

Island Barberry
(Berberis pinnata ssp. insularis)

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



J.S. Peterson USDA-NRCS Plants Database

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

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5-YEAR REVIEW
Island Barberry (*Berberis pinnata* ssp. *insularis*)

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5-YEAR REVIEW
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1. GENERAL INFORMATION

1.1. Reviewers

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1.2. Methodology used to complete the review:

This review was conducted by staff of the U.S. Fish and Wildlife Service (Service), Region 8, Ventura Fish and Wildlife Office, Ventura, California. The review is based on the following: information available in current published and unpublished literature, discussions with other agency biologists, discussions with species experts, information available on the internet, and the Ventura Fish and Wildlife Office species files. An unpublished report by the U.S. Geological Survey-Biological Resources Division (USGS-BRD) (McEachern et al. 2007) was the primary source for information on current population trends, current threats, and current projects that are focused on species recovery.

1.3. Background:

1.3.1. FR Notice citation announcing initiation of this review:

On February 14, 2007, the U.S. Fish and Wildlife Service announced in the Federal Register (FR) initiation of the 5-year review for *Berberis pinnata* ssp. *insularis* and asked for information from the public regarding the subspecies' status (72 FR 7064). No information was received as a result of this request.

1.3.2. Listing history

Original Listing

FR notice: 62 FR 40954

Date listed: July 31, 1997

Entity listed: subspecies (*Berberis pinnata* ssp. *insularis*)

Classification: endangered

1.3.3. Associated rulemakings

None

1.3.4. Review History

This species has not been subject to a review since listing.

1.3.5. Species' Recovery Priority Number at start of 5-year review: 3. This number denotes a subspecies with a high degree of threat and a high potential for recovery.

1.3.6. Recovery Plan or Outline

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

Date issued: September 26, 2000

Dates of previous revisions, if applicable: None

2. REVIEW ANALYSIS

2.1. 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 of any species of vertebrate wildlife. This definition limits listings as distinct population segments (DPS) only to vertebrate species of fish and wildlife. Because the species under review is a plant and the DPS policy is not applicable, the application of the DPS policy to the species listing is not addressed further in this review.

2.2. Recovery Criteria

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

Yes
 No

2.2.2. Adequacy of recovery criteria.

2.2.2.1. Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

Yes
 No

2.2.2.2. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

Yes
 No

2.2.3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information (for threats-related recovery criteria, please note which of the 5 listing factors* are addressed by that criterion. If any of the 5 listing factors are not relevant to this species, please note that here):

The recovery plan (Service 2000) contains generalized downlisting criteria for a suite of 13 species that occur on the northern Channel Islands. Downlisting criteria specific to *Berberis pinnata* ssp. *insularis* are included as follows:

- 1) Discover or establish five populations on Santa Rosa and Santa Cruz Islands, and two to three populations on Anacapa Island (addresses Listing Factors A, C, and E). This criterion has not been 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 four populations, each containing only one known plant, are known to exist 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 include increasing the number of populations either through: surveying historical sites and potential habitat within historical range to locate currently unknown populations, or repatriating or introducing several additional populations of the species. Delisting criteria specific to *Berberis pinnata* ssp. *insularis* comprises the following:

- 1) Discover or outplant five additional populations per island (addresses Listing Factors A, C, and E). This criterion has not been met. We believe this criterion is adequate and appropriate with respect to the recovery of the species.

* The 5 listing factors are:

- A) Present or threatened destruction, modification or curtailment of its habitat or range;
- B) Overutilization for commercial, recreational, scientific, or educational purposes;
- C) Disease or predation;
- D) Inadequacy of existing regulatory mechanisms;
- E) Other natural or manmade factors affecting its continued existence.

2) No decline after downlisting for 10 years (addresses Listing Factors A, C, and E). This criterion has not been met. We believe this criterion is adequate and appropriate with respect to the recovery of the species.

Although Listing Factors B and D were considered relevant to the subspecies at the time of listing, they were not considered primary threats and were not addressed in the downlisting or delisting criteria in the recovery plan (Service 2000). Currently we do not consider Factor B a threat and we do not consider Factor D to be a threat to the subspecies on Santa Cruz or Anacapa Islands. On Santa Rosa Island, we consider Factor D to be reduced. We will address these Listing Factors in the following sections.

2.3. Updated Information and Current Species Status

2.3.1. Biology and Habitat

Description and Taxonomy

Berberis pinnata ssp. *insularis* is a long-lived colonial shrub in the Barberry family (Berberidaceae). One individual from Santa Cruz Island is likely more than 80 years old and presumed to be the same plant collected by Mason in 1927 (McEachern et al. 2007). A cutting from this plant has been in cultivation for several decades (Wilken 1996). Mature plants are approximately 2 to 4 meters (5 to 12 feet) tall (McEachern et al. 2007). Because it sprouts from an underground root stalk, single plants can consist of several stems spread over several square meters. Bright yellow flowers are produced in February, followed by grayish blue fruits in late May (Center for Plant Conservation (CPC 2007)).

Distribution

This taxon was historically known to exist on three of the northern Channel Islands in the early 1900's (Anacapa, Santa Cruz, and Santa Rosa). However, *Berberis pinnata* ssp. *insularis* is now believed to be extirpated from Santa Rosa and Anacapa Islands (Service 2000). The only known population on Santa Rosa Island was last collected in 1930 and has not been relocated (McEachern and Chess 2006; McEachern et al. 2007; Service 2000). The last plant known to occur on Anacapa Island was found to have died in 1994 (Chaney 1994).

Berberis pinnata ssp. *insularis* is now represented in the wild by only four populations, each containing only one plant, and each from a different location on Santa Cruz Island (McEachern et al. 2007). All extant plants occur on private land owned by the Nature Conservancy.

USGS-BRD conducted field surveys at four of the five historical locations on Santa Cruz Island during the flowering seasons of 2005 and 2006. In 2005, three plants were found in three of four locations surveyed (McEachern and Chess 2006). A fifth historical location on Santa Cruz Island was not surveyed in 2005 due to time constraints, feral pig eradication activities, and difficult, remote access. During the 2006 survey effort, the

same three plants were again found at the same three locations surveyed the previous year. In addition, USGS-BRD found one additional plant at a historical site not surveyed in 2005 (McEachern et al. 2007).

USGS-BRD researchers also conduct annual surveys for *Berberis pinnata* ssp. *insularis* on Santa Rosa Island. However, no plants have been found there since 1930 (Service 2000; McEachern, pers. comm. 2007a).

Habitat

Berberis pinnata ssp. *insularis* appears to favor shady, mesic conditions. It occurs in the shaded understory of mixed pine forest-chaparral and riparian woodland, on rocky, north facing slopes and canyons (Junak et al. 1995). Habitat associations based on herbarium specimens collected on Santa Cruz Island also suggest the taxon is restricted to shaded, cool, moist, and well-drained sites in canyons associated with closed-cone pine forest or riparian oak woodland (Wilken 1996). On West Anacapa Island, *B. p.* ssp. *insularis* was reported to be associated with chaparral species including poison oak (*Toxicodendron deversilobum*), monkey flower (*Mimulus aurantiacus*), coyote bush (*Baccharis* sp.), goldenbush (*Hazardia detonsus*), island alum-root (*Heurchera maxima*), and wild cucumber (*Marah macrocarpus*) (Chaney 1994). The introduction of cattle, deer, elk, and pigs to the northern Channel Islands has resulted in severe degradation of the shady, mesic habitat conditions upon which the subspecies depends. We will discuss this issue more extensively in section 2.3.3 (Five-Factor Analysis).

Reproduction

Currently, sexual reproduction of *Berberis pinnata* ssp. *insularis* is not occurring in the wild; and the cause or causes are unknown (Wilken 1996; McEachern and Chess 2006; McEachern et al. 2007; CPC 2007). However, pollination may be limited and fruit production is severely hindered (McEachern et al. 2007). Predation of fruits and flowers may also be a factor (McEachern, pers.comm. 2007a). Years of habitat degradation, caused by feral pigs and sheep, may have also left many areas inhospitable for the germination of dispersed seeds (Wilken 1996).

In 2005, researchers from the USGS-BRD documented two of the three plants they found were flowering during the first field visit. These two plants were visited several times during the flowering season. During the second site visit, approximately one month after the first, a total of only five fruits were observed on the two plants, and evidence of insect boring was visible on 50 percent of fruits on one of the plants (McEachern and Chess 2006). During another field visit later in 2005, there were a total of only two fruits remaining and only on one of the plants. These two remaining fruits were protected with mesh cages to prevent potential predation by birds. During the final field visit in 2005, the remaining two fruits were found to be shriveled and dried. However, there was no visible evidence of insect or fungal activity, on these two fruits, that could have led to fruit abortion (McEachern et al. 2007).

In 2006, USGS-BRD researchers found flowers on the same two plants that were seen flowering in 2005. However, these same plants produced substantially fewer flowers in

2006 than in the previous year (McEachern et al. 2007). Only one of these plants completed fruit production, and no more than 10 fruits were observed. Insects were observed eating the developing flower buds on the other plant and it did not produce fruits in 2006 (McEachern et al. 2007). The plant that did not produce flowers in 2005 did not produce flowers in 2006. A fourth plant, found at a fourth site, produced flowers and fruits, although in limited numbers (McEachern et al. 2007).

Berberis pinnata ssp. *insularis* plants have been cultivated at several botanical gardens in California, and show variation among leaf structure and color (CPC 2007). This suggests that ex-situ collections may be important for recovery purposes, as inbred offspring may be showing reduced fitness. Tissue cultivation being undertaken by the CPC and the Santa Barbara Botanic Garden should ensure that known, existing genotypes are not lost (McEachern, pers. comm. 2007a; Wilken, pers. comm. 2007).

2.3.2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.3.2.1. Factor A. Present or threatened destruction, modification or curtailment of its habitat or range

At the time of listing in 1997, *Berberis pinnata* ssp. *insularis* was threatened by soil loss and alteration of its native habitat (62 FR 40954). The introduction of non-native sheep and pigs has resulted in substantial loss of native vegetation and soils. Pigs root up native vegetation, causing massive erosion and spreading invasive weeds (National Park Service 2005). Soil loss is a significant threat to *B. p. ssp. insularis* because it precludes seedling establishment.

In addition, the loss of canopy and understory plant species, due to rooting by feral pigs, has resulted in a reduction of the mesic conditions that *Berberis pinnata* ssp. *insularis* depends on (McEachern, pers. comm. 2007a). This may have resulted in reducing the amount of habitat that is suitable for the germination of dispersed seeds (Wilken 1996). Sheep were removed from Santa Cruz Island in the 1980s, and the removal of feral pigs was completed in January 2007 (McEachern, pers. comm. 2007a). The removal of these non-native animals should improve soil stability and habitat conditions for *B. p. ssp. insularis* as time goes on. Despite the recent removal of nonnative animals, our current assessment is that *B. p. ssp. insularis* continues to be threatened by the past alteration of its native habitat and the risk of stochastic extinction.

Berberis pinnata ssp. *insularis* now occurs on private lands owned, and conserved, by The Nature Conservancy (Santa Cruz Island), and on public land managed by the National Park Service (Santa Cruz Island). Major changes in land use, such as development projects, are not likely to occur.

2.3.2.2. Factor B. Overutilization for commercial, recreational, scientific, or educational purposes

At the time of listing, we discussed that the collection of whole plants of species with fewer than 100 known individuals, including *Berberis pinnata* ssp. *insularis*, could adversely affect the genetic viability and survival of the taxa (62 FR 40954). Our current assessment is that because this plant occurs on private preserve land and on public land managed by the National Park Service (Santa Cruz Island) with limited access, overutilization for commercial, recreational, scientific, or educational purposes is not a threat.

2.3.2.3. Factor C. Disease or predation

At the time of listing, *Berberis pinnata* ssp. *insularis* was not known to be threatened by disease or predation. The roots of *Berberis* species are often toxic (Williams 1993), suggesting that consumption by feral pigs is unlikely. Extant *B. p.* ssp. *insularis* plants do not show any sign of pig rooting (Wilken, pers.comm. 2007). Predation of *B. p.* ssp. *insularis* fruits by island scrub jays (*Aphelocoma insularis*) has also been observed in the wild (Wilken, pers. comm. 2007). Because the fruits of *Berberis* species are typically eaten and dispersed by birds (Wilken, pers. comm. 2007; Bransfield, pers. obs. 2007), some predation by birds is likely part of the natural reproductive strategy of *B. p.* ssp. *insularis*. However, years of habitat destruction, caused by feral pigs and sheep, may have left many areas inhospitable for the germination of dispersed seeds (Wilken 1996).

In addition, because the amount of fruit being produced is so low, the USGS-BRD is attempting to prohibit the predation of any fruits by birds in order to harvest the fruit and grow plants for tissue cultivation and eventual outplanting back into the wild (McEachern, pers. comm. 2007b). Therefore, in 2005, USGS-BRD researchers erected wire mesh cages around the only two developing *Berberis pinnata* ssp. *insularis* fruits at one location to protect them from predation by birds. However, when the cages were removed approximately two months later (when they should have been mature), the fruits had aborted (McEachern and Chess 2006; McEachern et al. 2007).

The factor that caused these and other fruits to fail is unknown. Insect predation on fruits and developing flower buds has been documented (McEachern and Chess 2006; McEachern et al. 2007), appears extensive (McEachern, pers. comm. 2007a), and is a likely cause of fruit failure (McEachern, pers. comm. 2007b). However, it is unknown which insect species are damaging the fruits and flowers (McEachern, pers. comm. 2007a). The extremely limited fruit production (McEachern and Chess 2006; McEachern et al. 2007) is restricting *Berberis pinnata* ssp. *insularis* from reproducing in the wild. Therefore, our current assessment is that predation of any immature fruits by birds, as well as predation of fruits and flowers by insects, are a threat to this subspecies. However, if the native habitat recovers and the threat, or threats, inhibiting fruit production are able to be remedied, natural seed dispersal by birds

would be a favorable method of increasing the *B. p. ssp. insularis* population (McEachern, per. com. 2007b).

The small number of extant individuals (only four) with an extremely narrow distribution, combined with the potential for reduced fitness due to its small gene pool, would also appear to make this subspecies susceptible to extirpation by disease. However, there is no evidence that disease is a problem at the current time.

2.3.2.4. Factor D. Inadequacy of existing regulatory mechanisms

Berberis pinnata ssp. insularis is also listed as endangered by the State of California under the Native Plant Protection Act (sec. 1900 *et. seq.* of the Fish and Game Code), and the California Endangered Species Act (sec. 2050 *et. seq.*). These State regulatory mechanisms are not likely to be invoked because *B. p. ssp. insularis* now occurs on private lands owned, and conserved, by The Nature Conservancy (Santa Cruz Island), and on public land managed by the National Park Service (Santa Cruz Island) where major changes in land use, such as development projects, are not likely to occur. Our current assessment is that inadequacy of existing regulatory mechanisms is not a threat on Santa Cruz Island, where the only known extant populations occur.

At the time of listing, we discussed the various Federal regulations and policies available in regards to historical *Berberis pinnata ssp. insularis* habitat on Santa Rosa Island. These included several Federal laws, including the National Environmental Protection Act and the Endangered Species Act, as well as Department of the Interior policies, and National Park Service policies and guidelines that apply to the management of National Park Service lands. In addition, the Congressional legislation enabling purchase of Santa Rosa Island as a national park from the Vail and Vickers Company (Public Law 96-199, 94 Stat. 67, March 5, 1980) directed the Secretary of the Interior to complete a natural resources study that would supply an inventory of all terrestrial and marine species and indicate their population dynamics and probable trends as to future numbers and welfare, and to recommend action that should be adopted to better protect the natural resources of the park.

The National Park Service also issues Special Use Permits for five-year terms for grazing and hunting. The first Special Use Permit was issued to the Vail and Vickers Company and included a condition that a range management plan be developed within five years. The Range Management Plan was adopted when the Park issued the second Special Use Permit. However, as noted in the final listing rule, the Range Management Plan did not address protection of *Berberis pinnata ssp. insularis* (62 FR 40969). Under a court-approved settlement agreement, the Vail and Vickers Company removed their cattle from Santa Rosa Island and they must also reduce the numbers of non-native deer and elk by 2008, and remove all deer and elk by 2011. These actions should help reduce, and will eventually eliminate, the impact non-native ungulates may be having on the historical *B. p. ssp. insularis* habitat on Santa Rosa Island. As such, we do not consider the inadequacy of existing regulatory

mechanisms as great a threat to the habitat on Santa Rosa Island as we did at the time of listing.

2.3.2.5. Factor E. Other natural or manmade factors affecting its continued existence

At the time of listing, the subspecies was threatened by stochastic extinction due to small population size and limited distribution. This continues to be a threat. The conservation biology literature commonly notes the vulnerability of taxa known from one or very few locations and/or from small populations (e.g., Shaffer 1981, 1987; Primack 2006; Groom et al. 2006). Species with few populations and individuals are threatened by stochastic events in several ways such as: loss of genetic diversity, susceptibility to factors which inhibit the successful completion of their life cycle, and random natural events (62 FR 40970). The loss of genetic diversity *Berberis pinnata* ssp. *insularis* has suffered due to the extremely small number of extant individuals, may be contributing to its reduced fitness and reduced reproductive vigor; potentially a factor contributing to the demonstrated lack of sexual reproduction in this subspecies (Wilken 1996; McEachern et al. 2007). The extremely small population size, and limited range and distribution (four known individuals on one island) also make this subspecies susceptible to extinction by stochastic events such as fire, erosion, pests, and disease. Our current assessment is that stochastic extinction is still a threat to this subspecies.

2.4. Synthesis

The first major step toward the recovery of *Berberis pinnata* ssp. *insularis* has been the removal of feral pigs from Santa Cruz Island. With the pigs gone, we expect the shady, mesic habitat conditions the subspecies requires to improve substantially. USGS-BRD, the National Park Service, and the Santa Barbara Botanic Garden are continuing to conduct research on *B. p.* ssp. *insularis*. These efforts include conducting field surveys to locate extant populations, to propagate and maintain, ex-situ, as many genetically distinct individuals as possible, and to identify outstanding threats and management strategies to address those threats.

However, the extremely narrow range and distribution of *Berberis pinnata* ssp. *insularis*, combined with degraded habitat quality and a lack of sexual reproduction (Wilken 1996; McEachern and Chess 2006; McEachern et. al. 2007; CPC 2007) indicate the subspecies remains in danger of becoming extinct in the wild. Therefore, the subspecies continues to meet the definition of endangered.

3. RESULTS

3.1. Recommended Classification

- Downlist to Threatened
- Uplist to Endangered
- Delist (Indicate reasons for delisting per 50 CFR 424.11):
 - Extinction
 - Recovery
 - Original data for classification in error
- No change is needed

3.2. New Recovery Priority Number: 6. This recovery priority number reflects a subspecies facing a high degree of threat and with a low recovery potential. The low number of extant individuals and failure to reproduce sexually in the wild continue to inhibit recovery. The cause, or causes, of the reproductive failure is unknown. However, limited pollination, predation by insects, and habitat degradation may be key factors. Until the subspecies' lack of reproductive success in the wild is remedied, recovery is unlikely.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

The National Park Service, The Nature Conservancy, and the Service should pursue the following actions to further the recovery of *Berberis pinnata* ssp. *insularis*:

- 1) Seek additional funding to continue field surveys and monitoring, demographic monitoring, population viability analyses, and further investigations into recovery prescriptions;
- 2) Seek additional funding to study the predation of *Berberis pinnata* ssp. *insularis* fruit and other potential sources of reproductive failure;
- 3) Restore native habitat at historical locations on Santa Cruz, Anacapa, and Santa Rosa Islands; and
- 4) Implement out-planting at historical locations on Santa Cruz, Anacapa, and Santa Rosa Islands.

5.0 REFERENCES

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PERSONAL COMMUNICATIONS AND OBSERVATIONS

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Island Barberry (*Berberis pinnata* ssp. *insularis*)

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, if applicable: N/A

Review Conducted By: Steve Kirkland

FIELD OFFICE APPROVAL:

Field Supervisor, Fish and Wildlife Service

Approve  Date 7/2/08

REGIONAL OFFICE APPROVAL:

Regional Director, Fish and Wildlife Service

Approve  Date 7/10/08