Staff Summary for February 12-13, 2025

13. Morro Manzanita

Today's Item **Information ☐** **Action ☒**

Consider and potentially act on the petition, Department's evaluation report, and comments received to determine whether listing morro manzanita (*Arctostaphylos morroensis*) as endangered under the California Endangered Species Act (CESA) may be warranted.

Summary of Previous/Future Actions

• Received petition	July 20, 2024
• Transmitted petition to Department	July 30, 2024
• Public receipt of petition	August 14-15, 2024
• Approved Department's request for 30-day extension	October 9-10, 2024
• Received Department's 90-day evaluation report	November 14, 2024
• **Today potentially determine petitioned action may be warranted**	**February 12-13, 2025**

Background

In July 2024, the Commission received a CESA petition to list morro manzanita as endangered from Dr. Christopher Kofron and Dr. Claudia Tyler; The Commission transmitted the petition to the Department for an evaluation and recommendation.

California Fish and Game Code Section 2073.5 requires that the Department evaluate the petition and submit a written evaluation with a recommendation to the Commission; the Commission publicly received the Department's evaluation report (exhibits 2 and 3) at its December 2024 meeting. The evaluation report delineates each of the categories of information required for a petition, evaluates the sufficiency of the available scientific information for each of the required components, and incorporates additional relevant information that the Department possessed or received during the review period. Based on the information contained in the petition and other relevant information, the Department concludes that there is sufficient information to indicate the petitioned action may be warranted.

At today's meeting, the Commission will receive a presentation on the Department's petition evaluation, receive a presentation from the petitioners, and hold a public hearing to receive oral testimony. If the Commission determines listing may be warranted, pursuant to Section 2074.2 of the Fish and Game Code the Department will undertake a one-year status review before the Commission can make a final decision on listing.

CESA and the Commission's listing regulation require that the petition contain specific scientific information related to the status of the species. CESA and case law interpreting it make clear that the Commission must accept a petition when the petition contains sufficient information to lead a reasonable person to conclude there is a substantial possibility the requested listing could occur; the requested listing is tied to the species' status, that is, whether the species' continued

existence is in serious danger or is threatened by a number of factors, and in no way relates to economic consequences that might result from listing.

If the Commission determines the petitioned action may be warranted, morro manzanita becomes a candidate for listing as endangered pursuant to Fish and Game Code Section 2074.2. Candidate species are protected during the remainder of the listing process pursuant to Fish and Game Code Section 2085.

Significant Public Comments (N/A)

Recommendation

Commission staff: Determine that listing may be warranted; direct staff to issue a notice reflecting this finding and indicating that morro manzanita is a candidate for endangered species status.

Department: Accept the petition for further consideration under CESA.

Exhibits

1. Petition, received July 22, 2024
2. Department memo, received November 14, 2024
3. Department 90-day evaluation report, dated November 2024
4. Department presentation

Motion

Moved by _____ and seconded by _____ that the Commission, pursuant to Section 2074.2 of the California Fish and Game Code, finds that the petition to list morro manzanita (*Arctostaphylos morroensis*) as an endangered species does provide sufficient information to indicate that the petitioned action may be warranted based on the information in the record before the Commission, and directs staff to issue a notice reflecting this finding and indicating that morro manzanita is a candidate for endangered species status.

OR

Moved by _____ and seconded by _____ that the Commission, pursuant to Section 2074.2 of the California Fish and Game Code, finds that the petition to list morro manzanita (*Arctostaphylos morroensis*) as an endangered species does not provide sufficient information to indicate that the petitioned action may be warranted based on the information in the record before the Commission.

PETITION TO THE STATE OF CALIFORNIA FISH AND GAME COMMISSION
SUPPORTING INFORMATION FOR

Morro manzanita (*Arctostaphylos morroensis)*

Dense stand of Morro manzanita *Arctostaphylos morroensis* in Montaña de Oro State Park. In the background is a *Eucalyptus* grove.

Table of Contents

EXECUTIVE SUMMARY

We recommend that Morro manzanita *Arctostaphylos morroensis* be listed as endangered. This plant species is endemic to the Los Osos area, San Luis Obispo County, California, occurring predominantly on Baywood fine sand. The area has a Mediterranean climate, with cool moist winters and warm dry summers. Fog is common. Temperatures range from ~ 6.5° to 23.5°C, and mean annual rainfall (recorded at Morro Bay Fire Station) is 42.1 cm, with 75% occurring between November and April (Tyler and Kofron 2024). Morro manzanita occurs at elevations <200 m (Parker et al. 2012). The historic geographic range was estimated to comprise 800 to 1,100 ha (USFWS 1994), and approximately 75% of this area is now developed (USFWS 2013). After a fire, Morro manzanita must re-establish from seeds in the soil seed bank, where the proportion of viable seeds to total seeds is very low with an average of 4% (Tyler and Odion 2020). The clearing of Morro manzanita and its habitat for residential development is the primary threat to Morro manzanita. This is an immediate threat. The Los Osos HCP and U.S. Endangered Species Act provide only limited protection for Morro manzanita on private land. Homebuilding would convert portions of the remaining, intact parcels into residential development, likely along with subsequent firebreaks for protection. Fragmentation of the remaining, high density, intact stands for residences, permissible under the Los Osos HCP, would be an irreversible loss of Morro manzanita and habitat (Tyler and Kofron 2024).

1. INTRODUCTION

Morro manzanita *Arctostaphylos morroensis* Wies. & Schreib. is a long-lived, perennial shrub endemic to San Luis Obispo County, southern California, USA. It is an erect evergreen shrub in the heath family, Ericaceae (Fig. 1). It can be distinguished from other species of manzanitas in the vicinity by its persistent shreddy gray bark, densely hairy lower leaf surfaces and leaf bases that are truncate to somewhat cordate (Kauffmann et al. 2021). Individuals, normally one to four meters in height, can become arborescent with old age (Fig 1). In some stands of maritime chaparral where it occurs, Morro manzanita can be the dominant shrub species, but its highly localized distribution has been further reduced to a small portion of coastal California in habitat that is fragmented by development.

The species was listed as threatened under the U.S. Endangered Species Act in 1994 (USFWS 1994) with identified threats being residential and urban development, including lack of protection on private land and lack of management on public lands, competition with invasive non-native plants, and risks of extinction associated with small and isolated populations. It is recognized also as a 1 B.1 rare plant (seriously threatened) by the California Native Plant Society. Research has been conducted on the reproductive ecology (Tyler et al. 2023), germination cues and seedbank dynamics (Tyler and Odion 2020), and early responses to prescribed burning (Odion and Tyler 2002). A recent comprehensive review summarizes what is known about the ecology and current conservation status of the species (Tyler and Kofron 2024).

A continuing threat to the persistence of Morro manzanita is clearing of habitat for conversion to residential development. USFWS (1994) stated "the restricted range and narrow habitat requirements of *A. morroensis*, coupled with continuing alteration, destruction, and fragmentation of habitat, make it vulnerable to becoming endangered in the near future." Although progress has been made in protecting maritime chaparral and coastal scrub with Morro manzanita through establishment of preserves, and federal listing under the ESA, threats by development on private lands remain. In addition, existing management to protect the species on public land is limited. In this petition, we present information to support listing Morro manzanita as an "endangered" species under the California Endangered Species Act (CESA). The protections afforded by CESA would be key to ensuring this species' persistence into the future.

2. RANGE, DISTRIBUTION, AND ABUNDANCE.

Morro manzanita is restricted to a small portion of coastal area in and near Los Osos, San Luis Obispo County, California (Fig. 2). Its distribution is predominantly correlated with the Pleistocene eolian sand mapped as Baywood fine sand (Carpenter and Storie 1928; Soil Conservation Service 1984; Wiegers 2009), where there is no slope to moderate slope (Fig. 3).

The current range of this species has been estimated to comprise ~ 350 ha based on mapped polygons that contain the species at various cover classes (Mullany 1990; LSA Associates 1992). However, Tyler and Odion (1996) pointed out this was an over-representation of the actual existing cover of Morro manzanita because individuals are often present in low-density patches

within a matrix of associated plant communities. In order to estimate the aerial cover of the species alone, Tyler and Odion (1996) recalculated to account for stands with a sparse cover having been equally weighted with stand with high cover. Using previously reported cover classes and estimated acreage of each (from Mullany 1990 and McGuire and Morey 1992) they estimated the species itself actually covered less than 162 ha (Tyler and Odion 1996). As a shrub with multiple stems at the base, sometimes present in dense stands, it is difficult to accurately determine counts of individual Morro manzanitas. However, LSA Associates (1992) used an estimated average individual size of 9 m^2 to propose a total population size of ~153,000. Crawford et al. (2004) estimated number of individuals range from 86,000 to 153,000.

The primary source of information on the geographic range of the species is the CNDDB (CDFW 2021). For Morro manzanita there are six known occurrences, each with an assigned number by CNDDB, which are not in sequence. As knowledge of the species' distribution improved, some previously recognized occurrences have been combined with other occurrences, maintaining the criteria that separate occurrences are >0.4 km from any other occurrence. Thus, the assigned numbers for Morro manzanita occurrences are 1, 4, 9, 18, 20 and 21 (Fig 2). Detailed information on these occurrences, and one new occurrence, were reported in Tyler and Kofron (2024) and summarized below.

For occurrence 1, Wieslander and Schreiber (1939) give the location for paratype specimen (UC1334951/Ben Bolt 644/VTM14631) as "Valencia Peak", collected 23 March 1936. They state the distribution of Morro manzanita as "sandy hills south of Morro Bay, 100 — 400 feet", but Valencia Peak (Montaña de Oro State Park) is 1,345 ft/410 m elevation with soils defined as Lopez very shaly clay loam, 30-75% slope (Soil Conservation Service 1984). Data in the pocket of the herbarium sheet give the following information: 1 mile east-northeast Valencia Peak; verbatim elevation as "400" ft; and habitat as woodland, north slope, and small type Monterey shale. CNDDB states "exact location unknown. mapped as best guess 1 air mile ENE of Valencia Peak". Recent field surveys, reported in Tyler and Kofron (2024), were unsuccessful in locating any Morro manzanita at this location. They suggest "Valencia Peak" or 1 mile east-northeast Valencia Peak are erroneous data and that the presence of Morro manzanita south of Valencia Peak should be investigated to determine if this occurrence remains valid.

Occurrence 4 is in north Los Osos. It is comprised of the Elfin Forest Preserve, the adjacent part of Morro Bay State Park, and private land (CDFW 2021). It is mapped as 16 polygons, mostly according to data from 1980 and 1990 to 1992. Where Morro manzanita is present in this occurrence it is at very low cover, from <1% to 25% cover (Mullany 1990). Estimates of abundance are not available. The majority of private land are residential parcels; here some individual Morro manzanitas are incorporated into residential landscaping (CDFW 2021) but total numbers are likely substantially reduced and their ecological function is unknown.

Occurrence 9 is west of Pecho Valley Road, and south of the west end of Los Osos Valley Road extending to ridges south of Hazard Canyon. This occurrence includes multiple preserve properties as well as private land. It is mapped as 15 polygons, mostly according to map data from 1980 and 1990–1992, with an estimate of >152,200 plants. It comprises the largest occurrence (CDFW 2021).

Occurrence 18 is in Morro Bay State Park. We observed ~ 12 individuals on 28 January 2023. We also observed here Oso manzanita *A. osoensis*. This is the northmost occurrence for Morro manzanita. The rocky, volcanic exposure of porphyritic dacite (igneous rock; Wiegers 2009) is an unusual substrate for the species. The underlying substrate is mapped as Rock outcrop-Lithic Haploxerolls complex (Soil Conservation Service 1984). The only previous observation here was in 1989 (Mullany 1990) with one or a few individuals reported.

Occurrence 20 is/was at coordinates 35.31398, -120.81615, as mapped by Mullany (1990) at the eastern terminus of Freeman Lane in east Los Osos. Tyler and Kofron (2024) reported that this occurrence is now likely extirpated as a result of house and facilities construction at this site in 2005

Occurrence 21 is in Morro Bay State Park. It is 19 m south of the Crespi Trail, on a south facing outcrop of shale (Nelson 2015). Soil Conservation Service (1984) mapped the underlying substrate as Rock outcrop-Lithic Haploxerolls complex. In 2023 Tyler and Kofron (2024) observed ~ 20 individuals at this occurrence, some with flowers and growing with Oso manzanita. The only previous observation of this occurrence was by Nelson (2015), who reported many plants.

Tyler and Kofron (2024) reported one new occurrence in their 2023 field surveys. They confirmed the presence of Morro manzanita along the Manzanita Trail and East Boundary Trail in Montaña de Oro State Park (described in Mullany 1990) at three localities not recorded in CNDDB (CDFW 2021). These were: 35.29106, -120.85267; 35.28797, -120.84735; and 35.29085, -120.84406. The first new locality with ~ 10 individuals is 0.37 km from occurrence 9, and thus would be included in this occurrence. The latter two (eastmost) comprise a new occurrence. The second new locality is 0.59 km from occurrence 9 (thus a new occurrence), and the third with one individual is 0.66 km from occurrence 9. At the second locality, which was at the periphery of a rocky outcrop, we observed ~ 12 individuals of Morro manzanita and several brittle leaf manzanita *A. crustacea* subsp. *crustacea*. The underlying soil type for all three new localities is mapped as Santa Lucia shaly clay loam (Soil Conservation Service 1984). Data for these localities were submitted through online field survey forms to CNDDB, and voucher specimens were deposited in the herbarium at UC Santa Barbara's Cheadle Center for Biodiversity and Ecological Restoration.

Summarizing the findings based on data for all occurrences of Morro manzanita from the CNDDB (CDFW 2021) and their field surveys, Tyler and Kofron (2024) proposed that the location of occurrence 1 was based on erroneous data, and that occurrence 20 is no longer extant. Three of the remaining three occurrences - 18, 21 and the one new occurrence - are small but significant outlying stands at the edges of the species' range. Occurrences 9 and 4 represent at least 98% of this species' area of occupancy, but these include land that has been converted to residential development. This is especially evident in occurrence 4 where many polygons mapped as Morro manzanita in north Los Osos are clearly lined by streets and dominated by houses (Fig 4.) This is also the case for some outlying polygons in occurrence 9 east of Morro Dunes Ecological Reserve Bayview Unit, and west of the Broderson Site. However, occurrence 9 also includes the largest remaining contiguous stands with highest cover (75 to 100%) of Morro manzanita (Mullany 1990). Especially noteworthy from a conservation perspective is that most

of these intact high cover stands are on private land south of the Broderson Site and southwest of Cabrillo Estates.

3. POPULATION TRENDS

The historical geographical range of Morro manzanita was estimated to comprise 800 to 1,100 ha (USFWS 1994). However, by the early 1990's, the area of occupancy was estimated to remain at only ~ 350 ha (Mullany 1990; LSA Associates 1992). This represented a loss of two-thirds of the species' historical geographic range, due to removal of individuals and habitat elimination (Odion and Tyler 2002). By 2013~ three-fourths of the historical habitat had been converted for residential use, resulting in highly fragmented populations (USFWS 2013) (Fig. 4).

Tyler and Odion (1996) Using previously reported cover classes and estimated acreage of each (Mullany 1990; McGuire and Morey 1992), they estimated the species area actually covered less than 162 ha (Tyler and Odion 1996). Whether considering area occupied by the species alone (~162 ha) or the habitat area of occupancy (~350 ha), it is clear that this is a significant reduction from the historical range for Morro manzanita. This substantial reduction in extent of the species, as well as the planned residential development that would lead to further local extirpation, was highlighted in the listing of the species as threatened in 1994 under the US Endangered Species Act (USFWS 1994).

4. LIFE HISTORY

4.1 Species Description. Wieslander and Schreiber (1939) first named and described Morro manzanita, referencing specimens collected in 1936 and 1938 in and near Hazard Canyon south of Morro Bay, an area now in Montaña de Oro State Park. The three collections, including holotype, are filed in the Herbarium at the University of California Berkeley (Wieslander and Schreiber 1939). Additional specimens used by Wieslander and Schreiber (1939) to verify the range are in the herbaria at Stanford University and the California Academy of Sciences.

Morro manzanita is an erect spreading shrub, generally 1 to 4 m in height (Parker et al. 2012), with some older individuals reaching 8.5 m tall. This manzanita species lacks a basal burl, which is both a distinguishing taxonomic characteristic, and indicative of its postfire recovery response (Jepson 1916; Wieslander and Schreiber 1939; Keeley and Zedler 1978). Some woody or shrub species - those with underground/basal burls - have the ability to resprout following fire, while others are non-sprouters that rely on postfire establishment of seedlings from a long-lived dormant seed bank (Wells 1969; Keeley 1991; Whelan 1995). The latter are "obligate seeders", a relatively uncommon life history type found mostly among shrubs in semiarid areas in California, Australia, and South Africa (Bond and van Wilgen 1996). Since the adults are consumed by fire, the persistence of populations of obligate seeders is dependent on the sufficient accumulation of viable seed in the soil seed bank in the interval between fires. Morro manzanita is an obligate-seeding species.

Other distinctive morphological traits include its bark and leaf morphologies. The grayish-brown bark on mature stems is shreddy but persistent. Its leaves are oblong to oblong elliptic (1.5 to 3 cm long), truncate to subcordate at the base (not auriculate clasping), with short petioles (2 to 5 mm). Notably, the leaf surfaces are unlike: dark green, shiny and lacking stomata above, while gray-tomentose on the lower surface (Hoover 1970; Wells 2000; Parker et al. 2012). Wells (1968) determined that Morro manzanita has a base chromosome number of 13 and it is diploid (2n = 26).

4.2 Lifespan. Morro manzanita is slow-growing and long-lived. While maximum lifespan has not been reported, Tyler and Odion (1996) estimated stand ages using historical aerial photographs from the collection in the Map and Imagery Library at the University of California, Santa Barbara. They examined images from 1949 to 1992 to identify areas that had been cleared and/or burned. In addition, cross-sections of co-occurring wedgeleaf ceanothus were collected from the areas where stand age was estimated; this species is an obligate seeder and thus would have germinated following fire, at the same time as the manzanitas present in the stand. The annual ring counts from cross-sections confirmed the minimum stand ages based on aerial photos. In 1996, the stand ages ranged from 37 to >47 years old, with the large tree-like (arborescent) individuals in the Elfin Forest Preserve estimated to be substantially older than 47 years; as described above, some of these individuals are exceptionally large. Since that 1996 report, there has been only one fire in all sites surveyed, a prescribed burn conducted in 1998. Thus, at present the youngest stand is 25 years old, and the oldest stand is a minimum of 74 years old (though most likely it is much older).

4.3 Flowering and pollination. One of the distinctive and distinguishing characteristics of species in the genus *Arctostaphylos* are the "nascent" or immature inflorescences, developed many months before flowering (Jepson 1938; Keeley 1997). In Morro manzanita, these immature panicles are pendent and campanulate (Wieslander and Schreiber 1939; Parker et al. 2012). Small urn-shaped flowers, which are white and occasionally tinged with pink, appear in January through March.

Similar to other obligate-seeding manzanita species (Keeley 1977; Fulton and Carpenter 1979; Mahall et al. 2010), Morro manzanita produces abundant flowers. Tyler et al. (2023) recorded an average of 50 to 135 flowers per stem across a two-year period. Flower production (number of flowers per stem) varies among sites and among years with much higher (two times the average) flower production across sites in a very wet year (1998) compared to a year with below- average rainfall (1999) (Tyler et al. 2023). In Morro manzanita flower production was most strongly related to present year resources (rainfall) (Tyler et al. 2023), which is similar to observations reported for pointleaf manzanita *A. pungens* (Richardson and Bronstein 2012).

Reproduction of Morro manzanita is **dependent on pollinators**. Tyler et al. (2023) found that when inflorescences were bagged to exclude animal pollinators, fruits were not produced. Bees are the most common pollinators of Morro manzanita, and include yellow-faced bumblebees *Bombus vosnesenskii*, the common anthophorid bee *Anthophora urbana*, halictid bees, *Colletes* sp., and European honey bees *Apis mellifera*. Other pollinators observed visiting Morro manzanita flowers include syrphid flies, monarch butterflies *Danus plexxipus*, bee flies

Bombylius sp. and Anna's hummingbird *Calypte anna* (Tyler et al. 2023). This is consistent with research on congeners that demonstrated self-compatibility and reliance on pollinators for successful reproduction – pink bracted manzanita *A. pringlei* var. *drupacea* and *A. glauca* (Brum 1975) and *A. pungens* (Richardson and Bronstein 2012). Bees have also been found to be important pollinators of other manzanita species (Gankin and Major 1964; Brum 1975; Fulton and Carpenter 1979). Morro manzanita's dependence on pollinators, especially insects, has important implications for conservation. The impacts of habitat loss and fragmentation are both direct and indirect, as small populations or isolated stands may experience pollinator limitation and low seed production (Agren 1996; Cunningham 2000; Tyler et al. 2023).

4.4. Fruiting. Fruit set, or the percent of flowers producing a fruit, varies among sites and years, ranging from an annual average of 10 to 18% (Tyler et al. 2023). These data were reported for two adjacent years (1998, 1999), with fruit set being consistent across years for some sites, and varying significantly (5 times higher in one year) at another site. To our knowledge, the only other reported data on fruit set in manzanitas are for *A. pungens* (Richardson and Bronstein 2012), in which highest values for fruit set in control/natural conditions was 36% in 1998, and no fruit set observed in the following year. Thus, although we suspect fruit set is comparatively low in Morro manzanita, longer-term data and data on congeners are lacking in order for this to be confirmed. Seed set, as determined by viable seed to ovule ratios, has been investigated in several species of manzanita by Kelly and Parker (1991). They reported that Morro manzanita has an average of 7.3 ovules per ovary/fruit (each flower contains one ovary in the Ericaceae), and that seed set is relatively high at 73% (Kelly and Parker 1991). This suggests that once pollinated, Morro manzanita successfully produces viable seeds, and that low fruit set may indicate pollinator limitation (Tyler et al. 2023.)

The fruits mature in spring-summer. They are reddish-brown and spherical to slightly flattened, or depressed globose. Morro manzanita fruits are drupes, covered by a thin exocarp, and containing a dry, mealy mesocarp surrounding multiple hard stones or "nutlets" (Meyer 2008; Parker et al. 2012). They contain an average of five (Kelly and Parker 1991) to eight (Tyler and Odion 1996) nutlets (i.e., seeds) per fruit. The nutlets are free to strongly adherent (i.e., partially fused.) Fruit drop occurs in late spring to late fall, though the timing can vary annually. Tyler et al. (2023) found that the majority of fruits fell from the plants during June and early July one year (1998), and August to early October in the following year (1999.)

4.5. Fruit predation. Dropped fruits of Morro manzanita are removed quickly by predators. Tyler et al. (2023) conducted studies of fruit removal rates by vertebrate predators, carried out in two years (1998, 1999). They found that in both years, predators, most likely small mammals and birds, removed a majority of fruits and did it relatively quickly. From 60 to 70% of fruits were removed within 1.5 months in both years. High predation rates have been reported for other species of manzanita (Keeley 1977; Kelly and Parker 1990).

Fruit removal alone does not mean all seeds are eliminated from the site, as some animals may scatter-hoard or cache seeds that could be incorporated into the soil seed bank (Parker 2015; Crowe and Parker 2023). However, in Morro manzanita it is unknown if such a mutualistic relationship exists, and some evidence points to consumers as seed predators rather than planters. For example, sites where seed bank density is exceptionally low (Elfin Forest) have the highest

rates of fruit removal (Tyler and Odion 2020; Tyler et al. 2023). In addition, relatively few Morro manzanita seeds are found in the soil away from the shrub canopies, and overall viable seed densities can be very low (Tyler and Odion 2020), suggesting that predation of a large fraction of fruits, even if some were buried and forgotten, could have a net negative impact.

4.6. Seed input and seed banks. Based on seed drop, seed predation rates, and estimates of the number of seeds per fruit for Morro manzanita, Tyler et al. (2023), estimated annual seed input to the soil seed bank over two years (1998 and 1999). The relative addition of seeds across years was similar at all sites (i.e., about 1.5 times greater in 1998 compared to 1999). However, seed input varied considerably among sites, and **rates appear to decline with stand age**. Annual seed input was at least 4 times lower at the oldest-aged stand at the Elfin Forest (316 seeds per m^2 in 1998) compared to the youngest stand in Montaña de Oro State Park (1,608 seeds per m^2 in 1998). The intermediate-aged stand had an intermediate value with an estimated seed input of 912 seeds per m^2 in this same year.

Tyler and Odion (2020) examined soil seed banks in different-aged stands, predicting that seed densities would be positively correlated with stand age. Soil cores (10 cm depth) were collected under multiple shrubs across three sites. Morro manzanita seed density in the soil varied greatly among sites, from 1,326 to 62,251 seeds per m^2. However, contrary to expectations, the oldest had especially low seed densities (Tyler and Odion 2020). Since seed input, as described above, was particularly low in the oldest stand, seed densities in the soil seedbank may decline even further. There has been one other study (Parker and Ingalls 2022) that reported seed bank densities of Morro manzanita. In their comparative study of ten *Arctostaphylos* species to investigate the relationship between seed size and seed bank density, Parker and Ingalls (2022) collected Morro manzanita seed and estimated the seed bank density (for 5 cm deep cores) to be an average of 1,900 per m^2. Although the location of their collections is not reported, if this value is doubled to make an equivalent comparison to results reported by Tyler and Odion (2020), their finding of a seed density of ~ 3,800 per m^2 is within the same range. Further study is warranted to investigate change in soil seedbanks over time. In addition, understanding the dynamics of fruits and seed accumulation in the litter layer would be useful as this may be a potential seed source for restoration efforts.

4.7. Seed viability and germination cues. Percent viability of Morro manzanita seeds, i.e., the proportion of viable to total seeds, within the soil seed bank is **very low** across all stands, with an average of 4% (Tyler and Odion 2020). The oldest stand (the Elfin Forest) has exceptionally low seed viability averaging 2%. Viability of fresh seeds has not been recorded in the literature, so rates of change with seed age are unknown.

Morro manzanita is an obligate-seeder, meaning that it does not resprout when the crown and stem are burned, and thus must re-establish from seeds in the soil seed bank. Seeds of obligate-seeders are mainly or even completely refractory (Sweeney 1956; Keeley 1987; Keeley 1991); that is, germination is inhibited until primary dormancy is released by a specific mechanism. Fire-related cues such as heat and by-products of combustion have been identified as principal mechanisms that break seed dormancy of fire recruiters that rely on soil-stored seed (Keeley 1991). In other manzanita species, germination rates are low, but enhanced with smoke, charate, heat shock, or some combination of these treatments (Odion 2000; Keeley et al. 2005; Jurado et

al. 2011). Tyler and Odion (2020) examined germination of Morro manzanita seeds in response to various cues, and confirmed that germination, while very low on average (1 to 4%), was greatest in treatments that combined heat and charred wood. However, neither heat nor charred wood alone enhanced germination (Tyler and Odion 2020.) One factor responsible for low germination is that seed viability is very low – from 3 to 6%. Germination as a percentage of estimated viable seeds was found to be relatively high (23 to 100%). Unexpectedly, ~ 40% of viable seeds from the soil seed bank germinated with no fire treatments. Viability and germinabilty of fresh Morro manzanita seed has not been investigated. Although fresh and litter-stored seeds are unlikely to contribute to post-fire seedling establishment, as they would be consumed in a burn, this seed source might be used in restoration purposes; thus, study of its viability rates and germination cues is recommended.

4.8. Response to and recovery from fire. To assess the effects of burning on seedling establishment in Morro manzanita, a prescribed fire was conducted by California State Parks in Montaña de Oro State Park in 1998. At the time of the burn, the stand was 40 years-old. The total area burned was ~ 2.3 ha. Odion and Tyler (2002) recorded pre-burn seed densities and seed viabilities, seed mortality due to fire, and postfire germination and seedling survivorship for three years, to compare the population that established after the burn with the one present before.

Prior to the burn, there was abundant soil-stored seed, ~ 11,000 seeds per m^2, though seed viability in this stand (and all others) was low, resulting in an average of 334 viable seeds per m^2 before the fire (Odion and Tyler 2002). As was expected, seed mortality through the burn was high, and following the experimental fire only about a third remained, leaving an average of 99 viable seeds per m^2. Germination was recorded in the first two wet seasons after the fire, though most seedlings did not survive their initial summer drought. After three years, the density of Morro manzanita seedling was less than half the estimated density of the adult shrubs present before the fire. The authors speculated that the most likely factors responsible for the low number of seedling recruits were low numbers of viable seed in the soil, and relatively high mortality of both germinants and young seedlings. Based on early postfire observations, Odion and Tyler (2002) suggested that with further mortality of the remaining seedlings and no additional germination, the 40-year-old stand may not have had an adequate seed bank to compensate for mortality and thus prevent population decline.

To improve understanding of long-term post-fire recovery of Morro manzanita, Tyler and Kofron (2024) resampled the stand burned in 1998. Twenty-five years post-burn they found that cover of Morro manzanita along the original vegetation transects was high, ranging from 30% to 100%, with a median of 93%, and mean of 83% cover Morro manzanita. This was substantially greater than three years after the burn, when Morro manzanita seedlings accounted for < 1% cover. This longer-term survey suggests that this stand is recovering slowly but successfully from the fire, at least in terms of percent cover of Morro manzanita.

While this stand was relatively young (40 years old) at the time of the prescribed fire, seedbank densities and subsequent seedling recruits may have indeed been adequate to restore cover of adults killed in the burn. Findings reported by Tyler and Kofron (2024) highlight that while early post-fire sampling is appropriate and useful, to accurately determine the response to fire in long-lived obligate-seeding species, much longer time scales of observation, on the order of decades,

are required. Their recent survey also indicates that burning should not be avoided as a management tool in supporting restoration of Morro manzanita, though stand age should be an important factor in considering the appropriate use of fire for a particular area. Odion and Tyler (2002) and Tyler and Kofron (2024) recommend against burning stands that are much younger than 40 years; another decade or so of seed input may have substantially increased the viable seed and thus potential seedling recruits in the prescribed burn stand. At this time, since nearly all stands containing Morro manzanita are at least 74 years old, with the exception of the 2 ha area described above, prescribed fire may be one of the most effective tools in ensuring the regeneration of new individuals in aging stands. This approach may not be feasible in some sites where there is close proximity to residential development, such as the Elfin Forest Preserve, even though these oldest stands may be experiencing declining soil seedbanks over time (Tyler and Odion 2022). In such sites, exposing seedbanks to fire-related cues to stimulate germination, using small scale approaches such as burn boxes, or treating soil off-site could be suitable alternatives.

5. KIND OF HABITAT NECESSARY FOR SURVIVAL

Morro manzanita is found only along a small portion of the Central California coast at elevations <200 m (Parker et al. 2012), primarily on stabilized sand dunes of Baywood fine sand (Carpenter and Storie 1928; Soil Conservation Service 1984; Wiegers 2009), with few outlying locations on outcrop shale or volcanic igneous substrate. The climate is Mediterranean, with cool moist winters and warm dry summers. Fog is common, and has been found to play a key role in determining the physiological performance of *Arctostaphylos* species (Vasey et al. 2014). Temperatures range from ~ 6.5º to 23.5ºC, and mean annual rainfall (recorded at Morro Bay Fire Station) is 42.1 cm, with 75% occurring between November and April (Tyler and Kofron 2024). The factors influencing species composition in the community types hosting Morro manzanita have not been investigated, but likely include soil characteristics, fog frequency, patch size, time since fire, and extent of soil disturbance or mechanical clearing.

6. FACTORS AFFECTING ABILITY TO SURVIVE AND REPRODUCE

6.1. Seedbank density and seed viability. Morro manzanita is an obligate-seeder, meaning that it does not resprout when the crown and stem are burned, and thus must re-establish from seeds in the soil seed bank. Percent viability of Morro manzanita seeds, i.e., the proportion of viable to total seeds, within the soil seed bank is very low across all stands, with an average of 4% (Tyler and Odion 2020).

6.2. Reproductive issues in isolated stands. Tyler and Odion (2020) found that seed from Morro manzanita in the most isolated stand, the Elfin Forest Preserve, had significantly lower seed viability compared to other stands, 2% vs. 4%, respectively. They hypothesized that low seed viability and high ‘‘infertility’’ (no evidence of embryo development) at the isolated stand may have been caused by inbreeding effects. Tyler et al. (2023) also reported especially low fruit

set at this isolated stand. Given the dependence of Morro manzanita on pollinators for successful reproduction (Tyler et al. 2023), the authors suggest that pollinator limitation may pose a threat to adequate fruit and seed production, particularly in small, isolated stands.

6.3. Clearing of habitat for residential development. Clearing of habitat for residential development, including the direct removal of Morro manzanitas is the **primary threat** to this species. Conversion of the remaining, high density, intact stands to residences under the Los Osos HCP would be an irreversible loss of Morro manzanita and habitat. In addition, clearing exacerbates the negative impacts of existing fragmentation by further reducing the patch sizes of and connections among the remaining stands (Tyler er al. 2023).

7. DEGREE AND IMMEDIACY OF THREAT

7.1. Clearing of habitat for residential development. A threat to the persistence of Morro manzanita and a primary factor in its Federal listing is clearing of habitat for residential development. USFWS (1994) stated "the restricted range and narrow habitat requirements of *A. morroensis*, coupled with continuing alteration, destruction, and fragmentation of habitat, make it vulnerable to becoming endangered in the near future." Although progress has been made in protecting maritime chaparral and coastal scrub with Morro manzanita through establishment of preserves, threats by development on private lands remain. One of the largest remaining intact areas with high cover of Morro manzanita is on private land. Conversion of these stands to residences would be an irreversible loss of both Morro manzanita individuals and habitat capable of supporting this species. Such loss of habitat exacerbates the current negative impacts of fragmentation including reduced movement of pollinators and other associated species.

In addition, alteration of the habitat on private land adjacent to housing, due to current fire management practices, extends negative impacts into intact Morro manzanita stands. California's new code section 51179 requires homeowners in areas at high risk of wildfire to maintain a defensible space around their homes, which is an area free of excess or dead vegetation. Ninety-five percent of occurrence 9 is an area designated very high risk, which is the most severe category. This includes the following housing estates in Los Osos: Vista Court, Cabrillo Estates, the Seascape Place/Rodman Drive area, Bayview Heights, and Marguerite Drive mobile homes area. A homeowner must maintain a combustible-free zone of 1.5 m from the house, a lean/clean/green zone within 9 m feet of the house, and reduce potential fuel within 30 m feet of the house (Kerstein 2021; Calif. Dept. Forestry Fire Prevention 2023). In 2019, a fire break (30 m wide) was constructed around the eastern edge of Cabrillo Estates, in which most vegetation was cleared and Morro manzanita severely pruned, removing the majority of shrub canopies and removing low branches contacting the ground. CA Department of Forestry and Fire Prevention is currently proposing to extend this firebreak to encompass the Seascape Place/Rodman Drive area along Pecho Valley Road, and construct another firebreak from Cabrillo Estates eastward to the vicinity of Los Osos Oaks State Natural Reserve. Such intensive removal of manzanita biomass converts this former maritime chaparral habitat to open landscaping with denuded shrub-like specimens. The functional ecological value of these pruned manzanitas is unknown, though without doubt their reproductive output will be substantially reduced and habitat for associated

wildlife will be altered. The original listing for Morro manzanita (USFWS 1994) acknowledged the past and future potential for such deleterious impacts stating that "in addition to direct removal of habitat, development has had secondary effects on quality of adjacent remaining habitat, such as fragmentation, deterioration of habitat due to increased recreational activity, and the introduction of non-native species." Clearing for firebreaks around residences that are adjacent to high cover Morro manzanita stands is another such secondary impact that poses a potential threat to the species. While maintaining defensible space is an important and valid public safety concern, it would be beneficial to explore alternatives to severe thinning of manzanitas beyond the 9 m requisite border, or to consider mitigation of impacts off-site.

7.2. Non-native, invasive plant species. Non-native, invasive plant species remain a threat to Morro Manzanita since listing in 1994 (USFWS 1994). Species include iceplant *Carpobrotus* sp., veldt grass *Ehrharta calcina*, and *Eucalyptus* spp. The latter is especially problematic. *Eucalyptus* plantations, as well as small stands, were planted in the early 1900's in Los Osos and within what is now Montaña de Oro State Park (Hook 1988). Based on soils, Baywood fine sands, and adjacent vegetation, it is very likely these were planted in sites formerly occupied by Morro manzanita (Mullany 1990). Where extensive *Eucalyptus* plantings abut dense Morro manzanita stands, few mature manzanitas remain under *Eucalyptus* canopy and there is no regeneration there, perhaps due to competition for water or other biotic factors (Mullany 1990.) Also concerning is that expansion of *Eucalyptus* has been documented. In 1949 *Eucalyptus* covered 48.3 ha, by 1986 it had expanded to 73.5 ha (Bicknell 1990), and by 2021 it had further expanded to 141.6 ha (McFadden 2021). Finally, the extensive *Eucalyptus* plantations in Montaña de Oro State Park are highly flammable, and thus pose a wildfire risk. While Morro manzanita is adapted to fire, burning at increased frequencies (i.e., fire intervals under 40 years) could lead to population declines. Dense cover of veldt grass poses a similar risk of altering fire regimes to the detriment of both Morro manzanita and other components of maritime chaparral and dune scrub; similar impacts of invasive species have been documented across a variety of plant communities (Brooks et al. 2004). At the same time, the current *Eucalyptus* plantations offer opportunities for restoration and expansion of Morro manzanita. Removal of at least portions of these plantations followed by seeding or planting with Morro manzanita would allow for re-establishment of this species into its former habitat. Potential locations for the initiation of such efforts would be the edges of *Eucalyptus* stands that have been recently thinned, such as along the East Cable Trail east of Pecho Valley Road in Montaña de Oro State Park. Here, intact Morro manzanita stands persist at the outer edges of the plantations, and removal of 10 to 20 *Eucalyptus* could provide 100 m^2 of area to replant manzanitas, gradually reducing the area occupied by the plantations along the accessible periphery.

7.3. Stochastic events. Stochastic events was identified as a main threat for Morro manzanita at listing (USFWS 1994) because of the negative effects that impact small, isolated populations. Environmental stochastic events that could reduce abundance of Morro manzanita would include wildfires that occur at intervals too short for adequate seedbank stores to accumulate. Frequent fires have not been observed in the area, but increased spread of invasive grasses or flammable *Eucalyptus* species could alter the natural fire regime. Demographic stochasticity refers to random fluctuations in reproduction and mortality, and in small populations these fluctuations can result in reduced growth rates (e.g., allee effect). Although further study is warranted, Tyler and Odion (2020) found that seed from Morro manzanita in the most isolated stand, the Elfin

Forest Preserve, had significantly lower seed viability compared to other stands, 2% vs. 4%, respectively. They hypothesized that low seed viability and high ‘‘infertility’’ (no evidence of embryo development) at the isolated stand may have been caused by inbreeding effects. Small, fragmented plant populations are susceptible to increased genetic drift and inbreeding (Sampson et al. 2016), which compromises plant reproduction (Aguilar et al. 2006). This may be particularly true for Morro manzanita, which is dependent on localized insect pollination (Tyler et al. 2023).

7.4. Climate change. Climate change may present a new threat to Morro manzanita. Langridge (2018) provided a comprehensive assessment of how climate change will affect California's Central Coast, including increased maximum/minimum temperatures, uncertainty in fog, slightly increased precipitation with substantially increased variability, increased extreme rainfall events, accelerated sea level rise, increased drought, and frequent and sometimes large wildfires. Mortality and stem die-off of several large Morro manzanitas in the Elfin Forest Preserve were observed since 2015, which may have been associated with the extremely low rainfall (P. Sarafian pers. comm. 2021) The tolerance of Morro manzanita to climate change is unknown, however, it is a habitat specialist in the coastal zone with marine fog. Morro manzanita cannot disperse to distant locations because it has a small geographic range and endemic soil requirements.

7.5. Sudden Oak Death pathogen *Phytophthora ramorum*. Lee et al. (2019) and Frankel et al. (2020) reported the sudden oak death pathogen affecting multiple species of *Arctostaphylos*, including Morro manzanita in the botanic gardens of the University of California Santa Cruz in 2017 (M. Garbelotto pers. comm. 2022). 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. Among eight species of *Arctostaphylos* tested for susceptibility, Morro manzanita was intermediate (Garbelotto et al. 2020). Although no infected plants of any species have been found in the wild in San Luis Obispo County, the nearest infections are 3 km north of the county line in Salmon Creek Canyon, southwest Monterey County (M. Garbelotto pers. comm. 2022), which is 72 km north of the nearest occurrence of Morro manzanita (occurrence 18). However, since 2019 the pathogen has been detected by polymerase chain reaction in four streams in coastal San Luis Obispo County: Santa Rosa Creek (also known as Old Creek), 14.8 km north of occurrence 18 (6.6 km northwest of Cayucos); 34 km northwest of occurrence 18; San Simeon Creek, 38 km northwest of occurrence 18; and San Carpoforo Creek, 63 km northwest of occurrence 18. Despite intensive searches, no infected vegetation has been found in the watersheds (K. Corella pers. comm. 2023). Continued monitoring for the presence of this pathogen would be prudent since the potential consequences could be substantial.

8. IMPACT OF EXISTING MANAGEMENT ACTIONS

Since the listing of Morro manzanita in 1994, California State Parks and CDFW have acquired substantial amounts of land for conservation in the vicinity of Morro Bay, including lands occupied by Morro manzanita. There are currently eight preserves that include significant cover of the species, and these are managed by three different agencies – California State Parks,

California Department of Fish and Wildlife, and the County of San Luis Obispo. The preserves are distributed across the Conservation Planning Areas. Approximately half of this area with Morro manzanita is managed by California State Parks, with their largest preserve (Montaña de Oro State Park) included within the South Los Osos and West Pecho Conservation Areas.

The private land south of the Broderson Site and southwest of Cabrillo Estates supports high cover (75 to 100%) of Morro manzanita (Mullany 1990). This encompasses the most substantial portion of remaining unfragmented, intact hectares of Morro manzanita outside of preserves. Protecting these existing core high-density stands from human-induced threats would contribute greatly toward conservation of this species. The Los Osos HCP and U.S. Endangered Species Act can provide only limited protection for Morro manzanita on private land. Homebuilding would convert portions of the remaining, intact parcels into residential development, along with likely subsequent firebreaks for protection. This is an **immediate threat**.

9. SUGGESTIONS FOR FUTURE MANAGEMENT

(1) Conserve and protect existing stands of Morro manzanita, with an emphasis on the largest remaining intact areas with high cover of Morro manzanita. The Los Osos HCP and U.S. Endangered Species Act can provide only limited protection for Morro manzanita on private land. The remaining, intact parcels with Morro manzanita in occurrence 9 should be acquired for conservation management by California State Parks, California Department of Fish and Wildlife, or local land trust.
(2) Encourage discussion with USFWS prior to fuel reduction impacting intact Morro manzanita stands in Los Osos, such as that conducted by CA Department of Forestry and Fire Prevention.
(3) Conduct field surveys to improve the data on current distribution and abundance for Morro manzanita. This should include verifying presence/absence of Morro manzanita in isolated patches mapped across Los Osos residential areas and others, as well as recording new locations. Submit these findings to CNDDB.
(4) Develop and implement site-specific management plans for Morro manzanita within preserves, including success criteria for evaluating effectiveness of management.
(5) Develop protocols for long-term restoration success of Morro manzanita. Conduct research on viability and germination requirements of freshly collected manzanita seed to aid in restoration efforts.
(6) Identify potential restoration sites across conservation planning areas both within protected areas to direct the management efforts there, and within private land to be considered within potential habitat conservation plans. Investigate options for restoring connectivity between fragmented stands, including re-establishment of associated native plant and animal species.
(7) Conduct research to describe the genetic diversity within and among existing stands/patches. If warranted by results of genetic diversity, when planting Morro manzanita for restoration, consider introducing some individuals, generated from seed or cuttings, from non-adjacent stands to enhance gene flow and genetic diversity, especially for isolated stands.
(8) Remove *Eucalyptus* and re-establish Morro manzanita where feasible in the southwest part of the range including sites along Pecho Valley Road. Potential *Eucalyptus* selected for removal

would exclude those individuals identified as Monarch butterfly roost sites or important wind breaks.
(9) Coordinate and share information between agencies, researchers and citizen groups including the San Luis Obispo Chapter of the California Native Plant Society, and Friends of El Moro Elfin Forest, who are involved with outreach and conservation of Morro manzanita.
(10) Continue studies of the relationship of Morro manzanita with fire.
(11) Conduct prescribed burns of vegetation in Los Osos to reduce the risk of wildfire. This would also benefit Morro manzanita by stimulating germination and establishment of new seedlings.
(12) Conduct modeling to anticipate effects of climate change on distribution and abundance of Morro manzanita, including changes in temperature, precipitation, amount and extent of marine fog, and sea level rise.
(13) Collect seeds of Morro manzanita for conservation seed banking.
(14) Introduce Morro manzanita (with representative genetic diversity) into living collections at several botanic gardens.

10. REFERENCES AND SOURCES OF INFORMATION

Agren, J. 1996. Population size, pollinator limitation, and seed set in the self-incompatible herb *Lythrum salicaria.* Ecology 77(6):1779-1790.

Aguilar, R., L. Ashworth, L. Galetto and M.A. Aizen. 2006. Plant reproduction susceptibility to habitat fragmentation: review and synthesis through a meta-analysis. Ecology Letters 9:968-980.

Bicknell, S.H. 1990. Montaña de Oro State Park presettlement vegetation mapping and ecological status of *Eucalyptus*: final report. Submitted to Calif. Dept. Parks Recreation. 80 pp.

Bond, W.J. and B.W. van Wilgen. 1996. Fire and plants. Chapman and Hall, New York, New York.

Brooks, M.L., C.M. D'Antonio, D.M. Richardson, J.B. Grace, J.E. Keeley, J.M. DiTomaso, R.J. Hobbs, M. Pellant and D. Pyke. 2004. Effects of invasive alien plants on fire regimes. BioScience 54(7):677-688.

Brum, G.D. 1975. Floral biology and pollination strategies of *Arctostaphylos glauca* and *A. pringlei* var. *drupacea* (Ericaceae). Ph.D. dissertation. University of California, Riverside, CA. 134 pp.

California Department of Fish and Wildlife (CDFW). 2021. California Natural Diversity Database: Special vascular plants, bryophytes, and lichens list. Sacramento, CA. 156 pp.

California Department of Forestry and Fire Prevention. 2023. Defensible space: practical ways to protect your home from wildfire. https://www.fire.ca.gov/dspace [accessed 28 July 2023].

Carpenter, E.J. and R.E. Storie. 1928. Soil survey of the San Luis Obispo area, California. Bureau of Chemistry and Soils, U.S. Department of Agriculture. Washington, D.C. 60 pp.

Crawford, Multari, Clark Associates. 2004. Los Osos Habitat Conservation Plan, Species Accounts, Appendix D [draft]. Prepared for Los Osos Community Services District, San Luis Obispo County, California. San Luis Obispo, Calif. 309 pp.

Crowe, R. and V. Parker. 2023. The morphological and ecological variation of *Arctostaphylos* (Ericaceae) fruit: a link between plant ecology and animal foraging behavior. Ecology and Evolution 13(3): e9801.
Cunningham, S.A. 2000. Effects of habitat fragmentation on the reproductive ecology of four plant species in Mallee woodland. Conservation Biology 14(3):758-768.
Frankel, S.J., J. Alexander, D. Benner, J. Hillman and A. Shor. 2020. *Phytophthora* pathogens threaten rare habitats and conservation plantings. Sibbaldia, International Journal of Botanic Garden Horticulture 18:53–65.
Fulton, R.E. and F.L. Carpenter. 1979. Pollination, reproduction, and fire in *Arctostaphylos*. Oecologia 38:147-157.
Gankin, R. and J. Major. 1964. *Arctostaphylos myrtifolia*, its biology and relationship to the problem of endemism. Ecology 45(4):792-808.
Garbelotto, M., T. Popenuck, B. Hall, W. Schweigkofler, F. Dovana, R. Goldstein de Salazar, D. Schmidt and L.L. Sims. 2020. Citizen science uncovers *Phytophthora ramorum* as a threat to several rare or endangered California manzanita species. Plant Disease 104:3173–3182.
Hook, D. 1988. Montaña de Oro State Park General Plan. Prepared for California Department of State Parks and Recreation. 212 pp.
Hoover, R.F. 1970. The Vascular Plants of San Luis Obispo County, California. University of California Press. 350 pp. "*Arctostaphylos morroensis*" pp. 215-216.
Jepson, W.L. 1916. Regeneration in manzanita. Madroño 1(1): 3-12.
Jepson, W.L. 1938. Embryonic panicles in *Arctostaphylos*. Erythea 8: 97-99.
Jurado, E., M. Márquez-Linares and J. Flores. 2011. Effect of cold storage, heat, smoke and charcoal on breaking seed dormancy of *Arctostaphylos pungens* HBK (Ericaceae). Phyton-Revista Internacional de Botanica Experimental 80:4-11.
Kauffmann, M., V.T. Parker and M. Vasey. 2021. Field Guide to Manzanitas: California, North America, and Mexico. Backcountry Press. 176 pp.
Keeley, J.E. 1977. Seed production, seed populations in soil, and seedling production after fire for two congeneric pairs of sprouting and nonsprouting chaparral shrubs. Ecology 58:820-829.
Keeley, J.E. 1987. Role of fire in seed germination of woody taxa in California chaparral. Ecology 68(2):434-443.
Keeley, J.E. 1991. Seed germination and life history syndromes in the California chaparral. The Botanical Review 57:81-116.
Keeley, J.E. 1997. Absence of nascent inflorescences in *Arctostaphylos pringlei*. Madroño 44(1):109-111.
Keeley, J.E., T.W. McGinnis and K.A. Bollens. 2005. Seed germination of Sierra Nevada postfire chaparral species. Madroño 52(3):175-181.
Keeley, J.E. and P.H. Zedler. 1978. Reproduction of chaparral shrubs after fire: a comparison of sprouting and seeding strategies. American Midland Naturalist 99(1):142-161.
Kelly, V.R. and V.T. Parker. 1990. Seed bank survival and dynamics in sprouting and nonsprouting *Arctostaphylos* species. American Midland Naturalist 124:114-123.
Kelly, V.R. and V.T. Parker. 1991. Percentage seed set, sprouting habit and ploidy level in *Arctostaphylos* (Ericaceae). Madroño 38(4):227-232.
Kerstein, H. 2021. Reducing the destructiveness of wildfires: promoting defensible space in California. Sacramento, Calif. 38 pp.

Langridge R. 2018. Central Coast Summary Report. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-006. University of California, Santa Cruz. 115 pp.
Lee C.A., S.J. Frankel and D.M. Rizzo. 2019. *Phytophthora ramorum* and congenerics: global threats to oaks. International Oaks (30):349–356.
LSA Associates, Inc. 1992. An assessment of the status of the Morro manzanita (*Arctostaphylos morroensis*). Prepared for Central Coast Engineering, San Luis Obispo, California. Irvine, Calif. 9 pp.
Mahall, B.E., L.K. Thwing and C.M. Tyler. 2010. A quantitative comparison of two extremes in chaparral shrub phenology. Flora-Morphology, Distribution, Functional Ecology of Plants 205(8):513-526.
McGuire, T. and S.C. Morey. 1992. Report to the Fish and Game Commission on the status of Morro Bay Manzanita (*Arctostaphylos morroensis*). State of California, The Resources Agency, Department of Fish and Game. 47 pp.
Meyer, S.E. 2008. *Arctostaphylos* Adans. manzanita. Pp. 266-270 in The Woody Plant Seed Manual. (Bonner, F. T., R.P. Karrfalt & United States Forest Service, ed.). Washington, D.C.: U.S. Dept. of Agriculture, Forest Service. 1228 pp.
Mullany, M. 1990. The distribution and variation of *Arctostaphylos morroensis* (Ericaceae). Master's thesis, California Polytechnic State University, San Luis Obispo, CA. 101 pp.
Nelson, K. 2015. California Native Species Survey Form: *Arctostaphylos morroensis*, date of field work 06/20/2015. Record in California Natural Diversity Database, Calif. Depart. Fish And Wildlife, Sacramento, CA.
Odion, D.C. 2000. Seed banks of long-unburned stands of maritime chaparral: composition, germination behavior, and survival with fire. Madroño 47(3):195-203.
Odion, D. and C. Tyler. 2002. Are long 1147 fire-free periods needed to maintain the endangered, fire-recruiting shrub *Arctostaphylos morroensis* (Ericaceae)? Conservation Ecology 6(2):4.
Parker, V.T. 2015. Dispersal mutualism incorporated into large-scale, infrequent disturbances. PLoS One 10(7):e0132625.
Parker, V.T. and S.B. Ingalls. 2022. Seed size–seed number trade-offs: influence of seed size on the density of fire- stimulated persistent soil seed banks. American Journal of Botany 109(3):486-493.
Parker, V.T., M.C. Vasey and J.E. Keeley. 2012. *Arctostaphylos*. Pp. 686-702 in The Jepson manual: vascular plants of California, 2nd edition. University of California Press. 1568 pp.
Richardson, L. and J.L. Bronstein. 2012. Reproductive biology of pointleaf manzanita (*Arctostaphylos pungens*) and the pollinator-nectar robber spectrum. Journal of Pollination Ecology 9:115-123.
Sampson, J., M. Byrne, N. Gibson and C. Yates. 2016. Limiting inbreeding in disjunct and isolated populations of a woody shrub. Ecology and Evolution 6:5867-5880.
Soil Conservation Service. 1984. General soil map. San Luis Obispo Co., California, coastal part. United States Department of Agriculture.
Sweeney, J.R. 1956. Response of vegetation to fire. UC Pub. Bot. 28:143-250.
Tyler, C.M. and C.P. Kofron. 2024. Ecology and conservation status of Morro manzanita *Arctostaphylos morroensis*: a threatened plant endemic to Los Osos, San Luis Obispo

County, California. Bulletin of the Southern California Academy of Sciences 123(1):25-52.
Tyler, C.M., D.E. Meade and D.C. Odion. 2023. Flowering, fruit set and seed predation in *Arctostaphylos morroensis,* a rare obligate-seeding shrub. Madroño 70(4):197-209.
Tyler, C.M and D.C Odion. 1996. Ecological studies of Morro Manzanita (*Arctostaphylos morroensis*). Report prepared for the California Department of Fish and Game, Endangered Plant Program. 46 pp.
Tyler, C.M. and D.C. Odion. 2020. Seed banks, seed germination, and implications for conservation of the endangered, fire-dependent shrub, *Arctostaphylos morroensis*. Natural Areas Journal 40(2):155-167.
U.S. Fish and Wildlife Service (USFWS). 1994. Endangered and threatened wildlife and plants; endangered or threatened status for five plants and the Morro shoulderband snail from western San Luis Obispo County, California. Fed. Register 59:64613–64623.
U.S. Fish and Wildlife Service (USFWS). 2013. *Arctostaphylos morroensis* (Morro manzanita). 5-year review: summary and evaluation. Ventura, Calif. 21 pp.
Vasey, M.C., V.T. Parker, K.D. Holl, M.E. Loik and S. Hiatt. 2014. Maritime climate influence on chaparral composition and diversity in the coast range of central California. Ecology and Evolution 4(18):3662-3674.
Wells, P.V. 1968. New taxa, combinations, and chromosome numbers in *Arctostaphylos* (Ericaceae). Madroño 19(6):193-210.
Wells, P.V. 1969 The relation between mode of reproduction and extent of speciation in the woody genera of the California chaparral. Evolution 23:264-267.
Wells, P.V. 2000. The manzanitas of California: also of Mexico and the world. Published by the author. 151 pp.
Whelan, R.J. 1995. The ecology of fire. Cambridge University Press, Cambridge, Great Britian.
Wiegers, M.O. 2009. Geologic map of the Morro Bay south 7.5' quadrangle, San Luis Obispo County, California: a digital database (version 1.0). Sacramento: California Geological Survey.
Wieslander, A. E. and B.O. Schreiber. 1939. Notes on the genus *Arctostaphylos*. Madroño 5(1):38-47.

11. FIGURES AND DETAILED DISTRIBUTION MAPS

Figure 1. Morro manzanita *Arctostaphylos morroensis*: top, in coastal maritime community at Montaña de Oro State Park; and bottom, tree-like individual on the north-facing slopes of the Morro Dunes Ecological Reserve Bayview Unit. The person standing in the bottom photo is 1.86 m tall.

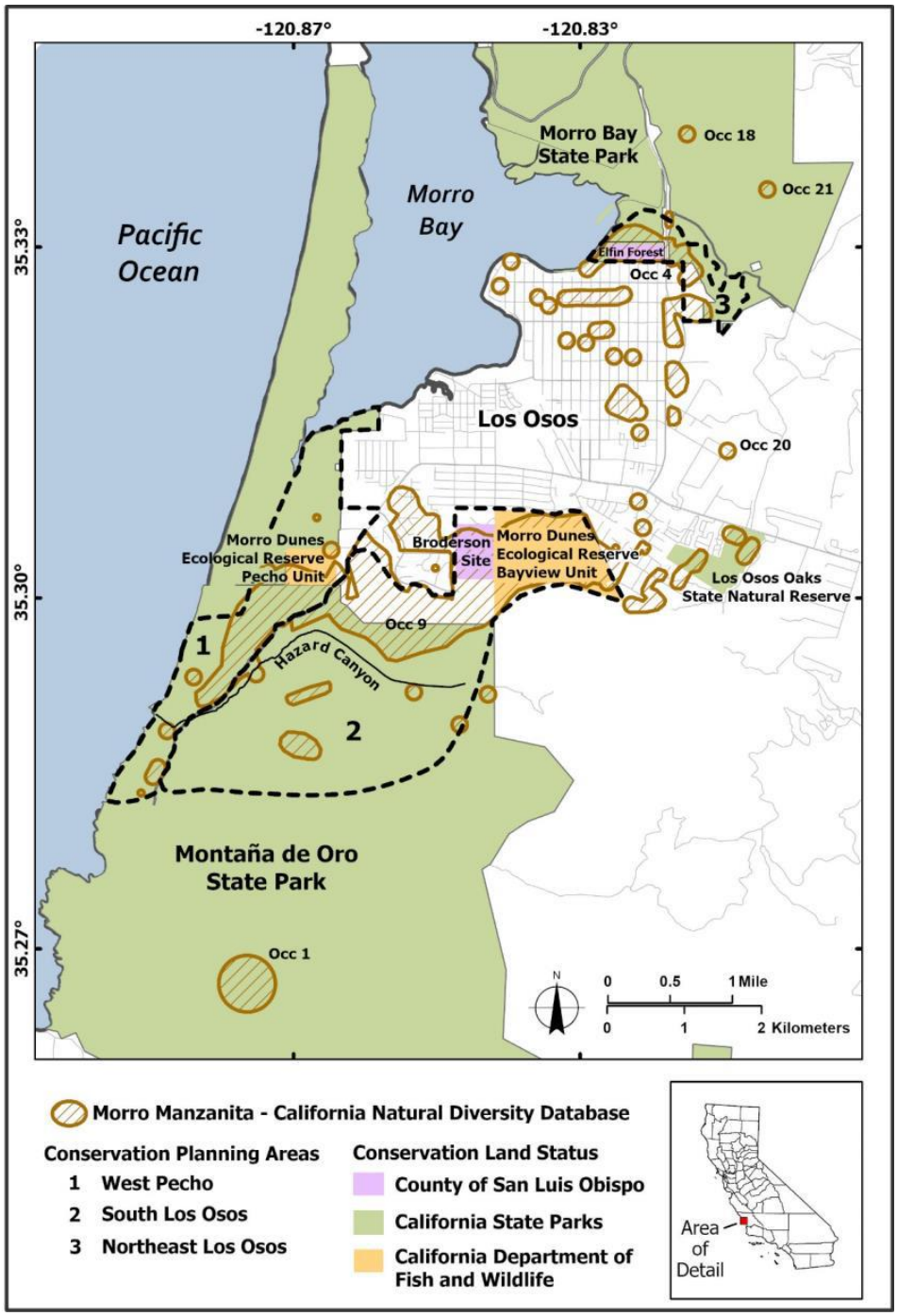


Figure 2. Geographic distribution of Morro manzanita *Arctostaphylos morroensis* in west San Luis Obispo County, California, showing conservation land status (i.e., managing agency). We used GIS map layers for species occurrences in the California Natural Diversity Database (CDFW 2021), which are mostly from maps dated 1980 and 1990 to 1992.

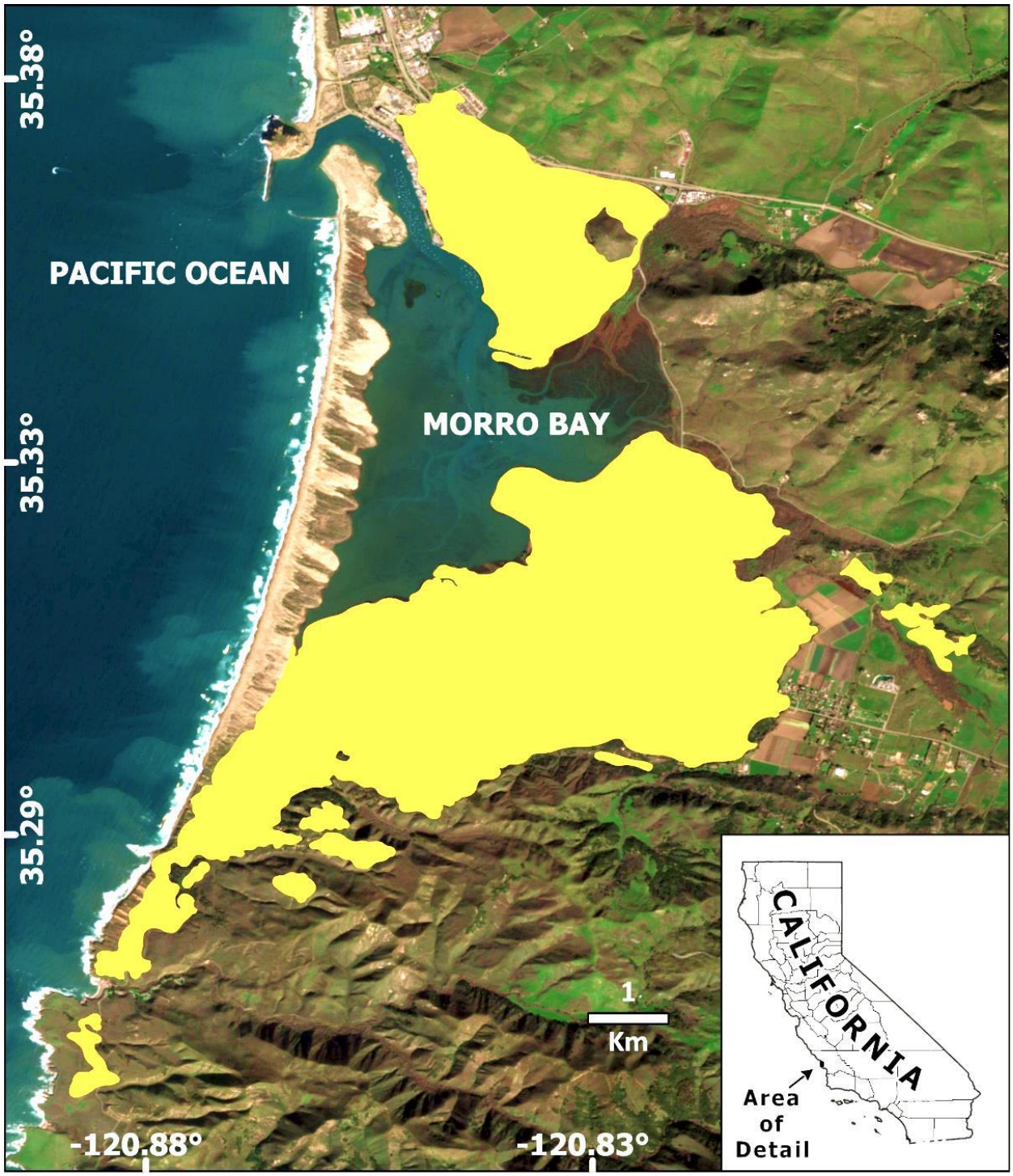


Figure 3. Distribution of Baywood fine sand (shown in yellow) in the Los Osos area, San Luis Obispo County, California.

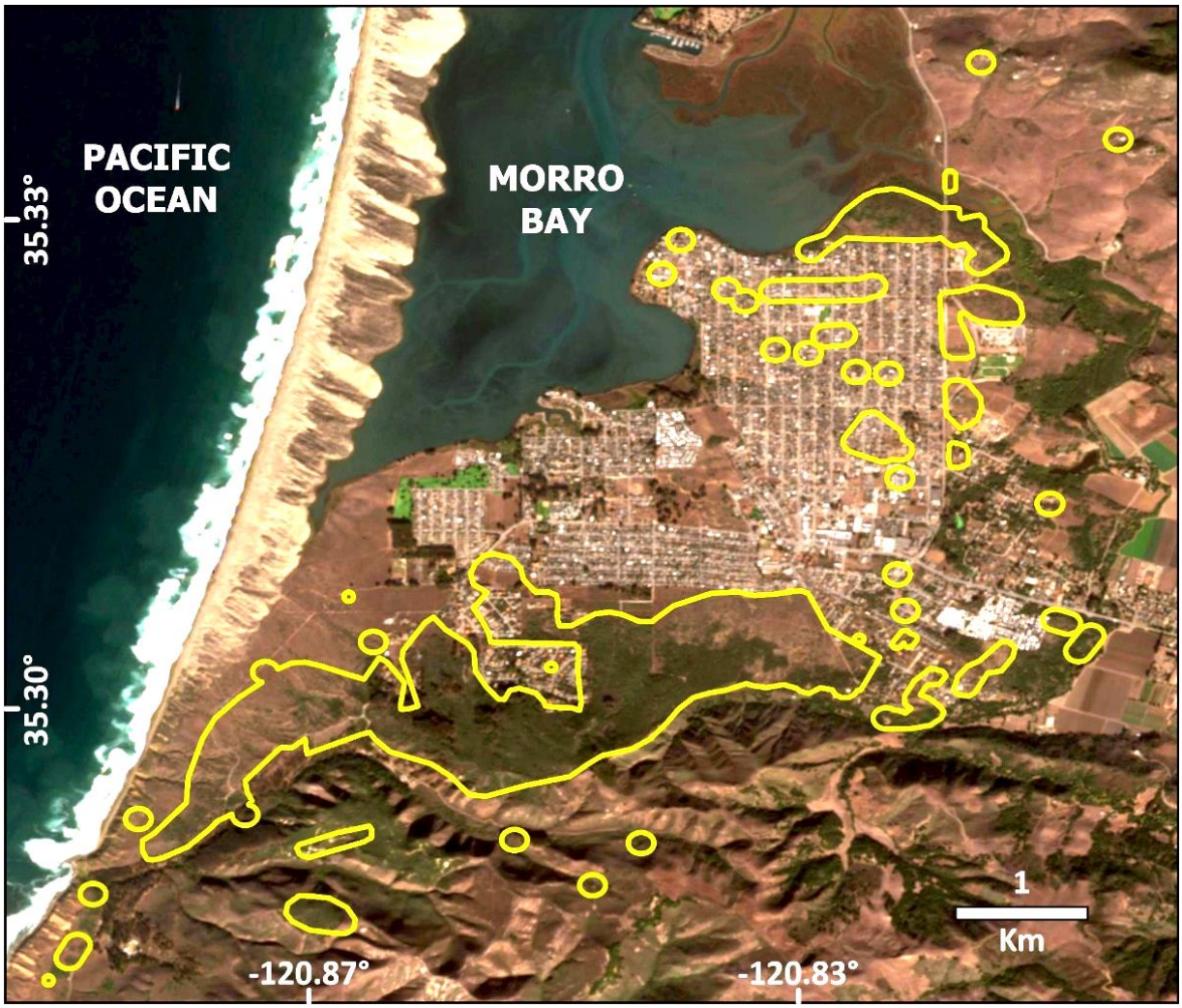


Figure 4. Geographic distribution of Morro manzanita *Arctostaphylos morroensis*, using GIS map layers of California Natural Diversity Database (CDFW 2021), excluding Valencia Peak, and underlain with 2023 Google Earth aerial image. Map credit: Mark Metevier, USFWS.

State of California
Department of Fish and Wildlife

Signed original on file,
received on November 14, 2024

Memorandum

Date: November 12, 2024

To: Melissa Miller-Henson
Executive Director
Fish and Game Commission

From: Charlton H. Bonham
Director

Subject: **Initial Evaluation of the Petition to List Morro Manzanita (*Arctostaphylos morroensis*) as Endangered under the California Endangered Species Act**

The California Department of Fish and Wildlife (Department) has completed its initial evaluation of the petition to list Morro manzanita (*Arctostaphylos morroensis*) as an endangered species under the California Endangered Species Act (CESA), Fish and Game Code section 2050 et seq. The Fish and Game Commission (Commission) received the petition from Dr. Christopher Kofron and Dr. Claudia Tyler on July 20, 2024. Pursuant to Fish and Game Code section 2073, the Commission referred the petition to the Department on July 30, 2024. On October 10, 2024, the Commission approved a Department request for a 30-day extension to further analyze the petition and complete its evaluation report in accordance with Fish and Game Code section 2073.5, subdivision (b).]

The Department completed the attached petition evaluation report as required by Fish and Game Code section 2073.5. The Department's petition evaluation report delineates the categories of information required in a petition, evaluates the sufficiency of the available scientific information, and incorporates additional relevant information that the Department possessed or received during the review period. Based upon the information contained in the petition, and other relevant information in the Department's possession, the Department has determined that there is sufficient scientific information to indicate that the petitioned action may be warranted. The Department recommends that the Commission accept the petition for further consideration pursuant to CESA.

If you have any questions or need additional information, please contact Jeff Drongesen, Branch Manager, Habitat Conservation Planning Branch at (916) 207-2823 or by email at NativePlants@wildlife.ca.gov.

Attachment

ec: *California Department of Fish and Wildlife*

Joshua Grover, Deputy Director
Ecosystem Conservation Division

Jeff Drongesen, Branch Manager
Habitat Conservation Planning Branch

Isabel Baer
Environmental Program Manager
Habitat Conservation Planning Branch

Kristi Lazar
Senior Environmental Scientist (Specialist)
Habitat Conservation Planning Branch

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

California Endangered Species Act

Petition Evaluation for Morro manzanita (*Arctostaphylos morroensis*)

Report to the Fish and Game Commission
November 2024

Cover page photo of Morro manzanita by Kristi Lazar (2024)

Suggested citation: California Department of Fish and Wildlife (CDFW). 2024. Report to the Fish and Game Commission, petition evaluation for Morro manzanita (*Arctostaphylos morroensis*). California Natural Resources Agency, Sacramento CA. 16 pp.

Table of Contents

List of Figures

List of Abbreviations, Acronyms, and Terms

CESA – California Endangered Species Act
CNDDB – California Natural Diversity Database
CRPR – California Rare Plant Rank
Commission – California Fish and Game Commission
Department – California Department of Fish and Wildlife
ESA – Federal Endangered Species Act
et al. – "and others"
HCP – Habitat Conservation Plan
PRISM – Parameter-elevation Regressions on Independent Slopes Model
USFWS – United States Fish and Wildlife Service

Executive Summary

On July 20, 2024, Dr. Christopher Kofron and Dr. Claudia Tyler submitted a petition to the California Fish and Game Commission (Commission) to list Morro manzanita (*Arctostaphylos morroensis*) as endangered pursuant to the California Endangered Species Act (CESA).

On July 30, 2024, the Commission referred the petition to the California Department of Fish and Wildlife (Department) in accordance with Fish and Game Code section 2073 (Cal. Reg. Notice Register 2024, No. 32-Z, p. 1016). Pursuant to Fish and Game Code section 2073.5 and California Code of Regulations, title 14, section 670.1, the Department prepared this petition evaluation within 120 days of receiving the petition. The purpose of the petition evaluation is to evaluate the sufficiency of the scientific information contained in the petition in relation to other relevant information possessed or received by the Department during the evaluation period, and to recommend to the Commission whether the petition should be accepted and considered.

Morro manzanita is an erect, evergreen shrub in the heath family (Ericaceae). The petition indicates that Morro manzanita is restricted to seven occurrences in and around the town of Los Osos in San Luis Obispo County and occurs primarily on stabilized sand dunes associated with Baywood fine sand. The petition provides information on abundance estimates and declining population trends. The petition highlights five threats to Morro manzanita: (1) clearing of habitat for residential development, (2) non-native, invasive plant species, (3) stochastic events, (4) climate change, and (5) sudden oak death pathogen *Phytophthora ramorum*. Existing management efforts were reviewed and suggestions for future management actions discussed. The petition also includes information sources and provides a detailed distribution map.

After reviewing the petition and other relevant information, the Department has determined that the petition meets the requirements in Fish and Game Code section 2072.3 and California Code of Regulations, title 14, section 670.1, subdivision (d)(1). In completing its petition evaluation, the Department has determined that there is sufficient scientific information to indicate that the petitioned action to list Morro manzanita as endangered under CESA may be warranted. Therefore, the Department recommends that the Commission accept the petition for further consideration pursuant to CESA.

1 Introduction

1.1 Petition Evaluation Overview

This petition evaluation serves as the basis for the California Department of Fish and Wildlife's (Department) recommendation to the California Fish and Game Commission (Commission) on whether the petition to list Morro manzanita (*Arctostaphylos morroensis*) as endangered under the California Endangered Species Act (CESA) should be accepted and considered. The recommendation is based on the sufficiency of scientific information in the petition, as well as other relevant information possessed or received by the Department during the evaluation period.

A petition to list a species under CESA must include "information regarding the population trend, range, distribution, abundance, and life history of a species, the factors affecting the ability of the population to survive and reproduce, the degree and immediacy of the threat, the impact of existing management efforts, suggestions for future management, and the availability and sources of information. The petition shall also include information regarding the kind of habitat necessary for species survival, a detailed distribution map, and any other factors that the petitioner deems relevant" (Fish & G. Code, § 2072.3; see also Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1)).

Once a petition is submitted to the Commission, the Department prepares a petition evaluation that evaluates each of the petition components and makes a recommendation to the Commission as to whether there is sufficient scientific information to indicate that the petitioned action to list the species under CESA may be warranted (Fish & G. Code, § 2073.5, subds. (a)-(b)). The petition evaluation is placed on the agenda for receipt at the next available meeting of the Commission after delivery. At that time, the petition evaluation will be made available to the public for a 30-day public comment period prior to the Commission taking any action on the petition. The Commission then considers the petition, the Department's petition evaluation, written comments received, and oral testimony to make a finding as to whether the petition provides "sufficient information to indicate that the petitioned action may be warranted" (Fish & G. Code, § 2074.2, subd. (e)(2)). The standard for accepting a petition for consideration and assessing sufficiency of information is addressed in *Center for Biological Diversity v. California Fish and Game Commission* (2008) 166 Cal.App.4th 597.

If the Commission determines that the petitioned action may be warranted, it accepts the petition, and the species becomes a candidate for CESA listing and proceeds to the status review stage of the CESA process. Within 12 months of the Commission's acceptance of the petition, the Department is required to produce a peer-reviewed report that advises the Commission on whether the petitioned action is warranted, based upon the best scientific information available (Fish & G. Code, § 2074.6). Finally,

the Commission determines whether the petitioned action to list the species as threatened or endangered is warranted, based on the Department's status review and other information in the administrative record (Fish & G. Code, § 2075.5).

1.2 CESA Petition History

On February 19, 1991, Dr. Malcolm McLeod of the California Native Plant Society submitted a petition to the Commission to list Morro manzanita as threatened under CESA (McLeod 1991; McGuire and Morey 1992). On December 5, 1991, the Commission designated Morro manzanita as a candidate for CESA listing (Cochrane 1996). On January 5, 1993, the Department recommended to the Commission that Morro manzanita be listed as threatened under CESA (McGuire and Morey 1992; Cochrane 1996). The Commission then voted on whether Morro manzanita should be listed under CESA and the vote was a tie (Cochrane 1996). The Commission directed the Department to work with local government, environmental groups, and landowners to initiate a management plan while Morro manzanita remained a candidate species (Cochrane 1996). On August 5, 1993, the Commission voted again and determined that, based on regional planning efforts that were underway, CESA listing was not warranted at that time (Cochrane 1996).

On July 20, 2024, Dr. Christopher Kofron and Dr. Claudia Tyler submitted a petition to the Commission to list Morro manzanita as endangered under CESA (Kofron and Tyler 2024). On July 30, 2024, the Commission referred the petition to the Department for evaluation. At its meeting on August 14-15, 2024, the Commission officially acknowledged receipt of the petition. At its meeting on October 10, 2024, the Commission granted the Department's request for a 30-day extension of the period to review the petition and prepare this petition evaluation.

1.3 Federal Status

On December 15, 1994, Morro manzanita was listed as a threatened species under the Federal Endangered Species Act (ESA) (USFWS 1994). In 2008, 2013, and 2022, the United States Fish and Wildlife Service (USFWS) conducted 5-year reviews for Morro manzanita to ensure that its classification as a threatened species under the ESA provided the appropriate level of protection (USFWS 2008, 2013, 2022). All three USFWS 5-year reviews concluded that Morro manzanita still met the definition of a threatened species under the ESA.

In 1998, the USFWS published a recovery plan for the Morro shoulderband snail and four plant species, including Morro manzanita (USFWS 1998). The recovery plan provided delisting criteria for Morro manzanita that required: (1) 90 percent of existing high and medium cover stands and 85 to 90 percent of low cover stands be preserved,

(2) evidence that the acreage and cover classes of Morro manzanita in preserves can be maintained over time, and (3) site-specific management plans to have been successfully implemented for the preserves (USFWS 1998). As of 2022, the first recovery criterion was close to being met with 70% of existing high and medium cover Morro manzanita stands and 89% of low cover stands protected in preserves (USFWS 2022). The second and third criteria have not been met as there are no monitoring programs in place to track the maintenance of Morro manzanita stands over time and site-specific management plans have only been developed for two of the five relevant preserves (USFWS 2022).

1.4 Additional Species Status Designations

1.4.1 NatureServe Conservation Status Ranks

NatureServe's conservation status ranks consist of a global conservation status rank (global rank or G rank), describing the status of a given taxon over its entire global distribution, and a subnational conservation status rank (subnational rank or S rank), describing the status of a given taxon over its state distribution (Master et al. 2012). Morro manzanita has been assigned a NatureServe conservation status rank of G1 S1, indicating that the species is critically imperiled both globally and within California, with a very high risk of extirpation due to one or more of the following: very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors (CNDDB 2020, 2024).

1.4.2 California Rare Plant Rank

The California Native Plant Society works in collaboration with botanical experts throughout the state, including Department biologists, to assign rare plants a California Rare Plant Rank (CRPR) reflective of their rarity status (CNDDB and CNPS 2020). Morro manzanita has been assigned a CRPR of 1B.1 (CNPS 2024). Plants with a CRPR of "1B" are considered rare, threatened, or endangered throughout their range with the majority endemic to California (CNDDB and CNPS 2020). The threat code extension of ".1" indicates that the species is seriously threatened in California, with over 80 percent of occurrences threatened and a high degree and immediacy of threat (CNDDB and CNPS 2020).

2 Species Description and Taxonomy

The Commission has the authority to list certain species or subspecies as endangered or threatened under CESA (Fish & G. Code, §§ 2062, 2067, 2070). The listing process is the same for species and subspecies (Fish & G. Code, §§ 2070-2079.1).

2.1 Species Taxonomy

Morro manzanita (*Arctostaphylos morroensis* Wiesl. & B. Schreib.) was first described by Wieslander and Schreiber in 1939 (Wieslander and Schreiber 1939). The original description was based on collections from 1936 and 1938 from the vicinity of Hazard Canyon in what is now Montaña de Oro State Park in San Luis Obispo County (Wieslander and Schreiber 1939). Morro manzanita has been recognized in all relevant floras since it was originally described, including The Jepson Manual and the Flora of North America (Parker et al. 2009, 2023).

2.2 Species Description

Morro manzanita is an erect, evergreen shrub in the heath family (Ericaceae) (Parker et al. 2023). Morro manzanita typically grows from 0.5 m to over 4 m (1.6 to 13.1 ft) tall, with leaves that are covered with matted hairs on the lower leaf surface (especially when leaves are young) and generally without hairs on the upper leaf surface (Wieslander and Schreiber 1939; Mullany 1990; Parker et al. 2023). Leaf blades are oblong-ovate to elliptic, 1.5 to 3.5 cm (0.6 to 1.4 in) long, and 1 to 2.6 cm (0.4 to 1 in) wide (Mullany 1990; Parker et al. 2023). Stomata (pores) are present on the lower leaf surface but generally absent or sparse on the upper leaf surface (Mullany 1990).

Like all manzanita species, Morro manzanita flowers have petals fused into an urn-shape and are white to pink in color. There are five sepals (outermost whorl of flower parts) below the fused petals (Parker et al. 2023). Flowers are arranged in clusters called inflorescences and inflorescences hang down when they are young (Parker et al. 2023). Beneath the inflorescences are bracts that are leaf-like, lanceolate to linear in shape, and minutely hairy (Wieslander and Schreiber 1939; Parker et al. 2023). Fruits are 7 to 10 mm (0.3 to 0.4 in) wide, berry-like, and shaped as spheres that have been flattened on the top and bottom (Parker et al. 2023).

Morro manzanita stems have gray, shredding bark on older stems and both short and long, white, non-glandular hairs on twigs and young inflorescences (Parker et al. 2023). One characteristic of many manzanita species is the presence of a basal burl (woody growth) which allows the species to resprout after fire. Morro manzanita does not have a basal burl, meaning that when a fire burns a Morro manzanita population, Morro manzanita shrubs are unable to resprout and rely solely on their seed bank in the soil to germinate and replenish the population (Wells 1969; Parker et al. 2023).

3 Summary of Petition Components

Pursuant to Fish and Game Code section 2072.3 and California Code of Regulations, title 14, section 670.1, subdivision (d)(1), the Department evaluated whether the petition contained information on each of the following petition components:

- Life history;
- Range;
- Distribution;
- Detailed distribution map
- Kind of habitat necessary for survival;
- Abundance;
- Population trend;
- Factors affecting the ability to survive and reproduce;
- Degree and immediacy of threat;
- Impact of existing management efforts;
- Suggestions for future management; and
- Availability and sources of information.

The Commission did not receive new information from the public during the petition evaluation period (Fish & G. Code, § 2073.4). Pursuant to Fish and Game Code section 2073.5, the Department evaluated the information contained in the petition to determine whether there is, or is not, sufficient information to indicate that the petitioned action may be warranted. A summary of the relevant information from the petition for each of the petition components is presented below. In some instances, the Department has grouped similar components together and renamed components to create a more cohesive and readable document.

3.1 Life History

This section summarizes the information in the petition regarding the species' life history (Fish & G. Code, § 2072.3; Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1)).

3.1.1 Scientific Information in the Petition

The petition discusses the life history of Morro manzanita in the "Life History" section on pages 8 through 13. The petition describes Morro manzanita as an erect, spreading shrub, generally 1 to 4 m (3.3 to 13.1 ft) in height. The petition indicates that Morro manzanita produces abundant flowers in January through March and is dependent on pollinators to reproduce. After flowering, the petition notes that Morro manzanita produces fruits that mature in spring and summer, with each fruit containing five to

eight seeds. The petition discusses studies that found a low percent (10 to 18%) of Morro manzanita flowers produced fruit, but that the fruits contained a high percentage (73%) of viable seeds (Kelly and Parker 1991; Tyler et al. 2023). The petition notes that fruits fall from Morro manzanita shrubs in late spring to late fall, with the majority of the fruits removed by animals (such as small mammals and birds).

The petition discusses how the lack of a basal burl means Morro manzanita does not resprout when burned by fire and the species relies on a dormant seed bank in the soil to persist in the landscape. The petition cites a study that examined Morro manzanita seed germination in response to fire-related cues and found that these cues, specifically heat and charred wood, enhanced seed germination but seed germination was very low overall, with only 1 to 4% of all seeds germinating on average (Tyler and Odion 2020). The petition also mentions that, based on a study of three Morro manzanita stands, the older the stand, the fewer seeds being added to the soil seed bank each year (Tyler and Odion 2020; Tyler et al. 2023).

3.2 Range, Distribution, and Detailed Distribution Map

This section summarizes the information in the petition regarding the species' range and distribution and provides a detailed distribution map (Fish & G. Code, § 2072.3; Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1)). A species' range for the purposes of CESA and this status review is the species' California range (Cal. Forestry Assn. v. Cal. Fish and Game Com. (2007) 156 Cal.App.4th 1535, 1551). Range describes the general geographical area in which a species occurs. Distribution describes the actual sites where individuals and populations of the species occur within the species' range.

3.2.1 Scientific Information in the Petition

The petition discusses the range and distribution of Morro manzanita in the "Range, Distribution, and Abundance" section on pages 5 through 8. The petition also provides two detailed distribution maps for Morro manzanita as Figures 2 and 4 on pages 23 and 25, respectively. Figure 4 of the petition is included as Figure 1 on page 8 of this petition evaluation.

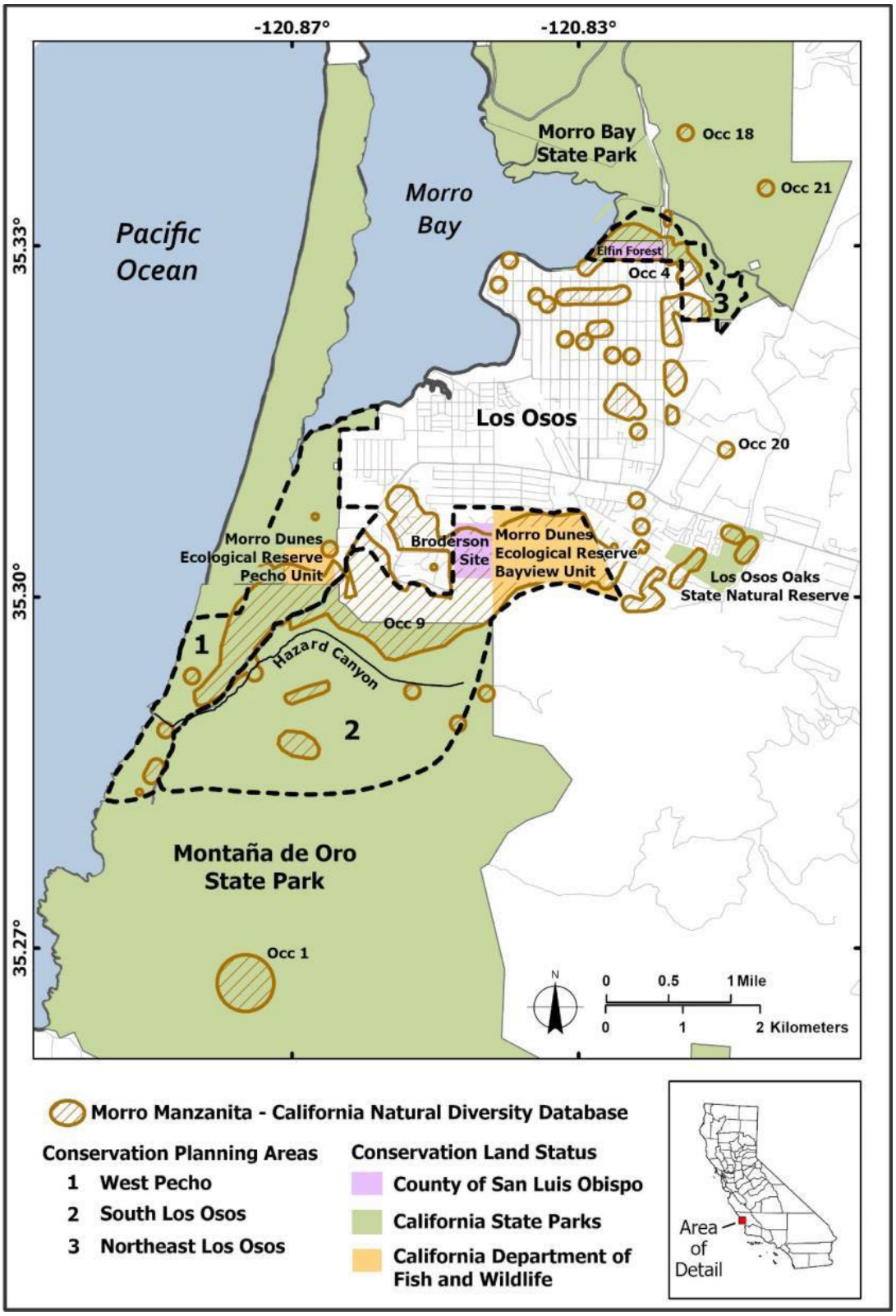


Figure 1. Map of the range and distribution of Morro manzanita as provided in Figure 4 of the petition. Occurrences from the California Natural Diversity Database (CNDDB) are labeled with CNDDB occurrence numbers. Some occurrences consist of multiple polygons.

The petition describes Morro manzanita as being restricted to the coastal area of San Luis Obispo County, in and around the town of Los Osos. There are six occurrences of Morro manzanita documented in the California Natural Diversity Database (CNDDB). The petition notes that an additional occurrence, not yet reflected in the CNDDB, was found in 2023 for a total of seven documented occurrences of Morro manzanita. The petition states that one of the occurrences is based on a historic collection that may be erroneous (CNDDB occurrence 1), one occurrence is likely extirpated (CNDDB occurrence 20), three occurrences are small and consist of a single or small number of polygons (CNDDB occurrences 18, 21, and the new occurrence), and the remaining two occurrences consist of multiple polygons representing at least 98% of the distribution of Morro manzanita (CNDDB occurrences 4 and 9).

3.3 Habitat

This section summarizes the information in the petition regarding the kind of habitat necessary for species survival (Fish & G. Code, § 2072.3; Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1)).

3.3.1 Scientific Information in the Petition

The petition discusses the kind of habitat necessary for Morro manzanita survival in the "Kind of Habitat Necessary for Survival" section on page 13. The petition describes Morro manzanita as being restricted to coastal San Luis Obispo County at elevations below 200 m (656 ft). The petition notes that Morro manzanita primarily occurs on stabilized sand dunes of Baywood fine sand, with a few outlying populations growing on shale or volcanic igneous substrates. The petition states that temperatures in the vicinity of Morro manzanita occurrences range from 6.5 to 23.5°C (43.7 to 74.3°F) and mean annual rainfall is 42.1 cm (16.6 in).

3.4 Abundance and Population Trend

This section summarizes the information in the petition regarding the species' abundance and population trend (Fish & G. Code, § 2072.3; Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1)).

3.4.1 Scientific Information in the Petition

The petition discusses abundance for Morro manzanita in the "Range, Distribution, and Abundance" section on pages 5 through 8, and discusses population trend in the "Population Trends" section on page 8.

The petition indicates that abundance of Morro manzanita is difficult to estimate due to its growth form and habit. Morro manzanita shrubs can have multiple stems at the base

of the plant and often occur in dense stands that are difficult to access. However, the petition mentions that the population size of Morro manzanita has been extrapolated from measures of area occupied, percent cover, and shrub size. Using this method, Morro manzanita has been estimated to have a total population size of 86,000 to 153,000 individuals (LSA Associates, Inc. 1992; McGuire and Morey 1992; Crawford, Multari & Clark Associates 2004).

The petition indicates Morro manzanita is experiencing a declining population trend based on a reduction in its historical range and based on its current known distribution. The petition discusses how the historical range of Morro manzanita was estimated by the USFWS to be between 800 and 1,100 ha (1,977 and 2,718 ac) based on the distribution of Morro manzanita's preferred substrate, Baywood fine sand (USFWS 1994). By 2013, the USFWS estimated that development had eliminated as much as 75% of historically suitable habitat (USFWS 2013). The petition also compares the historical range of Morro manzanita with more recent estimates of occupied area that indicate Morro manzanita currently occupies less than 162 ha (400 ac) (Tyler and Odion 1996).

3.5 Threats

This section summarizes the information in the petition regarding the factors affecting the ability of the species to survive and reproduce, and the degree and immediacy of threat (Fish & G. Code, § 2072.3; Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1)).

3.5.1 Scientific Information in the Petition

The petition discusses threats affecting Morro manzanita's ability to survive and reproduce in the "Factors Affecting Ability to Survive and Reproduce" section on pages 13 through 14 and discusses the degree and immediacy of threat for Morro manzanita in the "Degree and Immediacy of Threat" section on pages 14 through 16.

The petition identifies the following factors as threats to Morro manzanita: (1) clearing of habitat for residential development, (2) non-native, invasive plant species, (3) stochastic events, (4) climate change, and (5) sudden oak death pathogen *Phytophthora ramorum*.

Clearing of habitat for residential development

The petition describes clearing of habitat for residential development as an immediate and ongoing threat to Morro manzanita. There are large Morro manzanita stands that occur on private lands threatened with development. Development would require the direct removal of Morro manzanita shrubs, reducing the population size and contributing to habitat fragmentation. In addition, clearing of excess or dead vegetation around existing residences may negatively impact Morro manzanita. The petition also

notes that the California Department of Forestry and Fire Prevention has constructed a firebreak near a housing estate in the vicinity of a Morro manzanita stand and has proposed an extension to the firebreak.

Non-native, invasive plant species

The petition indicates that non-native, invasive plant species are an ongoing threat to Morro manzanita. In particular, *Eucalyptus* trees, as explained in the petition, were planted throughout the Los Osos area in the early 1900s with many of these trees presumably planted in areas that once contained Morro manzanita. The petition notes that the *Eucalyptus* stands continue to expand and few Morro manzanita persist under the trees. The petition discusses how *Eucalyptus* and other non-native invasive plant species in the area, such as veldt grass (*Ehrharta calycina*), are highly flammable and could result in altered fire regimes that are detrimental to Morro manzanita.

Stochastic events

The petition indicates that environmental and demographic stochastic events are a threat to Morro manzanita mainly due to the species' low seedbank density, poor seed viability, and small, isolated populations. As discussed in the petition, an environmental stochastic event of particular concern for Morro manzanita is wildfire. If wildfires occur at too frequent intervals, there may not be enough time post-fire for a Morro manzanita stand to re-establish, become reproductive, and build up an adequate seedbank between fires to sustain the population. The petition discusses how demographic stochastic events (related to fluctuations in reproduction and mortality) are especially detrimental for small, fragmented populations like those present in Morro manzanita. If pollinators are not able to move between populations (and cross-pollinate), Morro manzanita may experience increased genetic drift and inbreeding effects. The petition mentions that Morro manzanita may already be experiencing negative genetic effects from its small, isolated populations as evidenced by low seed viability in an isolated Morro manzanita stand at the Elfin Forest Preserve (part of CNDDB occurrence 4).

Climate change

The petition indicates that Morro manzanita may not be able to tolerate or adapt to the increase in temperatures, drought, and wildfires that are expected to occur on the central California coast in the future as a result of climate change. The petition notes that low rainfall may be the reason for mortality and stem die-off of several large Morro manzanita shrubs at the Elfin Forest Preserve since 2015. The petition also indicates that Morro manzanita is a habitat specialist which will likely restrict the species' ability to disperse to other locations in the face of a warming climate.

Sudden oak death pathogen *Phytophthora ramorum*

The petition indicates that, while not an immediate threat, the sudden oak death pathogen (*Phytophthora ramorum*) is a potential future threat to Morro manzanita. The sudden oak death pathogen, as discussed in the petition, is responsible for the killing of over 50 million trees in California and Oregon and while it primarily targets tanoak and coast live oak, studies have shown that the sudden oak death pathogen can infect manzanita. In a study that tested the susceptibility of several manzanita species to the sudden oak death pathogen, Morro manzanita showed an intermediate susceptibility (Garbelotto et al. 2020). The petition notes that no Morro manzanita have yet been identified as being infected with the sudden oak death pathogen in the wild; however, the pathogen is present in the area and has been documented to occur in several streams in coastal San Luis Obispo County. Since the sudden oak death pathogen can be carried through air, water, soil, and litter, spread of the pathogen to areas with Morro manzanita is a possibility in the future (Peterson et al. 2014; Grunwald et al. 2019).

3.6 Existing Management

This section summarizes the information in the petition regarding the impact of existing management efforts on the species (Fish & G. Code, § 2072.3; Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1)).

3.6.1 Scientific Information in the Petition

The petition discusses existing management for Morro manzanita in the "Impact of Existing Management Actions" section on pages 16 and 17. The petition indicates that current regulatory mechanisms are not adequate to protect Morro manzanita from immediate and ongoing threats. Morro manzanita is listed as threatened under the ESA; however, the ESA provides little protection for federally listed species on private land. The petition discusses how various private properties with Morro manzanita have been purchased and protected from development since the species was federally listed in 1994, but a substantial portion of the remaining Morro manzanita stands still occur on private land. In addition, Morro manzanita is a covered species in the Los Osos Habitat Conservation Plan (HCP). The Los Osos HCP was approved in February 2024 and the USFWS has issued an incidental take permit to the County of San Luis Obispo to authorize take/impacts to covered species associated with covered activities (Jodi McGraw Consulting 2022). The petition indicates that the Los Osos HCP would allow residential development and construction of firebreaks on private lands that currently contain dense, intact Morro manzanita stands.

3.7 Future Management

This section summarizes the information in the petition regarding suggestions for future management (Fish & G. Code, § 2072.3; Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1)).

3.7.1 Scientific Information in the Petition

The petition suggests future management actions for Morro manzanita in the "Suggestion for Future Management" section on pages 17 and 18. The petition recommends the following specific actions:

- Conserve and protect existing stands of Morro manzanita.
- Discuss fuel reduction activities impacting Morro manzanita stands in Los Osos with the USFWS.
- Survey for Morro manzanita across its range and collect data on abundance.
- Develop and implement site specific management plans for Morro manzanita within preserves.
- Develop protocols for long-term restoration of Morro manzanita, including conducting research on seed viability and germination requirements to aid in restoration.
- Identify potential restoration sites and investigate options for restoring connectivity between fragmented populations.
- Conduct research on the genetic diversity within and among Morro manzanita stands.
- Remove *Eucalyptus* and re-establish Morro manzanita stands where feasible.
- Coordinate and share information across agencies, researchers, and citizen groups who are involved with outreach and conservation of Morro manzanita.
- Further study the relationship of Morro manzanita with fire.
- Conduct prescribed burns in the Los Osos area.
- Conduct modeling to anticipate the effects of climate change on Morro manzanita.
- Collect seeds of Morro manzanita for conservation seed banking.
- Introduce Morro manzanita into living collections at botanic gardens.

3.8 Availability and Sources of Information

This section summarizes the information in the petition regarding availability and sources of information (Fish & G. Code, § 2072.3; Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1)).

3.8.1 Scientific Information in the Petition

The petition provides a list of sources for Morro manzanita in the "References and Sources of Information" section on pages 18 through 21. The petitioners provided electronic copies of sources from the petition to the Commission.

3.8.2 Other Relevant Scientific Information

The Department evaluated additional sources of information in its possession as it relates to the petition. The Department concluded that none of the additional information contradicts or undercuts the conclusions made in the petition at this juncture of the listing process. These sources can be found in the Literature Cited section of this document.

4 Sufficiency of Scientific Information to Indicate the Petitioned Action May Be Warranted

The Department evaluated the petition components set forth in Fish and Game Code section 2072.3 and California Code of Regulations, title 14, section 670.1, subdivision (d)(1) for sufficiency of information pursuant to Fish and Game Code section 2073.5. The Department finds that sufficient scientific information was provided for the petition components.

5 Recommendation to the Commission

Pursuant to Fish and Game Code section 2073.5, the Department evaluated the petition on its face and in relation to other relevant information the Department possesses. In completing its petition evaluation, the Department determined that the petition, and other relevant information, provide sufficient scientific information to indicate that the petitioned action to list Morro manzanita as endangered may be warranted. Therefore, the Department recommends the Commission accept the petition for further consideration under CESA.

Acknowledgements

This petition evaluation was prepared by Kristi Lazar in the Department's Habitat Conservation Planning Branch, Native Plant Program.

Literature Cited

CNDDB (California Natural Diversity Database). 2020. California Natural Diversity Database (CNDDB) Management Framework. California Department of Fish and Wildlife, Sacramento, CA, USA.

CNDDB (California Natural Diversity Database). 2024. RareFind 5 [internet]. Government version- dated August 2024. California Department of Fish and Wildlife, Sacramento, CA, USA.

CNDDB (California Natural Diversity Database), and CNPS (California Native Plant Society). 2020. The CNDDB and CNPS cooperative relationship and rare plant status review process. Sacramento, CA, USA. Available from: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=175695&inline (Accessed: 2 August 2024).

CNPS (California Native Plant Society). 2024. CNPS inventory of rare and endangered plants of California: *Arctostaphylos morroensis*. Available from: https://rareplants.cnps.org/Plants/Details/27 (Accessed: 2 August 2024).

Cochrane, S. 1996. Chronology of Morro manzanita (*Arctostaphylos morroensis*) activities: Letter and associated documents. Natural Heritage Division, California Department of Fish and Game.

Crawford, Multari & Clark Associates. 2004. Los Osos Habitat Conservation Plan, species accounts, Appendix D. Prepared for the Los Osos Community Services District.

Garbelotto, M., T. Popenuck, B. Hall, W. Schweigkofler, F. Dovana, R. Goldstein de Salazar, D. Schmidt, and L. Sims. 2020. Citizen science uncovers *Phytophthora ramorum* as a threat to several rare or endangered California manzanita species. Plant Disease 104:3173-3182.

Grunwald, N., J. LeBoldus, and R. Hamelin. 2019. Ecology and evolution of the sudden oak death pathogen *Phytophthora ramorum*. Annual Review of Phytopathology 57:301-321.

Jodi McGraw Consulting. 2022. Los Osos Habitat Conservation Plan. Prepared for the County of San Luis Obispo. Available from: https://www.slocounty.ca.gov/departments/planning-building/grid-items/community-engagement/active-planning-projects/los-osos-habitat-conservation-plan-(hcp) (Accessed: 5 August 2024).

Kelly, V., and V. Parker. 1991. Percentage seed set, sprouting habit and ploidy level in *Arctostaphylos* (Ericaceae). Madroño 38(4):227-232.

Kofron, C., and C. Tyler. 2024. A petition to the State of California Fish and Game Commission to list Morro manzanita (*Arctostaphylos morroensis*).

LSA, Associates Inc. 1992. An assessment of the status of the Morro manzanita (*Arctostaphylos morroensis*). Prepared for Central Coast Engineering, San Luis Obispo, CA, USA.

Master, L., D. Faber-Langendoen, R. Bittman, G. Hammerson, B. Heidel, L. Ramsay, K. Snow, A. Teucher, and A. Tomaino. 2012. NatureServe conservation status assessments: factors for evaluating species and ecosystem risk. NatureServe, Arlington, VA, USA.

McGuire, T., and S. Morey. 1992. Report to the Fish and Game Commission on the status of Morro Bay manzanita (*Arctostaphylos morroensis*). Natural Heritage

Division status report 92-4. California Department of Fish and Game, Sacramento, CA, USA.
McLeod, M. 1991. A petition to the State of California Fish and Game Commission to list Morro Bay manzanita (*Arctostaphylos morroensis*).
Mullany, M. 1990. The distribution and variation of *Arctostaphylos morroensis* (Ericaceae). California Polytechnic State University, San Luis Obispo, CA, USA.
Parker, V., M. Vasey, and J. Keeley. 2009. *Arctostaphylos*. In Flora of North America Editorial Committee, editor. Flora of North America North of Mexico [online]. 25+ vols. New York and Oxford. Available from: http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=250092374. (Accessed: 5 August 2024).
Parker, V., M. Vasey, and J. Keeley. 2023. *Arctostaphylos*. In Jepson Flora Project, editor. Jepson eFlora, Revision 12. Available from: https://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=13951 (Accessed: 2 August 2024).
Peterson, E., E. Hansen, and J. Hulbert. 2014. Source or sink? The role of soil and water borne inoculum in the dispersal of *Phytophthora ramorum* in Oregon tanoak forests. Forest Ecology and Management 322:48-57.
Tyler, C., D. Meade, and D. Odion. 2023. Flowering, fruit set, and seed predation in *Arctostaphylos morroensis*, a rare obligate-seeding shrub. Madroño 70(4):197-209.
Tyler, C., and D. Odion. 1996. Ecological studies of Morro Manzanita (*Arctostaphylos morroensis*). Report prepared for the California Department of Fish and Game, Endangered Plant Program.
Tyler, C., and D. Odion. 2020. Seed banks, seed germination, and implications for conservation of the endangered, fire-dependent shrub, *Arctostaphylos morroensis*. Natural Areas Journal 40(2):155-167.
USFWS (United States Fish and Wildlife Service). 1994. Endangered and threatened wildlife and plants; endangered or threatened status for five plants and the Morro shoulderband snail from western San Luis Obispo County, California. Federal Register 59:64613-64623.
USFWS (United States Fish and Wildlife Service). 1998. Recovery plan for the Morro shoulderband snail and four plants from western San Luis Obispo County, CA. United States Fish and Wildlife Service, Portland, OR, USA.
USFWS (United States Fish and Wildlife Service). 2008. *Arctostaphylos morroensis* (Morro manzanita). 5-year review: summary and evaluation. Ventura Fish and Wildlife Office, Ventura, CA, USA.
USFWS (United States Fish and Wildlife Service). 2013. *Arctostaphylos morroensis* (Morro manzanita). 5-year review: summary and evaluation. Ventura Fish and Wildlife Office, Ventura, CA, USA.
USFWS (United States Fish and Wildlife Service). 2022. Morro manzanita (*Arctostaphylos morroensis*) 5-year review: summary and evaluation. Ventura Fish and Wildlife Office, Ventura, CA, USA.
Wells, P. 1969. The relation between mode of reproduction and extent of speciation in the woody genera of the California chaparral. Evolution 23:264-267.
Wieslander, A., and B. Schreiber. 1939. Notes on the genus *Arctostaphylos*. Madroño 5(1):38-47.

Petition Evaluation for Morro manzanita

Presentation to the California Fish and Game Commission

February 12, 2025

Kristi Lazar

Native Plant Program,
Habitat Conservation Planning Branch

Presentation Overview

- Petition History
- Review Key Petition Components
- Department Recommendation

Petition History for Morro manzanita

Petition Received: July 20, 2024

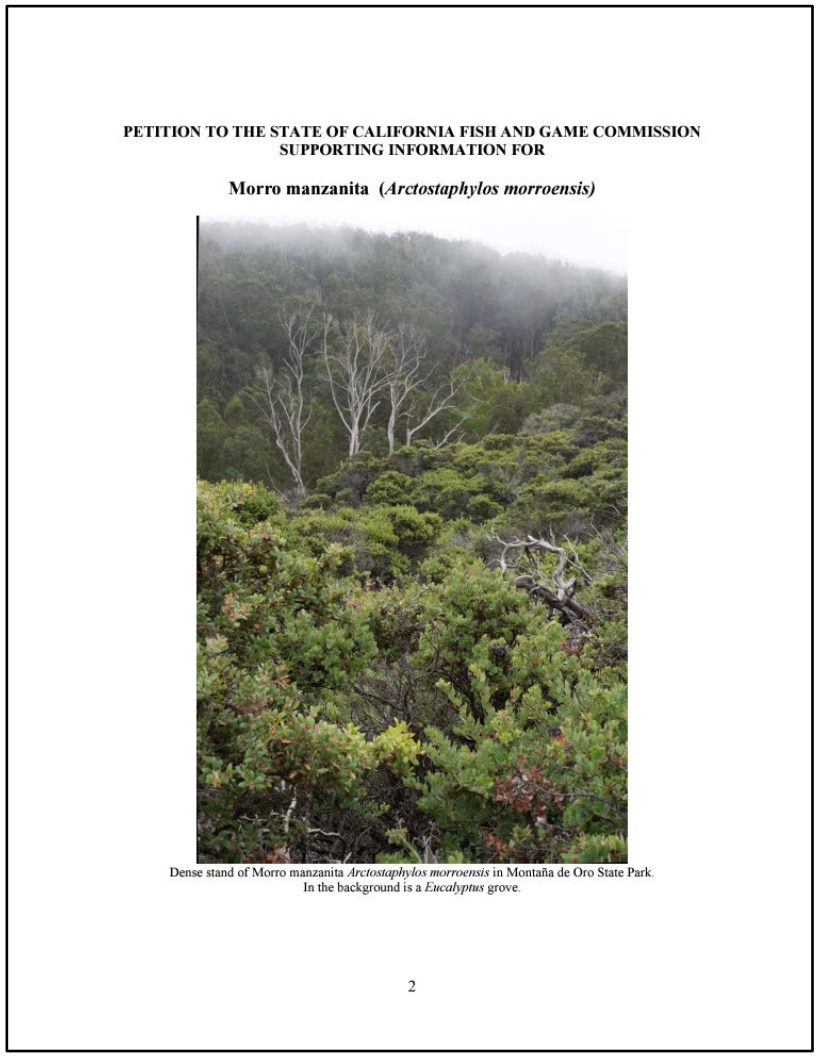
Petitioned Action: List as endangered under CESA

Petitioners: Dr. Claudia Tyler and Dr. Chris Kofron

Previous CESA petition for Morro manzanita:

- Submitted by Dr. Malcolm McLeod in 1991
- FGC determined listing was not warranted due to regional planning efforts underway in 1993.

Federal listing status: Threatened (1994)



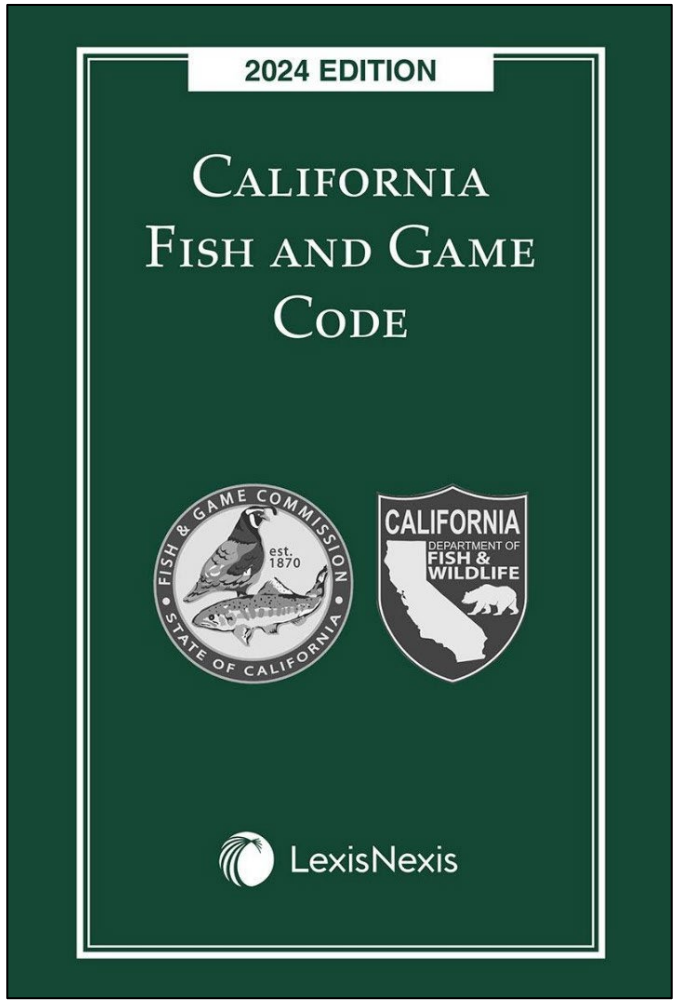
PETITION TO THE STATE OF CALIFORNIA FISH AND GAME COMMISSION
SUPPORTING INFORMATION FOR

Morro manzanita (*Arctostaphylos morroensis)*

Dense stand of Morro manzanita *Arctostaphylos morroensis* in Montaña de Oro State Park. In the background is a *Eucalyptus* grove.

2

Petition Components (Fish & Game Code §2072.3)



- **Life history**
- **Geographic range and distribution**
- **Habitat necessary for survival**
- **Population trend and abundance**
- **Factors affecting survival and reproduction**
- **Degree and immediacy of threat**
- Impact of existing management efforts
- Suggestions for future management
- Detailed distribution map
- Sources and availability of information

Life History

Photo: Neal Kramer 2014

Photo: Steve Matson 2006

Photo: Gary McDonald 2008
Basal burl on brittleleaf manzanita

Photo: Neal Kramer 2014
No basal burl on Morro manzanita

- Evergreen shrub
- Heath family (Ericaceae)
- Small white to pink flowers
- No basal burl
- Distinguished from nearby species mainly through leaf characteristics

Geographic Range and Distribution

Figure 2 in the petition. Red outline added by the Department.

- Coastal San Luis Obispo County in and around the town of Los Osos
- 7 documented element occurrences (EOs)
  - 1 EO is possibly erroneous
  - 1 EO is likely extirpated
  - 3 EOs consist of small number of plants
  - 2 EOs consist of 98% of the distribution (outlined in red)
- Figure shows the distribution of Morro manzanita as brown polygons

Habitat Necessary for Survival

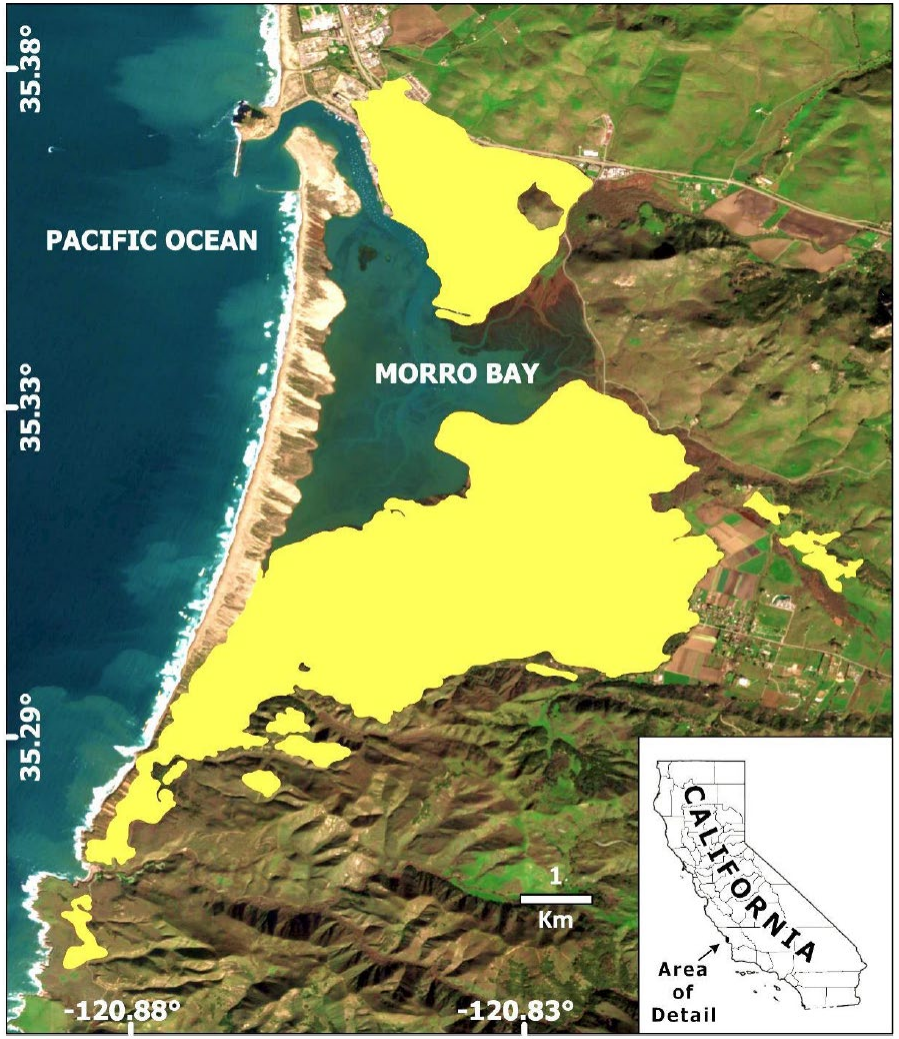


Figure 4 in the petition

- Elevations below 200 m (656 ft)
- Primarily restricted to Baywood fine sand soils.
- Very few Morro manzanita plants grow off of this soil type
- Figure shows the distribution of Baywood fine sand soils in the Los Osos area

Population Trend and Abundance

- Abundance difficult to estimate due to Morro manzanita's growth form and habit
  - Estimates range from 86,000 to 153,000 individuals

- Declining population trend based on:
  - Reduction in historical range
    - ~2/3 of historical Morro manzanita habitat eliminated by development
  - Currently small distribution
    - ~350 ha of Morro manzanita habitat
    - <162 ha actually contain the species

Photo: Kristi Lazar 2024

Factors Affecting Survival and Reproduction

- Clearing of habitat for residential development
- Non-native, invasive plant species
- Stochastic/random events
- Climate change
- Sudden oak death pathogen

Photo: Jean Pawek 2012

Factors Affecting Survival and Reproduction

- **Clearing of habitat for residential development**
  - Direct removal of shrubs
    - Reduces population size
    - Contributes to habitat fragmentation
  - Clearing of vegetation around residences
  - Construction of firebreaks

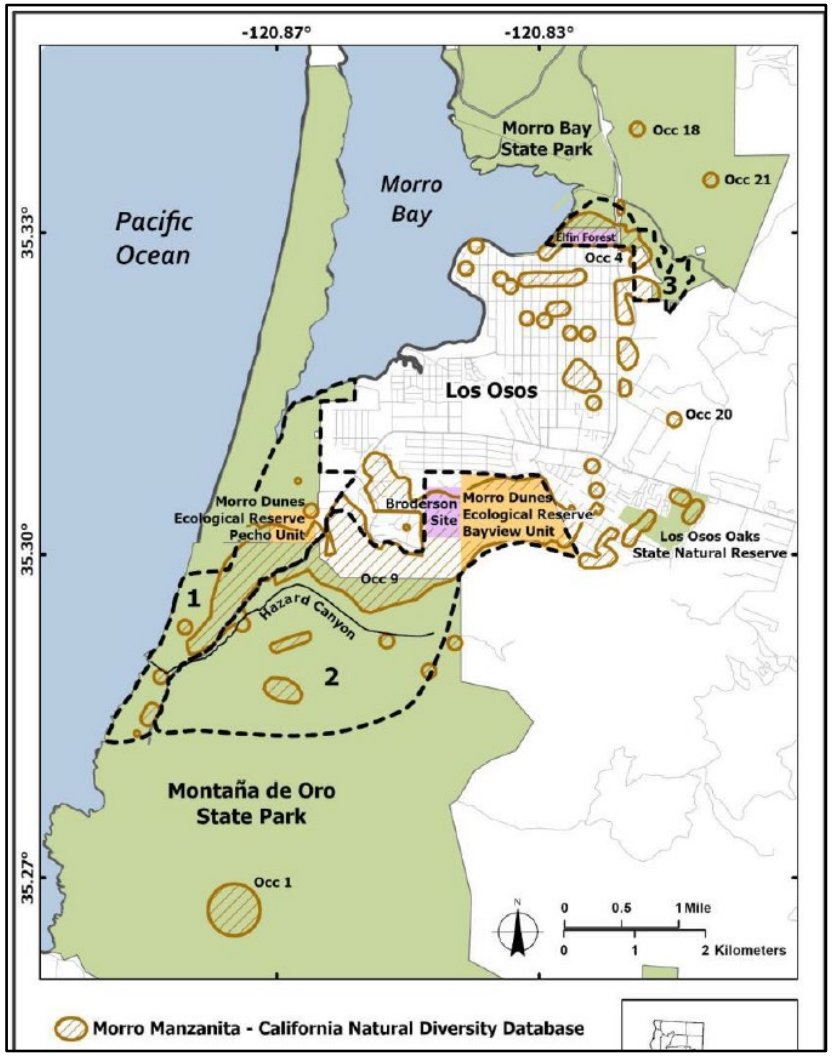


Figure 2 in the petition

Factors Affecting Survival and Reproduction

- **Non-native invasive plant species**
  - *Eucalyptus* planted throughout Los Osos and Montana de Oro State Park areas
  - *Eucalyptus* displace Morro manzanita and pose a wildfire risk.

Photo: Zoya Akulova 2013

Factors Affecting Survival and Reproduction

- **Stochastic/random events**
  - Small, isolated populations are more vulnerable chance events and genetic effects
- **Climate change**
  - Habitat specialist which restricts how far it can disperse
- **Sudden oak death pathogen**
  - Not yet found in wild populations
  - Morro manzanita was intermediately susceptible to the pathogen

Photo: Chris Winchell 2011

Degree and Immediacy of Threat

- Immediate threat: Clearing of habitat for development
  - The largest remaining intact area with high cover of Morro manzanita is on private land

2024 GoogleEarth imagery of Baywood-Los Osos area

Department Recommendation

The Department finds there is sufficient scientific information to indicate that the petitioned action to list the species as endangered may be warranted and recommends that the Commission accept and consider the petition.

Thank You | Questions

Kristi Lazar

Senior Environmental Scientist (Specialist)

(916) 594-5425

NativePlants@wildlife.ca.gov

Photo: Kristi Lazar 2024

Summary

- Evergreen shrub in the heath family
- Seven occurrences in the Los Osos area of coastal San Luis Obispo County
- Baywood fine sand soils
- Declining population trend based on reduction in historic distribution and current small distribution.
- Survival and reproduction affected by clearing for development, invasives, stochastic events, climate change, sudden oak death pathogen
- Most imminent and ongoing threat is from development
- The Department recommends the Commission accept the petition for further consideration under CESA