

Soft-leaved Paintbrush

(Castilleja mollis)

5-Year Review: Evaluation and Summary



Photo: Matt Guilliams, Santa Barbara Botanic Garden

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

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GENERAL INFORMATION:

Species: *Castilleja mollis*

FR citation: 62 FR 40954

Date listed: July 31, 1997

Classification: Endangered

BACKGROUND:

Most recent status review:

U.S. Fish and Wildlife Service. 2007. *Castilleja mollis* (soft-leaved paintbrush) 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 40 Species in California, Nevada, and Oregon. Notice of initiation of reviews; request for information. (87 FR 5832), 22 February 2022.

Critical Habitat Designation:

Critical habitat has not been designated for *C. mollis*.

State Listing:

C. mollis has a California Rare Plant Rank of 1B.1 (California Natural Diversity Database [CNDDB] 2023 p. 36).

Recovery Plan:

U.S. Fish and Wildlife Service. 2000. Thirteen plant taxa from the northern Channel Islands recovery plan. Portland, Oregon. 94 pp.

ASSESSMENT:

Information acquired since the last status review:

The U.S. Fish and Wildlife Service (Service) Ventura Fish and Wildlife Office conducted this 5-year review. The Service announced this review through a Federal Register notice on February 2, 2022 (87 FR 5832). We did not receive any information from the public about *C. mollis* in response to the notice. We also contacted Channel Islands National Park (CINP), United States Geographic Survey (USGS) Channel Islands Field Station, and 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.

Introduction:

Castilleja mollis (Orobanchaceae) is a perennial herb that occurs only on Santa Rosa Island in Santa Barbara County, California, about 25 miles (40 kilometers) from the mainland. Santa Rosa Island is owned by CINP and is managed primarily for natural resource conservation. *C. mollis* is a hemiparasite (parasitic on a host plant and also photosynthetic), and *Isocoma menziesii* (coastal goldenbush) is its primary host.

Santa Rosa Island had non-native ungulate herbivores from 1844 to 2020 (Table 1, McEachern et al. 2016 pp. 759–760, A. Adams pers. comm. 2021), which greatly affected island plants and vegetation. At the time of *C. mollis* listing in 1997, cattle, elk, mule deer, and horses were still on the island. Cattle were removed between listing and the 2000 recovery plan, and elk and mule deer were removed between the 2007 5-year review and 2015. The final two horses died of natural causes on the island in December 2020 and were the last non-native ungulates in CINP.

Table 1. Non-native ungulate herbivores on Santa Rosa Island (McEachern et al. 2016 pp. 759–760, A. Adams pers. comm. 2021). Bold text indicates animals present on the island after *C. mollis* listing.

common name	scientific name	dates present
donkeys	<i>Equus africanus asinus</i>	1800s
goats	<i>Capra aegagrus hircus</i>	1883 - Early 1900s
fallow deer	<i>Dama dama</i>	1890 - 1949
sheep	<i>Ovis aries</i>	1844 - 1960s
pigs	<i>Sus scrofa domestica</i>	1853 - 1993
cattle	<i>Bos taurus</i>	1844 - 1998
elk	<i>Cervus canadensis</i>	1879 - 2011
mule deer	<i>Odocoileus hemionus</i>	1880 - 2015
horses	<i>Equus ferus caballus</i>	1844 - 2020

Population data:

Distribution:

Historically and currently, *C. mollis* has been found in two populations on the north side of Santa Rosa Island which are separated by about 10 miles (16 kilometers): Carrington Point and Jaw Gulch (Table 2). Identification by California Natural Diversity Database Element Occurrence Number (CNDDDB EO #) has never been used by staff at CINP or USGS to identify the populations. The species has been extirpated from San Miguel Island, and two other locations reported by CNDDDB are in error.

Table 2. *C. mollis* populations listed by California Department of Fish and Wildlife (CDFW, 2023). CNDDDB = California Natural Diversity Database, EO = Element Occurrence

CNDDDB EO #	most recent CNDDDB report	island	population name	status	notes
14, 27	2003	Santa Rosa	Carrington Point	extant	both EO#s are from the same population
25, 28	2005	Santa Rosa	Jaw Gulch	extant	both EO#s are from the same population
26	1938	San Miguel	Point Bennett	extirpated	not found in repeated surveys
29	1988	Santa Rosa	Windmill Canyon	misidentification	herbarium specimens appear to be <i>C. affinis</i> subsp. <i>affinis</i>
30	1939	Santa Rosa	Water Canyon	misidentification	duplicate identified as <i>C. affinis</i>

Abundance and ongoing demography work:

There are no comprehensive population abundance estimates for *C. mollis*, but since 1995 the species has been the focus of demographic monitoring in permanent plots by Kathryn McEachern of USGS at both Carrington Point and Jaw Gulch (Schneider and Carson 2022 pp.

18–21.) Immediately after cattle removal (1998) and elk and deer reduction (2007), large increases in abundance were observed. This was followed by increasing mortality of small plants, and this mortality was correlated with increases in nighttime air temperature, or factors related to air temperature.

Overall, since 1995, there are fluctuations of increasing and decreasing density of plants in the plots, with about the same number of stems per area in 2019 as in 1995 across the two populations (McEachern et al. 2023 pp. 10–11). However, at Carrington Point there were nearly twice as many plants documented in plots in 2019 compared to 1995, while at Jaw Gulch the opposite was true with half as many in 2019 compared to 1995 (Schneider and Carson 2022 pp. 18–21).

While no comprehensive summary document has been produced, analysis of the long-term ongoing demography dataset and environmental monitoring is projected to be completed in the next few years, along with plant recruitment and mortality trends, and the effects of local climate variation on demographic patterns.

Ongoing Genetic Work:

In 2021, Santa Barbara Botanic Garden, USGS, and Claremont College received a Service Recovery Challenge Grant to investigate potential hybridization between *C. mollis* and *C. affinis* genetically, morphologically, spatially, and demographically to guide conservation decisions (Hasenstab-Lehman et al. 2022 pp. 4–26). Work is ongoing, but preliminary results suggest that the Jaw Gulch and Carrington Point *C. mollis* populations are genetically independent of each other, and that there is little hybridization between the two *Castilleja* species. Additionally, there are morphological traits that may be used to differentiate the species in the field. Finally, analysis of demography data shows that the *C. mollis* individuals have greater survival in wetter years and lower survival in hotter years, with Jaw Gulch plants more negatively affected by higher temperatures than are Carrington Point plants.

Conservation seed banking:

There are 21 accessions of *C. mollis* seed at the Santa Barbara Botanic Garden, a Center for Plant Conservation approved conservation seed bank (CaPR 2023, Table 3). All the accessions are characterized as possibly being hybrids of *C. mollis* and *C. affinis* subsp. *affinis*, although in some cases it is noted that care was taken to collect from plants that looked most like *C. mollis*. The conservation value of these accessions is uncertain, but given the preliminary analysis by Hasenstab-Lehman et al. 2022 (*Genetic Work* above), they may actually be pure *C. mollis*, especially at Jaw Gulch.

Table 3. *C. mollis* conservation seed banking at Santa Barbara Botanic Garden. Data are from CaPR 2023 and Schneider and Carson 2022.

population	collection date	# maternal lines or bulked	# seeds
Carrington Point	7/17/2006	unknown	unknown
Carrington Point	7/17/2006	unknown	unknown
Carrington Point	6/1/2008	unknown	unknown
Carrington Point	10/8/2014	bulked	420
Carrington Point	10/8/2014	bulked	380
Carrington Point	10/8/2014	bulked	1,058

population	collection date	# maternal lines or bulked	# seeds
Carrington Point	10/8/2014	bulked	666
Carrington Point	10/8/2014	bulked	1,020
Carrington Point	10/8/2014	bulked	1,775
Carrington Point	8/18/2015	bulked	396
Carrington Point	8/19/2015	bulked	1,823
Carrington Point	8/20/2015	bulked	497
Carrington Point	8/20/2015	bulked	906
Carrington Point	9/12/2015	bulked	5,965
Carrington Point	8/29/2019	19	4,276
Jaw Gulch	10/21/1999	2	unknown
Jaw Gulch	6/1/2008	unknown	unknown
Jaw Gulch	6/1/2008	unknown	unknown
Jaw Gulch	10/7/2014	bulked	342
Jaw Gulch	10/7/2014	bulked	441
Jaw Gulch	10/7/2014	unclear	460
Jaw Gulch	10/27/2018	13	unknown

EVALUATION OF THREATS:

At time of the 1997 listing, the specific threats to *C. mollis* were deer and elk browsing and grazing, soil loss, habitat alteration, and herbivory caused by cattle, damage caused by deer bedding, and competition with alien (non-native) plant taxa. All the same threats were identified as reducing the numbers of the host plant *I. menziesii*. General threats related to small population sizes were also noted: the loss of genetic diversity, stochastic loss of individuals through chance events, and loss of populations through catastrophic events. The 2000 recovery plan added possible hybridization with *Castilleja affinis* as a threat to the species, and the 2007 5-year review added insect damage to inflorescences as a possible threat. In addition to summarizing the previously mentioned threats, this five-year review evaluates climate change effects on plants and sea level rise, and increased visitor use, as potential threats to the species.

Non-native ungulate browsing, grazing, soil loss, habitat alteration, and bedding:

With the complete removal of non-native ungulates from Santa Rosa Island, there has been passive vegetation recovery similar to that of neighboring Santa Cruz Island (Beltrane et al. 2014 entire), and there is little current indication of ongoing soil erosion and habitat alteration in areas where the species occurs. These direct threats have largely been minimized, both for *C. mollis* and its host plant *I. menziesii*.

While the direct impacts of non-native ungulate herbivores are gone, it is likely that the effects of non-native plants facilitated by past ungulate activity will continue into the future. This residual habitat alteration remains a threat.

Competition with non-native plant taxa:

At the time of listing (Service 1997), competition with non-native plants was identified as a general threat to listed Channel Island plants. Non-native plant success was facilitated by the activities of non-native ungulates, and although the ungulates are gone, the non-native plants persist. If non-native plants are potential or actual competitors, their effects may actually increase in the future. For

example, non-native annual grasses are predicted to increase with anticipated climate change (Sandel and Dangremond 2012 entire), and thus negative effects competition on *C. mollis* may increase. Threat of competition from non-native plants remains.

The loss of genetic diversity, stochastic loss of individuals through chance events, and loss of populations through catastrophic events because of small population sizes:

There are two genetically distinct populations of *C. mollis* and the species is found on only a single island. If either population experiences a loss of individuals through random chance, genetic diversity is decreased, and the likelihood of the extirpation of a population through further attrition or catastrophic events is increased. If only a single population remains, the future of the species is even more precarious. The effects of small population sizes and few populations remain for *C. mollis*.

Hybridization with *Castilleja affinis*:

The preliminary work by Hasenstab-Lehman et al. (2022, entire) suggests that hybridization may not be a substantial threat to the species, but their study has not been completed.

Insect damage to inflorescences:

Since introduced in the 2007 5-year review, no further work has been done on the effects of insect damage to *C. mollis* inflorescences, and the magnitude of this threat remains.

Climate change:

Changes in climate could threaten *C. mollis* in several ways. First, as vegetation shifts with climate change, the species might not be able to disperse to suitable germination or recruitment habitat, as is predicted to happen to island annuals (Levine et al. 2008 p. 796). Second, the proper combination of environmental cues for germination could occur less frequently or not at all, decreasing germination and causing declines in abundance and possible extirpations (Levine et al. 2008 pp. 800–805; Levine et al. 2011 pp. 2241–2246).

Expected climate change for the geographic region of the islands predicts both rising annual temperatures (Langridge 2018 pp. 13–15) and less frequent, more episodic rainfall (Langridge 2018 pp. 16–17). Preliminary analysis of demography and environmental data (Hasenstab-Lehman et al. 2022) show that the *C. mollis* individuals have lower survival in hotter years, with Jaw Gulch plants more negatively affected by higher temperatures than are Carrington Point plants, so climate change induced temperature rise is a threat to the species.

Additionally, the species is found at less than 20 meters or 66 feet elevation. Sea level may rise by about 0.25 m (1 ft) by 2050 (Sweet et al. 2022 p. 19) and 1.0 m (3 ft) by 2100 (Sweet et al. 2022 p. 23). The low elevation habitat in which *C. mollis* is found is largely unprotected from the effects of rising sea level, and at least the lowest elevation plants might be threatened by inundation or removal by wave action in the future.

Another prediction with increasing annual temperature in California is an increasing dominance by non-native annual grasses (Sandel and Dangremond 2012, entire) in certain situations. If non-native grass cover increases further, the presumed competitive effects of increased grass cover would further threaten *C. mollis*.

Increased visitor use:

Implementation of the preferred alternative in the Channel Islands General Management Plan (2015, pp. 165–173) would facilitate easier visitor access to the backcountry of Santa Rosa Island. If this results in increased hiker use of the relatively level and scenic marine terraces of the Jaw Gulch area, the genetically distinct and possibly declining population of *C. mollis* there could be detrimentally impacted by trampling by hikers or unauthorized camping in the area. Additionally, at Carrington Point the species has been recently found on both sides of a popular hiking trail (K. McEachern pers. comm.), and could be trampled by hikers. The final impact of increased visitor use will likely be determined by the CINP Backcountry Wilderness Management Plan, which is under development, and until it is finalized, the magnitude of the threat of increased visitor use to the species is unknown.

RECOVERY CRITERIA:

We developed the following downlisting criteria for *C. mollis* in the 2000 Recovery Plan (Service 2000, p. 65):

Downlisting criteria for *Castilleja mollis*

1. *Maintain the existing distribution with multiple colonies in each population on Santa Rosa Island.*
 - The distribution remains the same since listing and when the recovery plan was written, and multiple colonies remain present. This criterion has been met.
2. *Maintain stable or increasing population trends, with evidence of natural recruitment, for a period of 15 years that includes the normal precipitation cycle.*
 - Preliminary demographic analysis suggests that the overall abundance of the species is stable, but that the Jaw Gulch population is decreasing while the Carrington Point population is increasing. This assertion requires a more complete analysis of the data, and currently this criterion is not met
3. *Damage from non-native mammals significantly reduced.*
 - The last non-native animals in the location of the species were removed in 2015. This criterion has been met.
4. *Seed stored in CPC cooperating facilities.*
 - While there is seed from both populations in a CPC (Center for Plant Conservation) cooperating facility, all conservation seed bank accessions are noted to possibly represent hybrids with *C. affinis*. However, ongoing genetic and morphological research indicates that two species may be readily discernable in the field, and that true hybrids may not be common. This criterion may not have been satisfactorily met, and conservation seed collection may need to continue using specific morphological traits to confidently identify plants to species.
5. *Seed germination and propagation techniques understood.*

- As noted in the 2007 5-year review, seed germination and outplanting studies have been completed, and show that seeds are viable, and germination is successful. This criterion has been met.
6. *Successful outplanting techniques developed.*
 - As noted in the 2007 5-year review, successful outplanting techniques have been developed. This criterion has been met.
 7. *Host plant and weed management plan developed and implemented.*
 - Neither a plan to increase the host plant abundance nor a weed management plan has been developed. This criterion has not been met.
 8. *Life history research conducted.*
 - Substantial demographic monitoring has been conducted, but not comprehensively analyzed. This criterion has not been met.
 9. *Hybridization with *Castilleja mollis* understood.*
 - The ongoing genetic and phenotypic study addresses this criterion, but currently the criterion is not met.
 10. *If declining, determine cause and reverse trend.*
 - While the number of individuals of the species may be stable overall, the Jaw Gulch population may be declining. Further analysis of the demography and genetic data may clarify the trends and suggest causes, but for now this criterion is not met.

Delisting criteria for *Castilleja mollis*

1. *Expansion of individuals into potential habitat within population boundaries.*
 - Populations have been monitored within plots, but there is no data on distribution outside of plots within populations. This criterion is not met.
2. *No decline after downlisting for 10 years.*
 - This criterion is not currently applicable.
3. *All potential habitat surveyed.*
 - The available appropriate habitat is limited and accessible and has been surveyed repeatedly since listing, with no new populations found. This criterion has 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 2007 5-year review remain accurate reflections of the species current status. After reviewing the best available scientific information, we conclude that *Castilleja mollis* remains an endangered species.

RECOMMENDATIONS FOR FUTURE ACTIONS:

1. Continue demographic monitoring of the two populations of *C. mollis*, and analyze long-term demographic and environmental monitoring data to determine trends.
2. Use morphological characters from the genetic study to define the geographic edges of the *C. mollis* populations.
3. Map the distribution of plants within the populations, including plants outside of the demography plots.
4. Augment current populations, especially Jaw Gulch, expand current populations, and establish new populations in areas above sea level rise effects.
5. Collect confirmed *C. mollis* seed from both populations for accession in conservation seed banks.
6. Ensure that visitor use does not impact *C. mollis* at the Jaw Gulch and Carrington populations.

APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approved _____

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