy of Existing Regulatory Mechanisms**

NPS bought Santa Rosa Island from a private ranching company in 1986. The cattle ranching operation and a subleased commercial deer and elk hunting operation were deeded continuing operating rights under 5-year renewable special use permits, renewable until the year 2011 (62 FR 40955). Although the known populations of Hoffmann's rock-cress occurred primarily on NPS lands where they received some protection from land-use impacts through the National Environmental Policy Act, the interagency consultation requirements of section 7 of the Act, and NPS guidelines for natural resource management, the special use permits had limited NPS' ability to manage the land for recovery of federally listed species. Since then, however, NPS revised their general management plan. This plan included a phased approach to reduce the ungulate numbers to complete removal by 2011; cattle were removed in mid-1998, ahead of the planned schedule. Channel Islands National Park also developed a conservation strategy that will aid this and other island endemic species in recovering (Coonan et al. 1996).

In Congress on May 3, 2006, the House Armed Services Committee passed a resolution that would allow elk and deer to remain on Santa Rosa Island indefinitely so that retired, wounded, and current members of the Armed Services could hunt them for sport. This decision would negate a 1997 Federal Court settlement to remove all elk and deer from the island by 2011 (EDC 1998). Consequently, U.S. Senators Feinstein and Boxer introduced a senate resolution on May 5, 2006, that would keep the island open to the public and in the control of NPS. This resolution was passed the following year and plans are being developed for final removal to continue as planned by the end of 2011 (Faulkner, in litt. 2011). With the removal of all remaining nonnative ungulates from the islands, the NPS and TNC will be able to continue with island recovery without nonnative ungulates and their associated impacts.

#### **FACTOR E: Other Natural or Manmade Factors Affecting its Continued Existence**

At the time of listing, we discussed that small population size, competition with nonnative plant species, and natural stochastic events were threats under Factor E. Since the time of listing and the last 5-year review, we have also identified climate change as a potential threat to this species.

##### Small Population Size

The species is threatened by stochastic extinction due to small population size and limited distribution, which remains a threat since the time of listing. Small population size makes it difficult for the species to persist while sustaining the impacts of soil loss, shrub canopy loss, and competition with nonnative annual plants; while impacts from deer and elk populations have been reduced, they still remain a concern on Santa Rosa Island. Current and future outplanting efforts have been undertaken to help reduce the impacts of small population size by increasing the number of individual plants. While these efforts are beneficial to the long-term existence of the plant, there have only been three successful outplanting trials to date, and all are in early stages of success.

### Competition with nonnative plants

The disruption of native habitats and displacement of native species by alien plants, particularly fennel (*Foeniculum vulgare*) and nonnative grasses, among others, were considered major threats at the time of listing. Currently, once-continuous canopies of chaparral, coastal scrub, and island woodland are still either fragmented or missing from large areas on Santa Cruz Island (McEachern and Chess 2006). Coastal sage and coastal bluff scrub plant communities, canyon live oak stands in the Central Valley, and Bishop pine woodland of the Sierra Blanca Ridge have been replaced by nonnative annual grasses, perennial stands of fennel, or barren landscapes. The National Park Service currently sprays fennel seedlings east of El Montanon annually during the spring in order to reduce the seed bank. Surveys were conducted in fall of 2011 to search for fruit-bearing olive (*Olea europaea*) trees as to reduce the spread of nonnative olive trees. Iceplant (*Mesembryanthemum crystallinum*) removal is continuing on Anacapa Island in fall of 2011. Currently, invasive plant removal on Santa Cruz Island is focused on Prisoner's Harbor where fennel, cardaria (*Cardaria draba*), kikuyu grass (*Pennisetum clandestinum*), and eucalyptus (*Eucalyptus regnans*) seedlings are being removed. NPS had substantially reduced fennel on Santa Rosa Island by 2007 (Rutherford and Chaney 1999). However, there is currently no active weed control program on Santa Rosa Island as ungulates have not yet been completely removed. A final commercial hunt will be performed between August and October of 2011 (Niessen et al., pers. comm. 2011).

The Nature Conservancy began a weed abatement program in 2007 that consists of a plan to eradicate approximately 20 different species of invasive plants within about 600 different populations on Santa Cruz Island. Most are woody species and all pose a threat to native plants with which they compete. In addition to this general weed abatement program, TNC conducts annual fennel eradication along drivable roads within TNC property lines. Since 2008 TNC has applied herbicide to all fennel populations within 10 feet of drivable roads. This process has been proven to be very efficient in controlling the spread of invasive fennel plants (C. Cory, TNC, pers. comm. 2011).

### Natural stochastic events

Because all populations of Hoffmann's rock-cress are small, isolated, and have only few individuals, this plant species is vulnerable to extinction by such random events as storms, drought, or landslides. The small populations and few individuals also make the taxon vulnerable to reduced reproductive vigor.

### Climate change

Current climate change predictions for terrestrial areas in the northern hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying (Field et al. 1999, Cayan et al. 2005, Intergovernmental Panel on Climate Change (IPCC) 2007). In addition, an increase in the rate of sea level rise has been predicted for the coast of California (California Coastal Commission (CCC) 2001, California Climate Change Center 2006). In particular, ocean bluffs along the coast will likely be subject to greater and more frequent wave attack, resulting in erosion and shoreline retreat (CCC 2001). Jeff Severinghaus, a professor of geosciences at the Scripps Institute of Oceanography in San Diego, recently estimated that for every foot (0.3 m) that the sea level rises in California, approximately 100 ft (30.5 m) of shoreline might be lost (Scolari 2009). The IPCC (2007) estimates that the sea level will rise approximately 7 to 22 in (0.2 to 0.6 m) by the end of this century.

Recently, the potential impacts of climate change on the flora of California were discussed by Loarie et al. (2008). Based on modeling, they predicted that species' distributions will shift in response to climate change and that the species will "move" to higher elevations and northward, depending on the ability of each species to do so. In the case of smaller island ecosystems, such as the Channel Islands, opportunities to move to higher elevations or further north are limited. We lack adequate information to make specific and accurate predictions regarding how climate change, in combination with other factors such as limited geographical distribution, will affect federally listed species; however, small-ranged species such as Hoffmann's rock-cress are more vulnerable to extinction due to these changing conditions (Loarie et al. 2008).

In summary, the combination of threats associated with soil loss and habitat degradation (discussed in Factor A), limited range, and existence of only ten populations of Hoffmann's rock-cress make this species particularly vulnerable to dramatic declines as a result of random human-caused or natural events.

### **III. RECOVERY CRITERIA**

Recovery plans provide guidance to the Service, States, and other partners on ways to minimize threats to listed species, and on criteria that may be used to determine when recovery goals are achieved. There are many paths to accomplishing the recovery of a species and recovery may be achieved without fully meeting all recovery plan criteria. For example, one or more criteria may have been exceeded while other criteria may not have been accomplished. In that instance, we may determine that, over all, the threats have been minimized sufficiently, and the species is robust enough, to reclassify the species from endangered to threatened or perhaps to delist it. In other cases, new recovery approaches and/or opportunities unknown at the time the recovery plan was finalized may be more appropriate ways to achieve recovery. Likewise, new information may change the extent that criteria need to be met for recognizing recovery of the species. Overall, recovery is a dynamic process requiring adaptive management, and assessing a species' degree of recovery is likewise an adaptive process that may, or may not, fully follow the guidance provided in a recovery plan. We focus our evaluation of species status in this 5-year review on progress that has been made toward recovery since the species was listed (or since the most recent 5-year review) by eliminating or reducing the threats discussed in the five-factor analysis. In that context, progress towards fulfilling recovery criteria serves to indicate the extent to which threat factors have been reduced or eliminated.

The recovery plan that includes Hoffmann's rock-cress contains generalized downlisting criteria for a suite of 13 species that occur on the northern Channel Islands; these include the goal of securing populations of a minimum of 2,000 individuals for all herbaceous species. Downlisting criteria specific to Hoffmann's rock-cress were also included as follows:

#### **Downlisting Criteria**

- 1) Discover or establish 10 populations per island (Santa Rosa and Santa Cruz) (addresses Listing Factors A, C, and E). The plant was thought to be extirpated from Santa Cruz Island until March 1985, when it was independently rediscovered at two historic localities by two separate parties: biologists from TNC rediscovered the plant by rappelling down a canyon wall in Platt's Canyon, and Steve Junak (botanist, Santa

Barbara Botanic Garden) rediscovered the Centinela population in the western part of the Central Valley (McEachern and Chess 2006). The Stanton Ranch and Trident Lady's Ridge populations were also discovered since the time of listing. Additionally, three outplanting trials have survived to date, bringing the total number of populations on Santa Cruz Island to seven. On Santa Rosa Island, repeated searches failed to find previously known populations. The species was thought to be extirpated until the 1996 discovery of a previously undocumented population (McEachern et al. 2004); two additional populations were located in 2008 and 2010, respectively. Since it was listed, a total of three populations have been discovered on Santa Rosa Island. Therefore, although surveys in historic and other suitable habitat have been conducted and new populations have been located, this criterion has not been fully met. We believe this criterion is adequate and appropriate with respect to the recovery of the species.

2) Maintain populations as stable or increasing with evidence of natural recruitment for a period of 15 years that includes the normal precipitation cycle (addresses Listing Factors A, C, and E). Because the species has not been listed for a minimum of 15 years, and because only ten populations are known to occur at this time, this criterion has not been met. We believe this criterion is adequate and appropriate with respect to the recovery of the species.

In the recovery plan, general delisting criteria for the suite of 13 plants involve increasing the number of populations either through: surveying historic sites and potential habitat within historic range to locate currently unknown populations, or repatriating or introducing several additional populations of the species. The delisting criterion specific to Hoffmann's rock-cress comprises the following:

#### **Delisting Criterion**

1) Demonstrate no decline after downlisting for 10 years (addresses Listing Factors A, C, and E). This criterion has not been met. Although we believe this criterion is adequate and appropriate, we think it could be refined in the future once additional information about the life history of the species and its response to recovery actions are better understood.

#### **IV. SYNTHESIS**

Since 2003, the USGS-BRD and NPS have developed and implemented a research and monitoring program on Santa Cruz Island (McEachern and Chess 2006) and Santa Rosa Island (USGS-BRD 2006) for Hoffmann's rock-cress that includes field survey and monitoring to determine population status, field and greenhouse experiments to identify techniques for population conservation, and outplanting trials on Santa Cruz Island. With pigs removed and the potential for habitat recovery, the USGS-BRD expects that some Hoffmann's rock-cress populations may be able to rebound without more active management. While the number of populations of Hoffmann's rock-cress has increased from seven to ten since the last 5-year review, the populations on Santa Cruz and Santa Rosa Islands are still small and remain vulnerable to extinction. The status of Hoffmann's rock-cress populations still meets the definition of an endangered species. There is still much to be learned about conservation needs

for this species and more research and study are needed to determine the best methods to ensure recovery.

## V. RESULTS

### A. Recommended Listing Action:

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

**New Recovery Priority Number and Brief Rationale:** N/A

## VI. RECOMMENDATIONS FOR FUTURE ACTIONS OVER THE NEXT 5 YEARS

- 1) Seek additional funding to continue field surveys and monitoring, demographic monitoring, outplantings, population viability analyses and further investigations into recovery prescriptions.
- 2) Continue nonnative vegetation removal on Santa Cruz Island.
- 3) Implement nonnative vegetation removal, particularly nonnative grasses, on Santa Rosa Island.

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**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW**  
*Arabis [Boechea] hoffmannii* (Hoffmann's rock-cess)

**Current Classification:** Endangered

**Recommendation Resulting from the 5-Year Review:**

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

**Appropriate Listing/Reclassification Priority Number:** N/A

**Review Conducted By:** Lauren Kehiayan and Della Snyder-Velto

**FIELD OFFICE APPROVAL:**

Field Supervisor, U.S. Fish and Wildlife Service

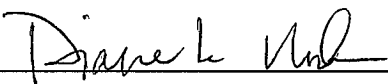
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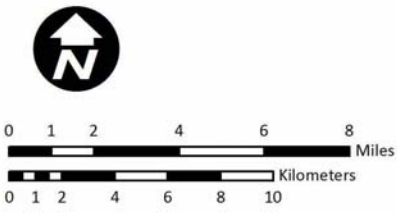
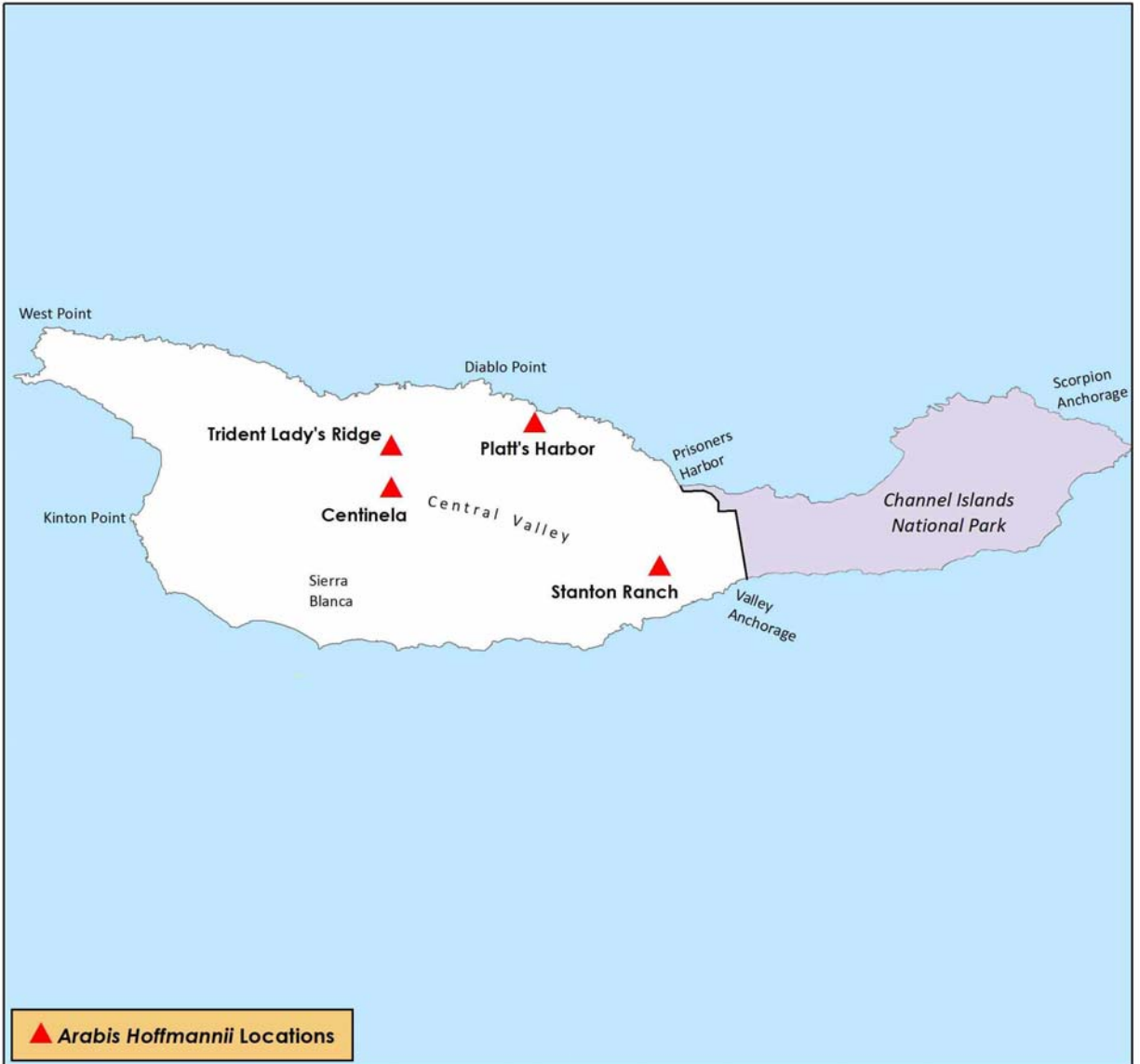


Figure 1: Spatial distribution of Hoffmann's rock-creep. (Photo NOAA 2009.)



U.S. Fish & Wildlife Service

### Locations of *Arabis hoffmannii* (Hoffmann's rock cress) on Santa Cruz Island, California



U.S. Fish and Wildlife Service  
 Ventura Fish and Wildlife Office  
 2493 Portola Road, Suite B  
 Ventura, CA 93003  
 805-644-1766

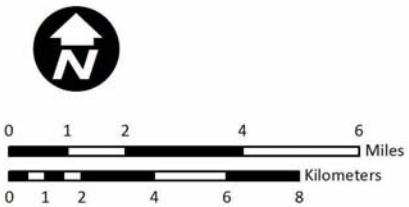
Map created June, 2011

Figure 2: Populations of Hoffmann's rock-cress on Santa Cruz Island.



U.S. Fish & Wildlife Service

### Locations of *Arabis hoffmannii* (Hoffmann's rock cress) on Santa Rosa Island, California



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 Ventura, CA 93003  
 805-644-1766

Map created June, 2011

Figure 3: Populations of Hoffmann's rock-cress on Santa Rosa Island.