Morro manzanita (*Arctostaphylos morroensis*)
5-Year Review: Summary and Evaluation

Photos credit: Michael Walgren, California State Parks, San Simeon, California.

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

April 2022

GENERAL INFORMATION

Species: Morro manzanita (*Arctostaphylos morroensis*)
Date listed: December 15, 1994
FR citation: 59 FR 64613
Classification: Threatened

BACKGROUND

Most recent status review
U.S. Fish and Wildlife Service [USFWS]. 2013. *Arctostaphylos morroensis* (Morro manzanita). 5-year review: summary and evaluation. Ventura, California. 21 pp.

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.

Critical habitat
Critical habitat has not been designated for Morro manzanita.

State listing
Morro manzanita is not listed by the State of California.

Recovery plan
USFWS. 1998. Recovery plan for the Morro shoulderband snail and four plants from western San Luis Obispo County, California. Portland, Oregon. 75 pp.

ASSESSMENT

This 5-year review was conducted by the USFWS Ventura Fish and Wildlife Office, California. We solicited information for this review from interested parties through a *Federal Register* notice on May 20, 2021, and we received no information in response. Additionally, we conducted a literature search and a review of information in our files, and we contacted State agencies, local agencies, species experts, and land managers.

Biology and ecology
The biology and ecology of Morro manzanita (family Ericaceae) was described in USFWS (2013, entire), and we provide a brief summary here. The species is a long-lived shrub (at least 47 years) standing up to 5 meters (m)/16.4 feet (ft) tall (Tyler and Odion 2020, p. 156). It is endemic to the vicinity of Los Osos in west San Luis Obispo County, California (Figure 1), with six known occurrences. We consider a location with Morro manzanita as a separate occurrence if >0.4 kilometer (km)/0.25 mile (mi) from the nearest occurrence (California Department of Fish and Game 2011, p. iii). Most stands (stand: a group of forest trees of sufficiently uniform species composition, age and condition to be considered a homogenous unit for management purposes; Maryland Department of Natural Resources 2021, p. 10) are on Baywood fine sand (Carpenter and Storie 1928, p. 36), which is a soil type in the vicinity of Morro Bay (Wiegers 2009, entire).

Morro manzanita occurs in coastal dune scrub, maritime chaparral, and coast live oak woodland on sites with no slope to moderate slopes (59 FR 64614). It flowers January to March, with fruit maturation and seed dispersal in the fall (USFWS 2013, p. 1).

Morro manzanita is an obligate-seeder rather than a resprouter after fire. Morro manzanita must re-establish from seeds in the soil seed bank after fire destroys the crown and stem. Some other species of *Arctostaphylos* resprout from a burl (a large woody structure where stem and roots meet that contains dormant buds; Huang et al. 2020, p. 924). Young individuals of Morro manzanita are extremely rare in mature stands. Its persistence in the landscape may depend on germination of seeds in the soil seed bank following fire, however, fire has been virtually eliminated from its remaining habitat (Tyler and Odion 2020, p. 155).

Situation at Federal listing as threatened in 1994

At the time of listing, the historical range of Morro manzanita was estimated to comprise 800–1,100 hectares (ha)/1,977–2,718 acres (ac). The area of occupancy was 340–360 ha/840–890 ac, with estimates of individuals ranging from 86,000–153,000. Approximately 65% of the habitat was on private lands and 35% on lands owned by California State Parks and California Department of Fish and Wildlife [CDFW]. The identified threats were residential and urban development, including destruction and fragmentation of habitat; lack of protection on private lands and lack of management on public lands; deterioration of habitat due to recreational activity; expansion of previously cultivated non-native *Eucalyptus* into habitat (Mullany 1990, p. 73–86) and competition from other alien plants; and stochastic extinction by virtue of the small and isolated nature of the remaining populations (59 FR 64613–64623).

Situations in 2008 and 2013: 5-year reviews with recommendations of no status change

In the 2008 5-year review, the status of Morro manzanita was reported to not be markedly different than at the time of listing in 1994. The primary change was the threat of habitat loss by development being substantially reduced by transfer of private lands with the species to CDFW or California State Parks, but with no management plans for the species. Altered fire regime/fire management practices was considered a possible threat (USFWS 2008, p. 9–13). In the 2013 5-year review, the status of Morro manzanita was not found to be different than in 2008. Two new threats were identified: altered fire regime/fire management practices and climate change (USFWS 2013, p. 9–15).

Distribution and abundance in 2022

Morro manzanita is endemic to the vicinity of Los Osos in west San Luis Obispo County, California. We have little new information about its distribution and abundance since our 2013 5-year review.

Tyler and Odion (2020, p. 155) stated the geographic range of Morro manzanita has been reduced to one-third of its historical size due to elimination of habitat, with the species now confined to 350 ha/865 ac of fragmented habitat, which is the same as at the time of listing in 1994. Their estimate is based on Odion and Tyler (2002, entire) citing Mullany (1990, entire).We have no additional information regarding number of individuals since the estimate of 86,000–153,000 reported at the time of listing.

California Natural Diversity Database (CDFW 2021, p. 10) contains a record for one additional stand of Morro manzanita reported in 2015, which comprises new occurrence 21 with many plants on 2 ha/5 ac in Morro Bay State Park (931 ha/2,300 ac). As knowledge of the species' distribution has improved, some previously recognized occurrences have been combined with other occurrences, so the next sequential number was 21, although there are only six total known occurrences. Details for occurrence 21 are the following: in Morro Bay State Park, San Luis Obispo County, 35.3388/-120.81154, 66 m/215 ft elevation, on south-facing slope at shale outcrop, 0.4 km/0.25 mi east of junction of Crespi Trail and Chumash Trail, 15 m/50 ft south of trail, many plants observed in 2015 on 2 ha/5 ac.

There have been various attempts to estimate the species' distribution and occupied area across the limited geographic range.

- USFWS (1994, p. 64614). "Based on the distribution of Baywood fine sands in the Morro Bay area, the historic habitat was estimated at between 800 and 1100 hectares (ha) (2,000 and 2,700 acres (ac)). Much of the area covered by Baywood fine sands and with no to low slopes have been subject to urban development, primarily by the communities of Los Osos, Baywood Park, and Cuesta-by-the-Sea on the south and east sides of Morro Bay. Some development, however, has also occurred on the steeper north-facing slopes of Irish Hills. Approximately 340 to 360 ha (840 to 890 ac) *Arctostaphylos morroensis* remain (LSA Associates 1992): half of this consists of small or low density patches that remain in and around developed areas of Los Osos and Baywood Park, and half consists of more continuous and more dense (at least 50 percent cover by this species) stands of manzanita."
- Tyler and Odion (1996, p. 21). "Using Mullany's (1990) cover classes and the estimated acreage of the polygons she drew (McGuire and Morey 1992), we calculated the maximum extent of *A. morroensis* for each cover class... For example, in the cover class 5–25%, we calculated acreage *of A. morroensis* on private and public land as follows: 93 acres (total habitat) x 25% = 23 acres. This method yields a maximum of 353 acres of Morro manzanita, 84 on public land."
- Odion and Tyler (2002, p. 1). "This genetically distinct species is restricted to about 350 fragmented ha of maritime chaparral at the south end of Morro Bay, San Luis Obispo County, California, USA (Mullany 1990)."
- USFWS (2008, p. 7). "The area historically occupied by *A. morroensis* was estimated to be between 2,000 and 2,700 acres. Currently, the range of *A. morroensis* is estimated to be approximately 840–890 acres, with the total number of individuals ranging between 86,000 and 153,000 (Crawford, Multari and Clark 2004). Much of the historic area of Baywood fine sands found on gentle to moderate slopes has been converted to urban development, primarily in the communities of Los Osos, Baywood Park, and Cuesta-by-the-Sea. Limited development has also occurred on the steeper north-facing slopes of the Irish Hills."
- USFWS (2013, p. 22). "Approximately 75 percent of its historical habitat has been converted for residential use, resulting in highly fragmented populations. The distribution of *A. morroensis* is correlated with the distribution of Baywood fine sands. Based on the distribution of these sands, the historical distribution of *A. morroensis* is estimated to have comprised between 2,000 and 2,700 acres (809 and 1,092 hectares (ha)). At the time of

listing, LSA (1992) estimated there were 840 to 890 acres (340–360 ha) of *Arctostaphylos morroensis* habitat (LSA 1992); they based this on aerial photos and surveys. Tyler and Odion (1996) recalculated acreage to account for the fact that, in the previous estimates, stands with a sparse cover of *A. morroensis* were equally weighted with stands with high cover. Using their method, they estimate that the area actually covered by *A. morroensis* may be less than 400 acres (162 ha) (Tyler and Odion 1996). We have no information regarding any more recent estimates."

- McGraw (2019, p. 3–16). "The current range of Morro manzanita is approximately 890 acres (LSA Associates 1992). Within that area, Morro manzanita covers approximately 350 acres (Tyler and Odion 1996)."
- Tyler and Odion (2020, p. 155) and Tyler (2022, p. 1). "One such species is Morro manzanita, (*Arctostaphylos morroensis* Weis. & Schrieb), which has been reduced to one-third its historical range due to habitat elimination, and is now confined to just ~350 ha of fragmented chaparral habitat in San Luis Obispo County, California." "That estimate is based on Odion and Tyler (2002) citing Mullany (1990). ...I don't have any more recent information... My guess is that what remains is even lower based on senescence of large individuals at the Elfin Forest, etc. but I have no data to back that up."
- Based on its combined records for all occurrences of Morro manzanita (CDFW 2021, entire), but with data based mostly from maps dated 1980 and 1990–1992, the estimated total area of occupancy for the species is 514 ha/1,271 ac.

In 2022 for this review, we estimated total area of occupancy for the species using the California Natural Diversity Database (CDFW 2021, entire) and/or showing in its Geographic Information System (GIS) map layers when used in January/February 2022 (Figure 1).

- occurrence 1: Montaña de Oro State Park, precise location unknown but mapped as circular area (28 ha/70 ac) 1.6 km/1 mi east-northeast of Valencia Peak, based on two herbarium specimens collected in 1936; mapped as circular area with 28 ha/70 ac (Metevier 2022b, p. 1), we assign area of 2 ha/5 ac.
- occurrence 4: private/Elfin Forest Preserve/Morro Bay State Park, mapped as many polygons mostly according to map data from 1980, 1990–1992; 104 ha/258 ac.
- occurrence 9: west of Pecho Valley Road, and south of west end of Los Osos Valley Road extending to ridges south of Hazard Canyon, mapped as many polygons mostly according to map data from 1980, 1990–1992, with estimate of 152,200+ plants; 402 ha/993 ac.
- occurrence 18: Morro Bay State Park, last observed 1989, referencing Mullany (1990, p. 30) with 1 or a few individuals, mapped as circular area (2 ha/5 ac).
- occurrence 20; several private properties near Freeman Lane mapped as circular area (2 ha/5 ac), last observed 1980's, referencing Mullany (1990, p. 30) with 1 or a few individuals.
- occurrence 21: Morro Bay State Park, first/last observed 2015, referencing a field survey form submitted by K. Nelson in 2015 reporting many plants; 2 ha/5 ac.

The estimated total area of occupancy for the species using stated areas in the California Natural Diversity Database (CDFW 2021) is 514 ha/1,271 ac. Although most of the data in the database are not recent — mostly from maps dated 1980 and 1990–1992 — these are part of the best available information.

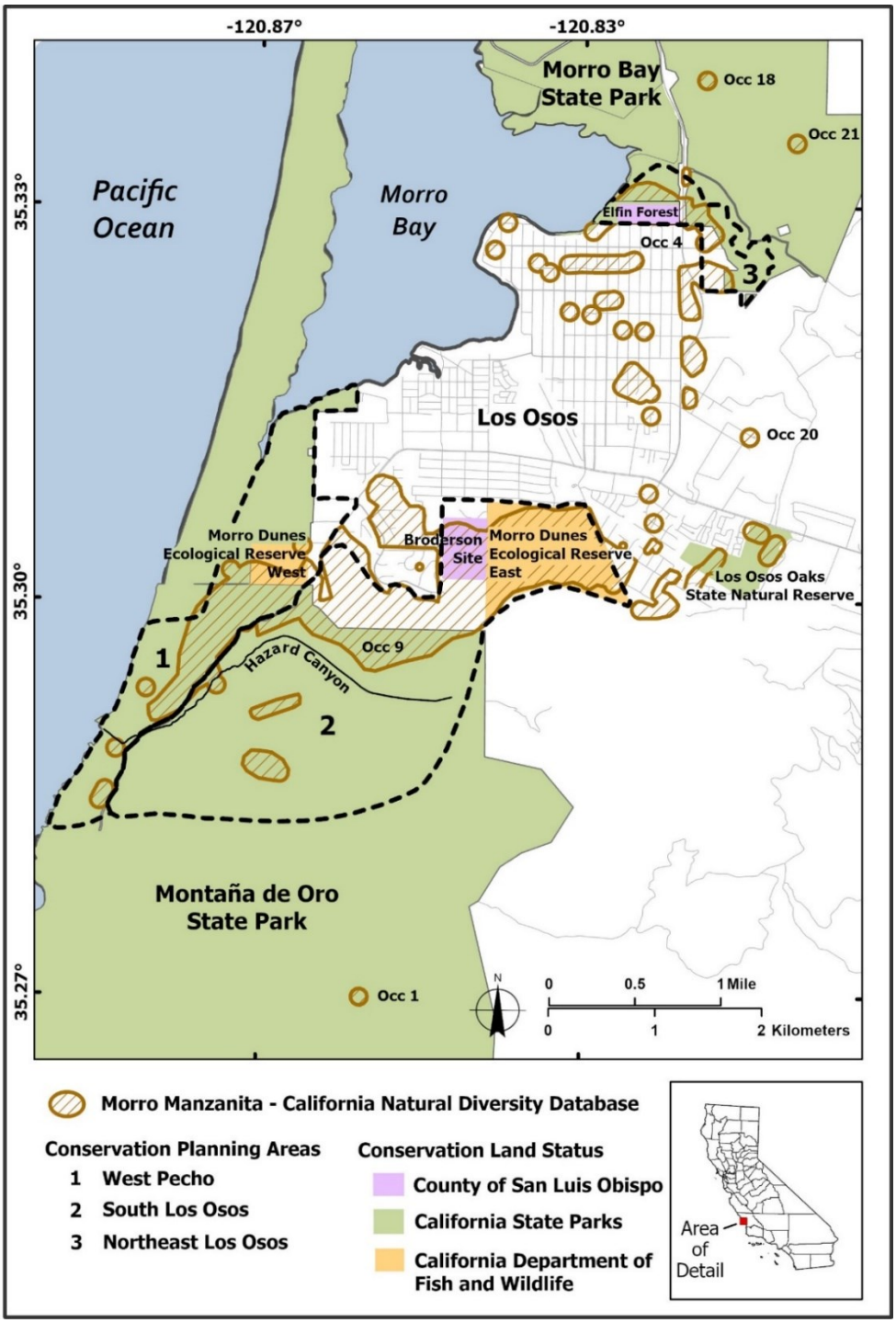

Figure 1. Geographic distribution of Morro manzanita (*Arctostaphylos morroensis*), endemic to the vicinity of Los Osos in west San Luis Obispo County, California. We used GIS map layers of the California Natural Diversity Database in 2022, which are mostly from maps dated 1980 and 1990–1992). Map credit: Mark Metevier.

Summary of threats in 2022
Currently, all threats identified in the 2013 5-year review are on-going. Although progress continues to be made in protecting maritime chaparral with Morro manzanita habitat from development, some areas are still threatened by development and altered fire regime/fire management practices. Some preserved areas are also threatened by invasive plant species, including expansion of previously cultivated, non-native *Eucalyptus* (Sims 2010, p. 220; Tyler and Odion 2020, p. 156), and management on most public lands is lacking. Stochastic events threaten the small population of the species within its small geographic range.

We have new reports on the threats of *Eucalyptus*, altered fire regime/fire management practices, and climate change-driven drought. Walgren (2021, p. 1) recently reported two preliminary observations: (1) stands of *Eucalyptus* appear to exclude Morro manzanita (and also endangered Morro shoulderband snail [*Helminthoglypyta walkeriana*; Walgren and Andreano 2012, p. 164]); and (2) a 40-year old stand of Morro manzanita in Montaña de Oro State Park (3,398 ha/8,396 ac) that was burned in 1998 (Odion and Tyler 2002, p. 4; 2003, p. 1) now appears similar to the pre-burning stage, having recovered after 23 years. Sarafian (2021, p. 1) observed die-off or partial die-off of several large Morro manzanitas in the Elfin Forest Preserve over the past 5 years, which he attributed to drought. He stated that "in the previous two decades I never saw large manzanitas die off so quickly or extensively as during the recent drought conditions."

Langridge (2018, entire) provided a comprehensive assessment of the climate changes that will affect California's Central Coast bioregion, including increased maximum and minimum temperatures, uncertainty in the future of fog, slightly increased precipitation with substantially increased variability, increased locally extreme rainfall events, accelerated sea level rise, increased drought, and frequent and sometimes large wildfires. The tolerance of Morro manzanita to these climate changes is unknown, however, it is a habitat specialist in the coastal zone with marine fog. Rare species like Morro manzanita with small geographic ranges and endemic soil requirements will not be able to disperse to distant locations.

We also identify two new potential threats: seeds with a low germination rate and the Sudden Oak Death pathogen (*Phytophthora ramorum*). The former was also mentioned as a potential threat at time of listing in 1994 (59 FR 64613–64623).

Tyler and Odion (2020, p. 155) reported for all seeds collected and treated/not treated, the germination rate was low at 4%, and 40% of the germinating seeds had received no fire treatments (heat/charred wood). Seeds soaked in water prior to treatments had significantly reduced germination, suggesting prescribed burns in the wet season would result in poor germination. They also found that soil seed density of Morro manzanita varied greatly among their study sites, and it did not increase with stand age as predicted. The oldest stand of Morro manzanita (Elfin Forest Preserve) had especially low soil seed density and germination rate. Sayers (2021, p. 1) grew young Morro manzanita in a greenhouse/nursery and reported that lightly burned seeds germinated "fairly easily."

Lee et al. (2019, entire) and Frankel et al. (2020, p. 54–55) reported the Sudden Oak Death pathogen affecting multiple species of *Arctostaphylos*, including Morro manzanita planted in the ground in the Arboretum and Botanic Gardens of the University of California, Santa Cruz in

2017 (Garbelotto 2022, p. 1). In 35 years, this disease had killed more than 50,000,000 trees in California and Oregon, primarily tanoak (*Lithocarpus densiforus*) and coast live oak (*Quercus agrifolia*). Among eight species of *Arctostaphylos* tested for susceptibility, Morro manzanita was in the intermediate category (Garbelotto et al. 2020, p. 3180). Although no infected plants of any species have been found in the wild in San Luis Obispo County, the nearest infections are 3 km/2 mi north of the county line in Salmon Creek Canyon, southwest Monterey County (Garbelotto 2022, p. 1), which is 72 km/45 mi north of the nearest occurrence of Morro manzanita (occurrence 18). However, the pathogen has been detected by polymerase chain reaction (PCR) analysis in three streams in San Luis Obispo County: Santa Rosa Creek, 34 km/21 mi northwest of occurrence 18; San Simeon Creek, 38 km/24 mi northwest of occurrence 18; and San Carpoforo Creek, 63 km/39 mi northwest of occurrence 18. Despite intensive searches in the watersheds, no infected vegetation has been found (Corella 2022, p. 1–2; Lee 2022, entire).

EVALUATION OF RECOVERY CRITERIA

The recovery objective for Morro manzanita is delisting. The species can be considered for delisting when all three of the following criteria have been achieved as stated in the 1998 Recovery Plan (USFWS 1998, p. 41). To evaluate recovery criteria in 2022, we calculated the occupied area of Morro manzanita using the information in the GIS map layers of the California Natural Diversity Database (mostly from maps dated 1980 and 1990–1992, which is the best available information), which we found to total 537 ha/1,328 ac (Metevier 2022b, entire; Table 1).

Delisting criterion 1

- Ninety percent of existing acreage supporting high (75–100%) and medium cover (25–75%) of Morro manzanita and 85–90% of low cover (1–24%) supporting Morro manzanita are secured from human-induced threats in preserves in the Northeast Los Osos, South Los Osos and West Pecho Conservation Planning Areas with no greater fragmentation by roads, residences, or other areas of human use than currently exists.

Since listing in 1994, California State Parks and CDFW have acquired substantial amounts of land in the vicinity of Morro Bay for conservation, including land occupied by Morro manzanita. In our 2013 5-year review, we considered this criterion very close to being achieved, but presented no data to support the statement (USFWS 2013, p. 14).

For this 5-year review, we calculated the following sizes of occupied areas with Morro manzanita for the Conservation Planning Areas (Metevier 2022c, p. 3): Northeast Los Osos, 38.25 ha/94.52 ac, with typically 1–25% cover (USFWS 2008, p. 9–10); South Los Osos, 243 ha/601 ac, with 50–100% cover; and West Pecho, 84 ha/208 ac, with 1–25% cover. The degree of cover with Morro manzanita is from USFWS (2013, p. 7–8).

The relevant preserves are Morro Bay State Park, Elfin Forest Preserve (landowners, County of San Luis Obispo and California State Parks), Montaña de Oro State Park, Morro Dunes Ecological Reserve (landowner, CDFW), and the Broderson Site (landowner, County of San Luis Obispo).

The percentage of occupied area in preserves in the Northeast Los Osos Conservation Planning Area is 73%. The Northeast Los Osos Conservation Planning Area contains a total of 38.25 ha/94.52 ac with Morro manzanita. Approximately 28.09 ha/69.42 ac with Morro manzanita are in preserves: Morro Bay State Park 14.37 ha/35.52 ac.; California State Parks part of Elfin Forest Preserve 3.48 ha/8.60 ac; and County of San Luis Obispo part of Elfin Forest Preserve 10.24 ha/25.30 ac. However, these hectares/acres with Morro manzanita are not necessarily secure from human-induced threats, such as targeted vandalism in a small preserve near urban development (Sarafian 2009a, p. 1–2; b, p. 1).

The percentage of occupied area in preserves in the South Los Osos Conservation Area is 70%. The South Los Osos Conservation Planning Area contains a total of 243 ha/601 ac with Morro manzanita (Metevier 2022a, p. 2). Approximately 170 ha/420 ac with Morro manzanita are in preserves (Metevier 2022a, p. 1; b, p. 3): Montaña de Oro State Park 64 ha/158 ac; Morro Dunes Ecological Reserve East 83 ha/206 ac; and the Broderson Site 23 ha/56 ac. However, these hectares/acres with Morro manzanita are not necessarily secure from human-induced threats.

The percentage of occupied area in preserves in the West Pecho Conservation Area is 97%. The West Pecho Conservation Planning Areas contains 84 ha/208 ac with Morro manzanita (Metevier 2022a, p. 2). Approximately 81 ha/201 ac with Morro manzanita are in preserves (Metevier 2022a, p. 1; b, p. 3): Montaña de Oro State Park 72 ha/178 ac; and Morro Dunes Ecological Reserve West 9 ha/23 ac. However, these hectares/acres with Morro manzanita are not necessarily secure from human-induced threats, such as previously cultivated, non-native *Eucalyptus* (Tyler and Odion 2020, p. 156).

Table 1. Properties with Morro manzanita (*Arctostaphylos morroensis*), the degree of cover with Morro manzanita (USFWS 2013, p. 7–8), and the size of the area covered with Morro manzanita (using GIS map layers of the California Natural Diversity Database in 2022, which are mostly from maps dated 1980 and 1990–1992).

Property with Morro manzanita (MM)	Degree of cover with MM	Size of area with MM	
Morro Bay State Park	typically low 1-25%	21 ha	53 ac
Elfin Forest Preserve County of San Luis Obispo	typically low 1-25%	10.24 ha	25.30 ac
Elfin Forest Preserve California State Parks	typically low 1-25%	3.48 ha	8.60 ac
Montaña de Oro State Park	low 1-25% and medium/high 50-100%	139 ha	344 ac
Morro Dunes Ecological Reserve East	medium 50-75%	83 ha	206 ac
Morro Dunes Ecological Reserve West	low 1-25%	9 ha	23 ac
Broderson Site	medium 50-75%	23 ha	56 ac
Los Osos Oaks State Natural Reserve	low 1-25%	11 ha	26 ac
private lands	low 1-25% and high 75-100%	237 ha	586 ac
	Total	**537 ha**	**1,328 ac**

In sum, 70% of existing acreage supporting high (75–100%) and medium cover (25–75%) of Morro manzanita (South Los Osos Conservation Area), and 89% of low cover (1–24%) supporting Morro manzanita (Northeast Los Osos and West Pecho Conservation Area) are in preserves. However, these hectares/acres with Morro manzanita are not necessarily secure from human-induced threats. Thus, at this point in time and using the best available information, this delisting criterion has yet to be met.

Delisting criterion 2

- Evidence that the acreage and approximate cover classes of Morro manzanita in preserves can be maintained over time and that preserves are not made unmanageable by small size, proximity to urban development, or fragmentation.

USFWS (2013, p. 14) stated monitoring programs to collect evidence that populations are being maintained need to be developed and implemented. We are not aware of any new monitoring programs for the species since 2013. Therefore, we have no evidence that any preserve with Morro manzanita satisfies this criterion.

Delisting criterion 3

- Site-specific management plans have been successfully implemented for the preserves.

Of the five relevant preserves, only the Broderson Site (County of San Luis Obispo 2017, p. 55–62) and Elfin Forest Preserve (USFWS 2013, p. 15) have site-specific management plans. Thus, this criterion has not been met.

CONCLUSION

We reviewed the best available scientific information and evaluated the threats affecting Morro manzanita in 2022 under the factors in 4(a)(1) of the U.S. Endangered Species Act 1973 (as amended). Currently, all threats identified in the 2013 5-year review are on-going. Low germination rate and the Sudden Oak Death pathogen are new threats to the species. We conclude that Morro manzanita still meets the definition of a threatened species, and we recommend no status change at this time.

RECOMMENDATIONS FOR FUTURE ACTIONS

Coordinated conservation and research are needed to better understand the biology and ecology of Morro manzanita, in particular to restore and maintain the existing stands and facilitate recruitment. These efforts should include:

- Conduct a more-detailed analysis of the distribution and abundance of and threats to Morro manzanita, with a coordinated team effort including site visits by USFWS and partners.
- Conserve and protect habitat in vicinity of and near existing stands of Morro manzanita
- Develop and implement site-specific management plans for Morro manzanita habitat within preserves including success criteria for evaluating effectiveness of management.
- Conduct modelling to anticipate the effects of climate change on distribution and abundance of Morro manzanita, including changes in temperature, precipitation, extent of marine fog layer, and sea level rise.
- Develop protocols for long-term restoration success.
    1. Consider using method with seedlings of Sarafian (2011, p. 5), and suggested method for collecting and sowing seeds of Tyler and Odion (2020, p. 164).
    2. In light of the threat of climate change with severe drought and increased temperatures,

consider using methods for cultivating seeds for propagation and outplanting in arid lands used by Abella et al. (2012, entire), Abella et al. (2015, entire), Abella (2017, entire) and Abella et al. (2020, entire).

- Continue studies of the species' relationship with fire.
- Collect seeds for conservation seed banking.
- Introduce Morro manzanita into living collections at several botanic gardens.

APPROVAL

Lead Field Supervisor, Fish and Wildlife Service

Approved STEPHEN HENRY Digitally signed by STEPHEN HENRY Date: 2022.04.19 12:59:11 -07'00'

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