Hoffmann's Rock-Cress

(*Arabis* [*Boechera*] *hoffmannii*)

5-Year Review: Evaluation and Summary

Photos: Ken Niessen USFWS

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

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GENERAL INFORMATION:

Species: *Arabis hoffmannii*
FR citation: 62 FR 40954
Date listed: July 31, 1997
Classification: Endangered

BACKGROUND:

Most recent status review:
U.S. Fish and Wildlife Service. 2011. *Arabis (Boechera*) *hoffmannii* (Hoffmann's rock-cress) 5-Year Review: Summary and Evaluation. Ventura Field Office. Ventura, California.

FR Notice citation announcing this status review:
Initiation of 5-Year Status Reviews of 76 species in California and Nevada. Notice of initiation of reviews; request for information (86 FR 27462), May 20, 2021.

ASSESSMENT:

Introduction:
Hoffmann's rock-cress was listed by the Service as *Arabis hoffmannii* in 1997. The Service recognized in the last 5-year review (Service 2011 p.4) that *Arabis hoffmannii* was reassigned to the genus *Boechera* as early as 2007. The Service will formally recognize *Boechera* as the genus for the taxon once the change is published in the Federal Register. For the purposes of this document, we continue to use *Arabis hoffmannii*.

Hoffmann's rock-cress (Brassicaceae) has been described as a monocarpic biennial forb, however, individuals may take several years to flower, and may flower for successive years. The species occurs on Santa Cruz Island and Santa Rosa Island in Santa Barbara County, California. The islands are about 3 miles (5 kilometers) apart and about 25 miles (40 kilometers) from the mainland. The plants on Santa Cruz Island are entirely on the private property of The Nature Conservancy (TNC), and Santa Rosa Island is owned by Channel Islands National Park (CINP). Both islands are managed for natural resource conservation. Hoffmann's rock-cress was also provisionally recorded in 1941 from Middle Anacapa Island, Ventura County, California, about 5 miles (8 kilometers) east of Santa Cruz Island, but the specimen is lost and despite searching the species has not been seen since (Niessen 2014 entire). Middle Anacapa is owned by CINP.

For about 180 years, Santa Cruz and Santa Rosa Islands each had non-native ungulate herbivores, (Table 1, McEachern *et al*. 2016 pp. 759-760, Andrew Adams pers. comm. 2021), which greatly affected island plants and vegetation. At the time of Hoffmann's rock-cress listing in 1997, sheep, pigs, cattle, and horses were still on Santa Cruz Island and cattle, elk, mule deer, and horses were still on Santa Rosa Island. For Santa Cruz Island, cattle were removed between the 1997 listing and the 2000 recovery plan, sheep and pigs were removed by the time of the 2007 5-year review, and horses were removed before the 2011 5-year review. For Santa Rosa Island, cattle were also removed before the 2000 recovery plan, elk and mule deer were removed

between the 2007 5-year review and 2011 5-year review, and the final two horses, the last non-native ungulates in CINP, died of natural causes on the island in December 2020.

Table 1. Non-native ungulate herbivores on Santa Cruz Island and Santa Rosa Island (McEachern *et al*. 2016 pp. 759-760, Andrew Adams pers. comm. 2021). Bold text indicates animals present on the islands after the Hoffmann's rock-cress 1997 listing.

common name	scientific name	dates present Santa Cruz Island	dates present Santa Rosa Island
donkey	*Equus africanus asinus*	never present	1800s
goat	*Capra aegagrus hircus*	late 1880s, 1919 - 1920	1883 - Early 1900s
fallow deer	*Dama*	never present	1890 - 1949
sheep	*Ovis aries*	1853 - **2001**	1844 - 1960s
pig	*Sus scrofa domestica*	1852 **- 2006**	1853 - 1993
cattle	*Bos taurus*	1830 - **1999**	1844 - **1998**
elk	*Cervus canadensis*	never present	1879 - **2011**
mule deer	*Odocoileus hemionus*	never present	1880 - **2015**
horse	*Equus ferus caballus*	1830 - **2009**	1844 - **2020**

At the time of 1997 listing, the major threats to Hoffmann's rock-cress were loss of soil, habitat degradation, and trampling of potential seed germination sites by non-native ungulates on Santa Cruz and Santa Rosa Islands, predation resulting from feral pig rooting and Santa Cruz Island, and competition with annual plants on both islands. At the time of listing, we also discussed the inadequacy of existing regulatory mechanisms, and the threats associated with small population sizes and limited distribution.

The 2000 recovery plan and 2007 5-year review reiterated the threats identified at time of listing and did not identify any new threats. The 2011 5-year review evaluated the continued importance of these threats and identified climate change and climate change related sea level rise as new potential threats.

This 5-year review does not identify any new threats to Hoffmann's rock-cress, but we do evaluate all previously identified threats.

Information acquired since the last status review:
This 5-year review was conducted by the U.S. Fish and Wildlife Service (Service) Ventura Fish and Wildlife Office. Data for this review were solicited from interested parties through a Federal Register notice announcing this review on May 20, 2021. We also contacted species experts to request any data or information we should consider in our review. Additionally, we conducted a literature search and a review of information in our files.

Population data:
Distribution:
Historically, Hoffmann's rock-cress has been found in 7 populations designated by the California Natural Diversity Database (CNDDB, CDFW 2022) as Element Occurrences. There have been no additional reports of Hoffmann's rock-cress to CNDDB since the 2005 5-year review. However, since listing, 6 more natural populations have been discovered. This brings the total known (or possible) populations to 13: one on Middle Anacapa Island, 7 on Santa Cruz Island,

and 5 on Santa Rosa Island. The Middle Anacapa Island and two of the Santa Rosa Island occurrences may be extirpated.

Middle Anacapa Island: The only record of Hoffmann's rock-cress for Middle Anacapa Island is a provisional entry in a 1941 field notebook (Niessen 2014). A possible specimen was collected at the extreme west end of the island, but that specimen has subsequently been lost. There is a possibility that the plant in question was not actually Hoffmann's rock-cress, but another member of the mustard family.

Santa Cruz Island: Hoffmann's rock-cress was first collected in 1888 at an unspecified location on Santa Cruz Island (CCH2 2022). The named sites next collected were at Platts in 1932 (the type location), Alberts in 1950, Centinela in 1985, and Trident in 2004. In 2019, 3 more new sites, Sauces-Dewey, Ridge, and Sauces Road, were discovered on TNC property (note that two of the sites reported as new by Schneider and Carson 2019 appear to be restoration sites). The species is extant at all these sites.

Santa Rosa Island: Hoffmann's rock-cress was collected once in 1930 in Water Canyon, and then not again until 1996 in Lobo Canyon, where a few plants persisted for a few years. It was then found at Sierra Pablo West in 2008, South Point in 2010, and Sierra Pablo East in 2022; the species is extant at these three locations.

Abundance:
Generally, the early discovered sites on Santa Cruz Island (Platts, Centinela, Alberts, Trident) seem to have relatively few plants per site, in the range of tens to perhaps a few hundred plants (Table 2). Later discovered (2019) Santa Cruz Island sites had hundreds to thousands of plants each. Santa Rosa Island sites have also had on the order of dozens of plants or fewer, except for South Point which has had almost 500.

Table 2. Hoffmann's rock-cress populations and documented abundances. **CNDDB** = California Natural Diversity Database, **EO** = Element Occurrence, **MAI** = Middle Anacapa Island, **SCZ** = Santa Cruz Island, **SRI** = Santa Rosa Island.

CNDDB EO #	island	population	year	source	# of plants
3	MAI	Moran	1941	CDFW 2022	present?
3	MAI	Moran	2014	Niessen 2014	0
2	SCZ	Platts	1932	CDFW 2022	present
2	SCZ	Platts	1985	CDFW 2022	present
2	SCZ	Platts	1994	CDFW 2022	12
2	SCZ	Platts	2006	CDFW 2022	19
2	SCZ	Platts	2022	J. Knapp, TNC, pers. com. 2022	present
4	SCZ	Centinela	1967	CDFW 2022	present
4	SCZ	Centinela	1985	CDFW 2022	< 50
4	SCZ	Centinela	1994	CDFW 2022	78
4	SCZ	Centinela	1995	CDFW 2022	59
4	SCZ	Centinela	1996	CDFW 2022	82
4	SCZ	Centinela	1999	CDFW 2022	>100
4	SCZ	Centinela	2000	CDFW 2022	>36
4	SCZ	Centinela	2002	CDFW 2022	>200
4	SCZ	Centinela	2003	CaPR 2022	50

CNDDB EO #	island	population	year	source	# of plants
4	SCZ	Centinela	2004	CDFW 2022	present
4	SCZ	Centinela	2005	CDFW 2022	485
5	SCZ	Alberts	1950	CDFW 2022	present
5	SCZ	Alberts	1995	CDFW 2022	7
5	SCZ	Alberts	1996	CDFW 2022	16
5	SCZ	Alberts	2002	CDFW 2022	15
5	SCZ	Alberts	2003	CaPR 2022	29
5	SCZ	Alberts	2004	CDFW 2022	33
5	SCZ	Alberts	2005	CDFW 2022	81
5	SCZ	Alberts	2006	CDFW 2022	138
5	SCZ	Alberts	2008	Service 2011	138++
5	SCZ	Alberts	2019	Schneider and Carson 2019	present
8	SCZ	Trident	2004	CDFW 2022	125
8	SCZ	Trident	2005	CDFW 2022	143
8	SCZ	Trident	2006	CDFW 2022	140
8	SCZ	Trident	2008	Service 2011	15+
8	SCZ	Trident	2009	CaPR 2022	10
8	SCZ	Trident	2019	Schneider and Carson 2019	present
none	SCZ	Sauces-Dewey	2019	Carson and Schneider 2019	2000
none	SCZ	Ridge	2109	J. Knapp, TNC, pers. com. 2022	thousands
none	SCZ	Sauces Rd	2109	J. Knapp, TNC, pers. com. 20226	hundreds
6	SRI	Lobo Cyn	1996	CDFW 2022	9-11
6	SRI	Lobo Cyn	2012	McEachern *et a*l. 2014	0
6	SRI	Lobo Cyn	2013	McEachern *et a*l. 2014	0
6	SRI	Lobo Cyn	2014	McEachern *et a*l. 2014	0
7	SRI	Water Cyn	1930	CDFW 2022	present
none	SRI	Sierra Pablo West	2008	Service 2011	34
none	SRI	Sierra Pablo West	2014	McEachern *et a*l. 2014	95
none	SRI	Sierra Pablo West	2019	Schneider and Carson 2019	33
none	SRI	Sierra Pablo East	2022	Niessen pers.obs. 2022	25
none	SRI	South Pt	2010	Niessen 2010	29
none	SRI	South Pt	2014	McEachern and Gados 2022	present
none	SRI	South Pt	2015	Clark *et al*. 2015	450
none	SRI	South Pt	2022	Shea. 2022	80 (partial survey)

Trends in abundance:

Most locations do not have enough repeat observations to determine trends in abundance (Table 2), however some data are suggestive.

On Santa Cruz Island, the Centinela site has plant counts from 1985 to 2005; over that time period the number of plants seemed to erratically increase to the highest count of 485 in 2005. The Alberts site appears to have a gradual increase in plant numbers from 1995 to 2008 to more than 138 plants. It may be that these sites responded positively first to the removal of the sheep and then the pigs. Trident had a fairly constant number of plants from 2004 to 2006 at about 140 plants, but only one tenth the number in 2008 and 2009. These sites generally have not been surveyed since the late 2000s, and more recent numbers are unknown. The 2019 discovered sites had hundreds to thousands of plants; perhaps they also had many fewer plants in the 2000s.

On Santa Rosa Island, the South Point population increased from 29 to 450 plants from 2010 to 2015; a partial survey of the site in 2022 found 80 plants (Shea 2022), with more likely in the unsurveyed area. The increase coincides with the removal of the deer from Santa Rosa Island in the early 2010s.

Microsite characterization:
An exhaustive mapping survey for Hoffmann's rock-cress at South Point on Santa Rosa Island characterized habitat and microhabitat for over 500 plants (Clark *et al.* 2015 entire). Most plants were found on northwest-facing microterraces or even slopes under open *Quercus pacifica* (island oak) canopy, on soil with litter depths of less than 2 centimeters (0.75 inch). This information was later used to establish outplanting sites on Santa Rosa Island (McEachern and Gados 2021 p.6).

Recovery outplanting:
Experimental outplanting was conducted at three sites on Santa Cruz Island starting in 2005 and at several sites on Santa Rosa Island starting in 2018 (McEachern and Gados 2021 pp. 6-8). Plants have persisted at the Santa Cruz Island sites; a technical report is expected after 2022 fieldwork. Data collection on the Santa Rosa Island plantings is ongoing. While about one quarter of outplanted plants at 3 sites survived to reproduction in 2019, fewer were seen in 2020, and by 2021 no live plants were present, although there may be seeds in the soil. In early 2021, plots were seeded at four additional sites, and at least 140 seedlings germinated, but by August 2012 no seedlings could be found.

One apparent difference between Santa Cruz Island and Santa Rosa Island outplanting is the effect of mice and perhaps arthropod herbivores on seedlings. On Santa Cruz Island these animals did not seem to affect seedlings, while on Santa Rosa Island they did. Experiments to examine seedling herbivory on Santa Rosa Island began in early 2020, but were discontinued because of COVID-19 restrictions (Schneider and Carson 2020 p. 15). There are plans to reinitiate the experiments in the future.

Conservation seed banking:
There are 21 accessions of wild collected Hoffmann's rock-cress seed in Center for Plant Conservation approved conservation seed banks (Table 3). Some populations (Centinela and Alberts on Santa Cruz Island) may have conserved adequate numbers of seeds over a sufficient range of years, although ideally more would be segregated by maternal line. Note that the species is easily grown in the nursery to increase seed numbers for recovery projects (Schneider *et al.* 2021); seed viability is 99%.

Table 3. Hoffmann's rock-cress conservation seed banking at Center for Plant Rescue approved facilities. Data from CaPR 2022. **CNDDB** = California Natural Diversity Database, **EO** = Element Occurrence, **SCZ** = Santa Cruz Island, **SRI** = Santa Rosa Island, **CBG** = California Botanic Garden, **SBBG** = Santa Barbara Botanic Garden, **NLGRP** = National Laboratory for Genetic Resource Preservation

CNDDB EO #	population	island	collection date	facility	by maternal lines or combined	# maternal lines	# seeds
4	Centinela	SCZ	5/29/1991	CBG	data deficient	data deficient	62630
4	Centinela	SCZ	7/7/1993	SBBG	maternal lines	10	1000

CNDDB EO #	population	island	collection date	facility	by maternal lines or combined	# maternal lines	# seeds
4	Centinela	SCZ	7/7/1993	SBBG	combined	8	800
4	Centinela	SCZ	5/15/1994	SBBG	maternal lines	14	700
4	Centinela	SCZ	7/8/1996	SBBG	data deficient	3	1000
4	Centinela	SCZ	7/6/1997	SBBG	maternal lines	10	500
4	Centinela	SCZ	5/21/1999	SBBG	maternal lines	23	1000
4	Centinela	SCZ	7/2/2003	SBBG	combined	35	1000
4	Centinela	SCZ	6/25/2005	SBBG	data deficient	11	300
4	Centinela	SCZ	8/1/2007	NLGRP	combined	24	2500
5	Alberts	SCZ	7/11/1993	SBBG	maternal lines	1	100
5	Alberts	SCZ	7/4/1997	SBBG	maternal lines	2	200
5	Alberts	SCZ	7/1/2003	SBBG	combined	6	50
5	Alberts	SCZ	5/2/2019	SBBG	combined	data deficient	423
8	Diablo	SCZ	6/1/2005	SBBG	combined	10	500
8	Diablo	SCZ	6/1/2009	SBBG	data deficient	10	300
none	Sauces Rd	SCZ	5/2/2019	SBBG	combined	data deficient	13252
none	Sauces	SCZ	6/7/2019	SBBG	maternal lines	3	4476
none	Sierra Pablo West	SRI	4/14/2008	SBBG	maternal lines	data deficient	data deficient
none	Sierra Pablo West	SRI	11/21/2019	SBBG	maternal lines	7	315
none	South Point	SRI	7/10/2015	SBBG	maternal lines	23	data deficient

EVALUATION OF THREATS:

At the time of 1997 listing, the major threats to Hoffmann's rock-cress were loss of soil, habitat degradation, and trampling of potential seed germination sites by non-native ungulates on Santa Cruz and Santa Rosa Islands, predation resulting from feral pig rooting and Santa Cruz Island, and competition with annual plants on both islands. Also, we discussed the inadequacy of existing regulatory mechanisms, and the threats associated with small population sizes and limited distribution. The 2000 recovery plan and 2007 5-year review did not identify any new threats. The 2011 5-year identified climate change and climate change related sea level rise as new potential threats. This 5-year review does not identify any new threats to Hoffmann's rock-cress, and we evaluate all previously identified threats.

Soil loss, habitat degradation, trampling of germination sites, and predation caused by non-native ungulates:

With the complete removal of non-native ungulates from Santa Cruz Island, there has been significant passive soil and vegetation recovery (Beltrane *et al.* 2014 entire), and Santa Rosa Island has had similar recovery. There is little current indication of continuing soil loss and habitat degradation in areas where Hoffmann's rock-cress occurs. Additionally, there is no further trampling or predation caused by non-native ungulates. On Santa Rosa Island, there was a large increase in plant numbers coinciding with deer removal. The direct threats of non-native ungulates no longer exist.

While direct impacts of non-native ungulate herbivores are gone, it is likely that impacts of the non-native plants, especially grasses initially established by the past activities of ungulates, will continue into the future (see *Competition with non-native grasses* discussion below). Therefore, the residual effects of non-native ungulates remain a threat.

Competition with non-native grasses:
At the time of listing, Hoffmann's rock-cress was considered to be threatened by competition from non-native annual grasses. The establishment, spread, and abundance of non-native grasses began with the introduction of the first non-native ungulates. At listing, Hoffmann's rock-cress was known mostly from coastal bluff scrub vegetation (Platts, Centinela, Water Canyon, Lobo Canyon), but also from chamise (*Adenostoma fasciculatum* var. *fasciculatum*) chaparral (Alberts). Since listing, the species has also been found, even more abundantly, in annual grassland and coast live oak (*Quecus agrifolia* var. *agrifolia*) woodland and in the interface between these two vegetation types (Diablo), and in island scrub oak (*Quercus pacifica*) chaparral (Sierra Pablo, South Point, Sauces, Sauce Rd, Ridge). It seems as though the ecological amplitude of the species is not fully understood, both in native and non-native vegetation, which is the case for other recovering island plants as well. It may be that non-native grasses do have a negative effect, but research is required.

If non-native grasses are detrimental competitors, their effects may increase. Non-native annual grasses may increase with anticipated climate change (Sandel and Dangremond 2012 entire, and see *Climate change* discussion below). Thus, the concern about the threat of competition of from non-native annual grasses remains.

Inadequacy of existing regulatory mechanisms:
Since the time of listing, the portion of Santa Cruz Island on which Hoffmann's rock-cress is found has been owned by TNC and managed for conservation. At the time of listing, Santa Rosa Island was being managed as a working cattle ranch and as a commercial hunting preserve. There was concern that these then ongoing legal activities allowed continued soil damage and habitat alteration by non-native ungulates. Santa Rosa Island ceased to be a working ranch in 2011 with the expiration of a final special-use permit, and the island is now managed for conservation and visitor use. With removal of the cattle in 1998, elk in 2011, and mule deer in 2014, the inadequacy of existing regulatory mechanisms as a threat to Hoffmann's rock-cress on Santa Rosa has been removed.

Limited distribution and small population sizes:
At time of listing there were three known occurrences of Hoffmann's rock-cress on Santa Cruz Island and one on Santa Rosa Island; there are 12 in total now. Both above-ground and seedbank population sizes are generally unknown for Hoffmann's rock-cress. As shown by repeat population size estimates of occurrences at Centinela and Alberts (Table 2), above-ground abundance can vary widely among years. For annual plants in variable environments, seeds in the soil can have variable and often small germination fractions, but can remain viable in the soil for many years (Pake and Venable 1996 pp. 1431-1434). If this is true for the short lived perennial Hoffmann's rock-cress, it can provide some buffer against extirpation. The ecological range of Hoffmann's rock-cress is also not currently well defined, and may be more varied than the vegetation in which it is currently found, so perhaps conditions at germination can also be

varied. However, because relatively few plants exist in few locations, the threat of extinction for Hoffmann's rock-cress by random naturally occurring events due to limited distribution and small population sizes remains.

Climate change:
In the 2011 5-year review, climate change effects, including sea level rise, were introduced as threats to Hoffmann's rock-cress. Expected climate change for the geographic region of the northern Channel Islands predicts both rising annual temperatures (Langridge 2018 pp. 13-15) and less frequent, more episodic rainfall (Langridge 2018 pp. 16-17), which could lead to changes in patterns of soil moisture and shifts in vegetation. Changes in climate could threaten Hoffmann's rock-cress in at least two ways, as demonstrated by work with federally listed annual plants on Santa Rosa Island. First, as vegetation shifts with climate change, Hoffmann's rock-cress might not be able to disperse to suitable germination or recruitment habitat (Levine *et al.* 2008 p. 796). Second, the proper environmental cues could occur less frequently or not at all, decreasing germination of Hoffmann's rock-cress and causing declines in abundance and possible extirpations (Levine *et al.* 2008 pp. 800-805; Levine *et al.* 2011 pp. 2241-2246).

In the California Channel Islands, sea level may rise by about 0.25 m by 2050 (Sweet *et al*. 2022 p. 19) and 1.0 m by 2100 (Sweet *et al.* 2022 p. 23). Although identified as a potential threat by the 2011 5-year review, this is unlikely to be a significant to Hoffmann's rock-cress. The species is only known from one coastal location (Platts), which has had a very small proportion of all known plants. Additionally, these plants are at over 30 meter (100 foot) elevation on relatively stable igneous rock, and the predicted sea level rise is unlikely to affect the population within the timespan of the prediction. We therefore do not think that sea level rise is a threat to the species.

Another prediction with increasing annual temperature in California is an increasing dominance by non-native annual grasses (Sandel and Dangremond 2012 entire). If non-native grasses are important competitors with Hoffmann's rock-cress, and grass cover increases further, the presumed competitive effects of these grass species would be more likely to threaten Hoffmann's rock-cress.

Summary of threats:
The threats to Hoffmann's rock-cress of further loss of soil, habitat degradation, trampling of potential seed germination sites by non-native ungulates, and predation resulting from feral pig rooting have been eliminated on Santa Cruz Island and Santa Rosa Island. While direct impacts of non-native ungulate herbivores are gone, it is likely that the effects of non-native plants initially facilitated by the ungulates will continue into the future, especially if non-native annual grasses are competitors, and will increase with increasing temperatures resulting from climate change. There are only 12 populations of Hoffmann's rock-cress and some of the above-ground populations are small, and the magnitude of the soil seed banks are unknown, and so the threat of extirpations and extinction from random natural events remains. Predicted climate change, warmer temperatures and more episodic rainfall, may decrease the frequency of the needed germination cues, thus decreasing above-ground population sizes. Climate change may also shift vegetation in such a way that germination and recruitment sites no longer occur where there is a Hoffmann's rock-cress seed bank.

EVALUATION OF DOWNLISTING AND DELISTING CRITERIA:

The current status of criteria in the 2000 Recovery Plan (Service 2000, pp. 64) is as follows:

Downlisting criteria for Hoffmann's rock-cress

1. *Discover or establish 10 populations per island (Santa Rosa and Santa Cruz).*
    - Several new populations of Hoffmann's rock-cress have been discovered since time of listing, but not 10 for each island. This criterion has not been met.
2. *Populations remain stable or increase for a period of 15 years that includes the normal precipitation cycle.*
    - Populations have not been monitored consistently over time to determine stability or increase. This criterion has not been met.
3. *Seed stored in CPC cooperating facilities.*
    - There is seed in CPC (Center for Plant Conservation) cooperating facilities, but it is not comprehensive across the species range or across years. This criterion has not been met.
4. *Seed germination and propagation techniques understood.*
    - Seeds have been successfully germinated and bulked in the nursery. This criterion has been met.
5. *Successful outplanting techniques developed.*
    - Seeds and seedlings have been successfully outplanted on Santa Cruz Island, less so on Santa Rosa Island. This criterion has been met.
6. *Life history research conducted and incorporated into recovery criteria.*
    - Life history characteristics and habitat requirements have been researched for the species. This criterion has been met.
7. *If declining trend documented, determine cause and reverse trend.*
    - Data are not available to effectively evaluate trends in abundance. This criterion has not been met.

Delisting criteria for Hoffmann's rock-cress

1. *No decline after downlisting for 10 years.*
    - This criterion is not currently applicable.
2. *All potential habitat surveyed.*
    - There is remaining insufficiently surveyed potential habitat on Santa Cruz Island, and new populations continue to be found. Santa Rosa Island also has additional potential habitat that could contain plants. This criterion has not been met.

CONCLUSION:

The evaluation of threats affecting the species under the factors in 4(a)(1) of the Act and the analysis of the status of the species in our previous 5-year review remain accurate reflections of the species current status. After reviewing the best available scientific information, we conclude that Hoffmann's rock-cress remains an endangered species.

RECOMMENDATIONS FOR FUTURE ACTIONS:

1. Continue searching for additional populations of Hoffmann's rock-cress on Santa Cruz and Santa Rosa Islands.
2. Establish regular monitoring for known natural populations of Hoffmann's rock-cress on both islands.
3. Collect seed for restoration seed bulking, and augment natural populations of few individuals with population-specific seed to boost population sizes.
4. Establish new recovery populations on both islands, especially Santa Rosa Island.
5. Improve the completeness of coverage of Hoffmann's rock-cress in conservation seed banks, with all populations over a wider range of years.

APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approved STEPHEN HENRY Digitally signed by STEPHEN HENRY Date: 2022.08.30 12:21:34 -07'00'

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