

Arctostaphylos glandulosa subsp. *crassifolia*
(Del Mar manzanita)

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



Photo by Emilie Luciani (U.S. Fish and Wildlife Service).

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

August 2023

5-YEAR REVIEW

Arctostaphylos glandulosa subsp. *crassifolia* (Del Mar manzanita)

GENERAL INFORMATION

Species: *Arctostaphylos glandulosa* subsp. *crassifolia* (Del Mar manzanita), a plant subspecies

Date listed under the Endangered Species Act: October 7, 1996

Federal Register citation: Service 1996 (61 FR 52370)

Classification: Endangered

Recovery Plan: There is no recovery plan for this subspecies.

Recovery Priority Number: 6C

Critical Habitat Designation: No critical habitat has been designated for this subspecies.

BACKGROUND

Under the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*), the U.S. Fish and Wildlife Service (Service), referred to as “we” in this document, maintain lists of endangered and threatened wildlife and plant species (referred to as the List) in the Code of Federal Regulations (CFR) at 50 CFR 17.11 (for wildlife) and 17.12 (for plants). Section 4(c)(2)(A) of the Act requires us to review each listed species’ status at least once every 5 years.

Most recent status review: Service 2010. *Arctostaphylos glandulosa* subsp. *crassifolia* (Del Mar manzanita) 5-year Review: Summary and Evaluation. Carlsbad Fish and Wildlife Office, Carlsbad, California. 43 pp.

We initiated the previous status review for *Arctostaphylos glandulosa* subsp. *crassifolia* on March 25, 2009 (Service 2009, pp. 12878–12883). The review was finalized on August 13, 2010 and recommended no change in status (Service 2010, p. 43).

Federal Register notice announcing this status review: On May 20, 2021, we published a *Federal Register* notice announcing initiation of the 5-year review of this subspecies, and the opening of a 60-day period to receive information (Service 2021, pp. 27462–27464).

Species Overview and Habitat:

Arctostaphylos glandulosa subsp. *crassifolia* is one of seven accepted subspecies of *A. glandulosa* (ITIS 2023, unpaginated). It is a perennial woody, burl-forming shrub in the *Ericaceae* (heath family). The subspecies occurs in southern maritime chaparral habitat in San Diego County, California.

ASSESSMENT

Information acquired since the last status review

This 5-year review was conducted by the Service’s Carlsbad Fish and Wildlife Office. Data for this review were solicited from the public and interested parties through a *Federal Register*

notice announcing this review on May 20, 2021. We incorporated new information sent to us by the U.S. Marine Corps and Center for Natural Lands Management in response to our *Federal Register* notice. We reviewed data from the California Natural Diversity Database (CNDDDB) and contacted researchers that have worked on genetics of the subspecies. Additionally, we conducted a literature search and reviewed information in our files.

SUMMARY OF NEW INFORMATION SINCE 2010

Genetics and Taxonomy

The *Arctostaphylos* genus is known for its complex patterns of morphological variation that have challenged taxonomists for many years (Keeley *et al.* 2007, p. 42; Keeley *et al.* 2017, entire). These complexities, along with possible hybridization and introgression of *Arctostaphylos glandulosa* (Eastwood manzanita), have led to difficulties in determining defining characteristics and range of *A. g.* subsp. *crassifolia* (Keeley *et al.* 2007, pp. 42–46). Furthermore, morphological and genetic differences have been observed between *A. g.* subsp. *crassifolia* in the large inland population at Marine Corps Air Station (MCAS) Miramar and the type locality along the coast (Burge and Parker 2017, p. 30; Colón 2020, pers. comm.). Differences in the MCAS Miramar population has led to questions about whether true *A. g.* subsp. *crassifolia* exists at MCAS Miramar (Burge and Parker 2017, p. 30; Colón 2020, pers. comm.). While the taxonomic classification and nomenclature of *A. g.* subsp. *crassifolia* has remained the same since listing, two genetic studies were completed since the 2010 5-year review (Burge *et al.* 2018, entire; Huang *et al.* 2020, entire) and more research is ongoing.

One of the recent studies investigated whether plants identified as *Arctostaphylos glandulosa* subsp. *crassifolia* using morphological criteria¹ would also group together by genetic similarity (Burge *et al.* 2018, pp. 117, 120). Analyses suggested that plant morphology is a reliable predictor of underlying genetic groups but there is only a weak association between genetic groups and the taxonomic names assigned based on current morphological circumscriptions (Burge *et al.* 2018, p. 126). When genetic analysis included only individuals identified as putative *A. g.* subsp. *crassifolia*, plants from the type locality and nearby coastal locations in northwestern San Diego County formed one genetic group while plants from more distant locations [including samples from MCAS Miramar and coastal Baja California (Mexico)] formed an incohesive second group (Burge *et al.* 2018, p. 127, Figure 5). The authors emphasized the need for more reliable circumscriptions for *A. glandulosa* subspecies identification and that broader sampling is needed to determine the taxonomic limits of *A. glandulosa* subspecies (Burge *et al.* 2018, pp. 126–128).

Another recent study (Huang *et al.* 2020, entire) examined the environmental and genetic differentiation among 8 of the 10 recognized subspecies of *Arctostaphylos glandulosa*. One of the main conclusions of the study was that genetic structure (i.e., differentiation) in *A. glandulosa* reflects geographic distribution of sampled individuals more so than current subspecies designations (Huang *et al.* 2020, p. 923). The analyses did not detect ecological differentiation among subspecies and identified genetic differentiation in only *A. g.* subsp.

¹ Morphology characteristics included leaves and stems but not fruit morphology in this study because sample collection occurred prior to fruiting (Burge *et al.* 2018, p. 120).

gabrielensis (Huang *et al.* 2020, pp. 923, 935). While genetic differentiation was not supported in subsp. *crassifolia* (or in the other six analyzed subspecies), the subsp. *crassifolia* samples all grouped together in one of the analyses (Huang *et al.* 2020, pp. 930–931, Figure 7) suggesting that additional analyses could support genetic differentiation of the subspecies. Huang *et al.* (2020, p. 935) suggests that recognition of *A. g.* subsp. *crassifolia* as a distinct subspecies should be reconsidered, but the authors also caution that limitations in their analyses prevent strong conclusions (Huang *et al.* 2020, p. 923). The authors also suggest that sequencing an *Arctostaphylos* genome and much more in-depth sampling across the range of *A. glandulosa* and inclusion of potential progenitor species in analyses may be needed (Huang *et al.* 2020, p. 937).

In response to this need for greater clarity of *Arctostaphylos glandulosa* taxonomy to address management of rare subspecies, additional genetic research is ongoing at University of California, Riverside. In contrast to the lack of genetic differentiation found for *A. g.* subsp. *crassifolia* in Huang *et al.* (2020, pp. 923, 935), preliminary results of a phylogenetic study (unpublished) provide support for *A. g.* subsp. *crassifolia* being distinct (Litt 2023, pers. comm.).

Distribution and Occurrences

At the time of the 2010 5-year review for *Arctostaphylos glandulosa* subsp. *crassifolia*, there were 51 known occurrences [including 1 relocation and restoration site (EO 15) and 1 transplanted occurrence at San Diego Botanic Garden in Encinitas, California (EO 59)] that were extant or presumed extant (Service 2010, pp. 5, 7) (Appendix A). Six of the 51 occurrences were yet to be included as Element Occurrences (EO) in CNDDDB, the database maintained by California Department of Fish and Wildlife (CDFW) (Appendix A). Since then, all occurrences identified in the 2010 5-year review have been assigned EO numbers in CNDDDB, EO 53 was subsumed into the nearby EO 47, and 6 new EOs (EOs 61–62, 65–67, and 73; Figure 1; Table 1) have been described (CDFW 2023, database). Thus, there are 56 extant (or presumed extant) EOs that are currently known (CDFW 2023, database). However, the subspecies identity of plants at inland locations such as MCAS Miramar has been questioned; some experts have suggested that plants at these locations are hybrids or belong to a different subspecies of *A. glandulosa* (Burge and Parker 2017, p. 30; Colón 2020, pers. comm.; CDFW 2023, dataset).

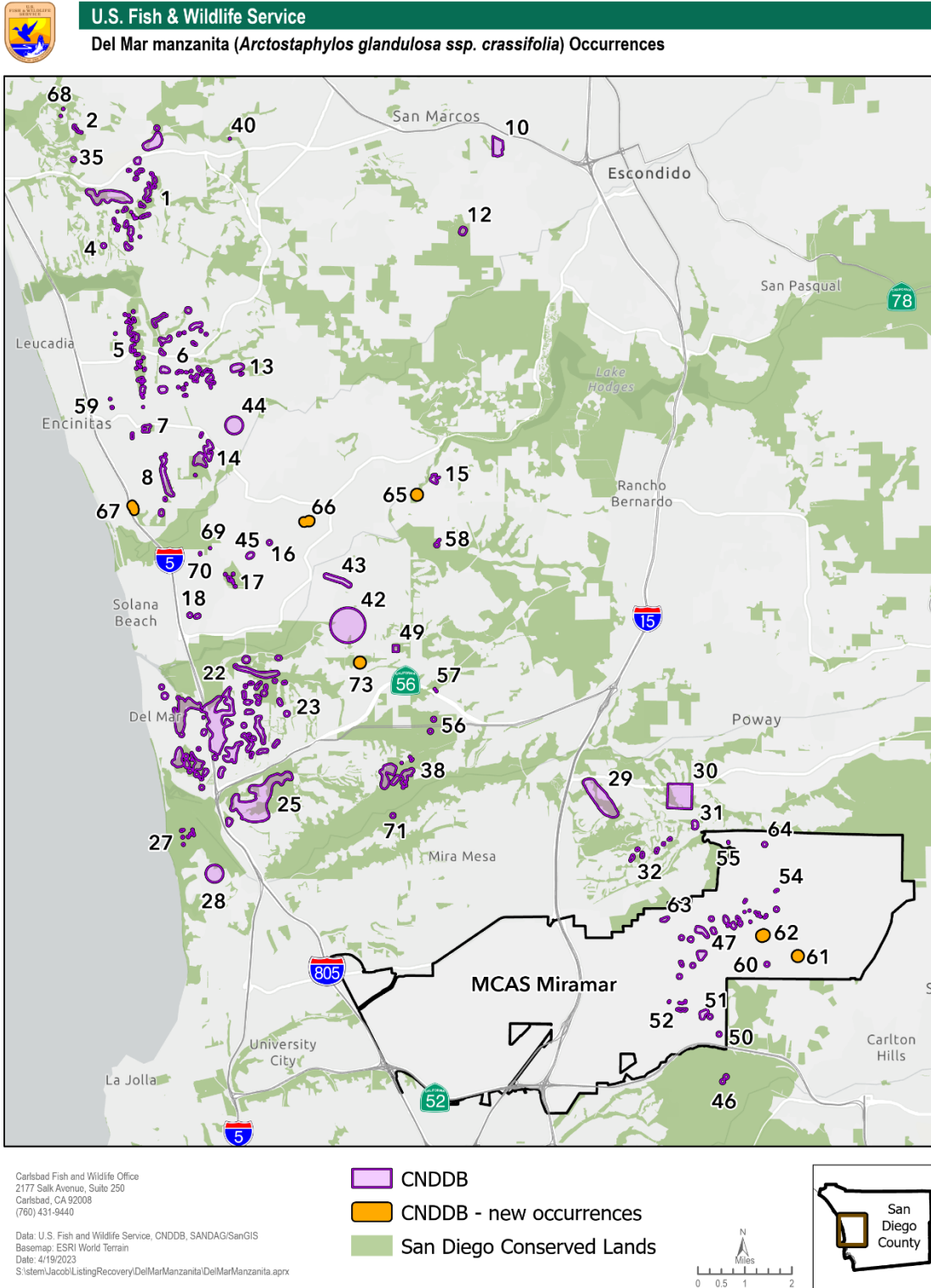


Figure 1. Map of *Arctostaphylos glandulosa* subsp. *crassifolia* occurrences from the California Natural Diversity Database (CDFW 2023, database) and lands preserved for conservation and open space (SANDAG Technical Services 2022, database). Occurrences in orange show those that have been described since the previous 5-year review.

Table 1. California Natural Diversity Database (CNDDDB) Element Occurrences not described in the 2010 5-year review for *Arctostaphylos glandulosa* subsp. *crassifolia*.¹

Location	CNDDDB Element Occurrence	Owner	Population Status	Conservation Status (Figure 1)
Encinitas, between I-5 and Bulrush Lane	67	Nature Collective (formerly San Elijo Lagoon Conservancy) and Private	Presumed extant; 33 plants observed in 2003; possibly impacted by adjacent development	Partially conserved
Crosby at Rancho Santa Fe	65	San Diego County	Extant; described as a “stable and growing population” with 312 plants in 2021 (Rincon Consultants, Inc. 2022, p. H-2)	Fully conserved
Rancho Santa Fe, SSE of junction of Linea del Cielo and Mimosa Place	66	Private	Presumed extant; 11 plants observed in 2006	Partially conserved; the western part is on the Ewing Preserve (CDFW 2023, dataset); note this Preserve is not in the Conserved Lands database, Figure 1.
Between La Zanja Canyon and Gonzales Canyon	73	Private	Presumed extant; Described at 1% cover during 2013 vegetation surveys; possibly impacted by development	Fully conserved
MCAS Miramar, Quail Canyon	61	Department of Defense	Presumed extant	Managed for conservation by MCAS Miramar
MCAS Miramar, Spring Canyon	62	Department of Defense	Presumed extant	Managed for conservation by MCAS Miramar

¹ Table information is from CNDDDB (CDFW 2023, database) and the San Diego Association of Governments conserved lands database (SANDAG Technical Services 2022, database), unless cited otherwise.

Conservation Status

Approximately 37 percent of mapped CNDDDB occurrence area² is on San Diego conserved lands (Figure 1). These lands have largely been conserved through Service-approved Habitat Conservation Plans such as the San Diego Multiple Species Conservation Program and the San

² Calculation of percent area excluded 6 occurrences (EOs 10, 12, 29, 30, 42, and 43) because they either were mapped to a “non-specific area” or had very low accuracy (i.e., 0.4 mi). EO 66 was also not included in the calculation of conserved lands because the Ewing Preserve (which overlaps the western part of EO 66) is not included in the SANDAG Technical Services (2022) conserved lands database, which was used to calculate area.

Diego Multiple Habitat Conservation Program, which serve to minimize and mitigate adverse impacts to listed species, including *Arctostaphylos glandulosa* subsp. *crassifolia*. Several of the conserved land parcels (through acquisitions, covenants, or easements) were placed into conservation since the 2010 5-year review was written. Thus, more *A. g.* subsp. *crassifolia* habitat is conserved now than during 2010. New additions to the conserved lands network that overlap with *A. g.* subsp. *crassifolia* EOs include properties named Zamudio Del Mar Mesa (2010), Estates at Costa Del Mar II (2011), Poco Lago Homeowners Association (2012), University Heights (2014), Baticuitos Bluffs (2015), and San Elijo Lagoon Ecological Reserve³ (2017) (SANDAG Technical Services 2022, dataset).

Another 10 EOs (including new EOs, 61 and 62), while not on San Diego conserved lands database, are managed for conservation by MCAS Miramar. The MCAS Miramar Integrated Natural Resources Management Plan (INRMP) outlines the plan to maintain and, where feasible, enhance populations of *Arctostaphylos glandulosa* subsp. *crassifolia* and other natural resources while maintaining maximum compatible use for Department of Defense operational requirements (MCAS Miramar 2018, p. 5.2). The 2010 5-year review for *A. g.* subsp. *crassifolia* mentioned that 30 plants at two occurrences on MCAS Miramar (EOs 50 and 51) are expected to be impacted by a military family housing project and subsequently mitigated through a restoration plan for at least 90 *A. g.* subsp. *crassifolia* and associated habitats (Service 2010, p. 13). However, the Military Family Housing project was withdrawn in 2015 (Service 2015, p. 1). Thus, effects to *A. g.* subsp. *crassifolia* from the proposed housing developing and associated conservation measures are no longer anticipated (Service 2015, p. 1).

Propagation and Translocation Project

In 2012, we completed formal consultation for the California Department of Transportation (Caltrans) Interstate 5 North Coast Corridor Project in San Diego County (Service 2012, entire). We determined that the project would permanently impact six *Arctostaphylos glandulosa* subsp. *crassifolia* individuals (Service 2012, p. 8) in EO 22. Caltrans agreed to offset impacts to the species by salvaging and translocating all *A. g.* subsp. *crassifolia* in the project impact footprint to the nearby Dean mitigation property (Service 2012, p. 15), which is located just north of EO 22 on the east side of Interstate 5. Because there has been limited success with translocation of this species, Caltrans also agreed to propagate additional individuals at a facility that has experience working with *Arctostaphylos* species and eventually plant those at the Dean mitigation property (Service 2012, p. 15).

Guided by the *Arctostaphylos glandulosa* ssp. *crassifolia* translocation and propagation plan for the project (AECOM 2013, entire), cuttings were taken from individuals in the project impact footprint and propagated in a greenhouse. Cuttings were not taken from all of the six *A. g.* subsp. *crassifolia* individuals in the project impact footprint because some of the plants were not healthy enough (McMillan 2013, *in litt.*). In 2015, three 15-gallon greenhouse plants (propagated from the cuttings) were planted at the Dean property, and in 2019, eight small 1-gallon plants (also propagated from cuttings) were planted at the Dean property (Caltrans 2019, p. 10; Scatolini 2023, pers. comm.). Additional propagules were started in the greenhouse as well but

³ Although the San Elijo Lagoon Ecological Reserve was established in 2017, the site was already set aside as open space prior to the 2010 5-year review.

survival was low. Approximately 12–15 plants in 1-gallon pots were killed by frost in 2013 while in the greenhouse (Scatolini 2023, pers. comm.).

As of 2023, only two of the 15-gallon plants have survived and both are healthy (Scatolini 2023, pers. comm.). Of the eight small 1-gallon plants that were transplanted, only one survived the first few months (Caltrans 2019, p. 10). One of the three larger 15-gallon plants died after its roots were disturbed during restoration of other native plants to the site (Brown 2022, pers. comm.).

The six *Arctostaphylos glandulosa* subsp. *crassifolia* individuals in the project impact footprint have not yet been translocated to the Dean property because construction in those areas has not begun. It is possible that the salvage and translocations will not occur if the project can avoid them or if the plants die of natural causes. The plants began showing signs of distress in 2013, potentially from frost damage early in the year (McMillan 2013, pers. comm.). Frost events also occurred in 2015 and 2017, likely stressing them further (Brown 2022, pers. comm.).

Wildfire and Post-fire Recovery

As described in the 2010 5-year review, *Arctostaphylos glandulosa* subsp. *crassifolia* responds positively to fire (Service 2010, p. 15). In 2003, the high-severity Cedar Fire burned 100 percent of *A. g.* subsp. *crassifolia* locations at MCAS Miramar (MCAS Miramar 2018, p. 4.38). Prior to the 2003 Cedar Fire, plants that grew among dense unburned chaparral appeared unhealthy with “many branches dead or desiccated and trunks covered with lichen” (Kellogg 2004, p. 8). Since the fire, populations of *A. g.* subsp. *crassifolia* resprouted vigorously (MCAS Miramar 2018, p. 4.38). Post-fire monitoring of *A. g.* subsp. *crassifolia* on MCAS Miramar occurred during 2006, 2009, and 2012 (Tetra Tech, Inc 2012, p. i). In the 11 monitoring plots, the number and size of *A. g.* subsp. *crassifolia* individuals has increased since monitoring began in 2006 (Tetra Tech, Inc 2012, pp. 10–14). The number of *A. glandulosa* seedlings (subsp. *crassifolia* seedlings could not be distinguished from seedlings of co-occurring subspecies) has also been monitored in the 11 plots. The greatest number of seedlings (114) were found during 2006, the first monitoring year after the fire, followed by 2009 (71 seedlings), and 2012 (49 seedlings) (Tetra Tech, Inc 2012, pp. 10–11). Although the total number of seedlings has decreased, the number of seedlings observed in some plots increased between 2006 and 2009, or between 2009 and 2012 (Tetra Tech, Inc 2012, p. 11, Table 1), indicating that seed germination may still be occurring up to 9 years after the Cedar Fire.

In 2014, approximately 60 acres burned at varying intensities across Rancho La Costa Preserve (Center for Natural Lands Management 2021, *in litt.*, p. 5). Following the fire, the Center for Natural Lands Management,⁴ installed fencing to protect habitat, installed and maintained erosion control measures, removed invasive species, and documented native species recolonization. In 2015, 19 *Arctostaphylos glandulosa* subsp. *crassifolia* were resprouting in an area where only 9 individuals had been identified during previous surveys. In 2016, the same 19 resprouts were observed but no seedlings were found during either year (Center for Natural Lands Management 2021, *in litt.*, p. 5).

⁴ The Center for Natural Lands Management is a nonprofit conservation organization that manages a number of preserves in California and Washington. A summary of recent survey information at the six preserves they manage with *Arctostaphylos glandulosa* subsp. *crassifolia* is provided in Appendix B.

Herbivory and Disease

While the health of the *Arctostaphylos glandulosa* subsp. *crassifolia* population in the MCAS Miramar post-fire monitoring plots has increased, surveyors also observed signs of herbivory and disease. While monitoring 253 tagged individuals, MCAS Miramar surveyors observed nectar-robbing (i.e., when insects access floral resources from the outside of the flower opening without touching the flowers anthers or stigma) on “many individuals,” signs of insect herbivory of leaves on 14 percent of individuals, and black leaf spots (which could be a sign of sun damage or fungal growth) on 32 percent of individuals (Tetra Tech, Inc 2012, p. 15). The report recommended that disease and herbivory continue to be monitored to determine if these factors negatively impact *A. g.* subsp. *crassifolia* growth and reproduction over time (Tetra Tech, Inc 2012, p. 18).

The Center for Natural Lands Management also mentioned disease as a potential threat to *Arctostaphylos glandulosa* subsp. *crassifolia*. In a letter to the U.S. Fish and Wildlife Service, the Center for Natural Lands Management stated that powdery mildew (*Podosphaera xanthii*), a fungal disease, had been observed affecting the leaves of *A. g.* subsp. *crassifolia* at preserves they managed in Carlsbad, California (Center for Natural Lands Management 2021, *in litt.*, p. 2). In 2017, they initiated monitoring to determine presence of powdery mildew on *A. g.* subsp. *crassifolia* at the La Costa Glen Habitat Conservation Area, but did not find any (Center for Natural Lands Management 2021, *in litt.*, p. 2–3).

Summary of Threats

The listing rule described habitat destruction and fragmentation from urban, agricultural, or recreational development; fuel modification; trampling; and nonnative invasive plant species as primary threats to *Arctostaphylos glandulosa* subsp. *crassifolia* (Service 1996, pp. 52371, 52377–52381). The listing rule also described interruption of the natural fire cycle as a potential threat (Service 1996, pp. 52381–52382). The 2010 5-year review for *A. g.* subsp. *crassifolia* provided additional information on threats described in the listing rule. The review further identified small population size—as evidenced by the lack of seedlings at occurrences—as a threat, military training at MCAS Miramar as a minimal threat potentially offset by management considerations, and climate change as a potential threat (Service 2010, pp. 10–29).

Partners that manage lands with *Arctostaphylos glandulosa* subsp. *crassifolia* also reported threats that may affect the subspecies. A report from MCAS Miramar suggested that hybridization could be a threat to the subspecies, in addition to altered fire regime (including plant canopy encroachment), nonnative invasive plants, erosion with high rainfall events, nectar-robbing and herbivory, and potential disease (Tetra Tech, Inc 2012, pp. 15–18). The Center for Natural Lands Management, which manages six preserves with *A. g.* subsp. *crassifolia*, described the following as current and continuing threats to the subspecies on their preserves: human access (e.g., off-highway vehicle use, trash and debris, erosion, itinerant encampments); altered fire regime; powdery mildew (potentially causing leaf die-off); nonnative invasive plants; and erosion with high rainfall events that could potentially wash away individuals on steep cliffs (Center for Natural Lands Management 2021, *in litt.*, p. 3).

The status of threats to *Arctostaphylos glandulosa* subsp. *crassifolia* is largely the same as described in the 2010 5-year review (Service 2010, pp. 10–29), with two differences. First, additional habitat has been conserved since the previous status review (see Section titled Conservation Status), which reduces threats from development and conflicting land use while also potentially increasing management of other threats. Second, potential effects to plant health from herbivory and possible fungal disease have been reported (see section titled Herbivory and Disease). Additional surveys are needed to determine the extent of herbivory and disease across the subspecies' range and additional monitoring of plant health is needed to determine if herbivory or disease is having an appreciable effect on *A. g.* subsp. *crassifolia*. The primary threats to *A. g.* subsp. *crassifolia* include development, fuel modification practices, human access, and altered fire regime. Other potential threats include small population size, military training, climate change, fungal disease, and herbivory (including nectar robbing).

CONCLUSION

This status review of *Arctostaphylos glandulosa* subsp. *crassifolia* described new information about genetics and taxonomy, six new occurrences that have been described since the 2010 5-year review, conservation status of occupied habitat, results of a propagation and translocation project, wildfire and post-fire recovery, and observations of herbivory and potential fungal disease. Two genetic studies were completed and published since the 2010 5-year review (Burge *et al.* 2018, entire; Huang *et al.* 2020, entire) and more research is ongoing. The recent genetic studies highlight a strong need for a comprehensive taxonomic study of *A. glandulosa* to understand subspecies distribution and inform rare plant conservation.

Based on our current estimation of the distribution of *Arctostaphylos glandulosa* subsp. *crassifolia*, there are 55 known wild EOs (54 natural and 1 relocated/restored) and 1 transplanted EO (CDFW 2023, database), 5 more EOs than were described in the 2010 5-year review. However, the taxonomic identity of plants at several of the occurrences has been questioned; some experts have suggested that plants at these locations are hybrids or belong to a different subspecies of *A. glandulosa* (Burge and Parker 2017, p. 30; Colón 2020, pers. comm.; CDFW 2023, dataset).

There have been few changes in threats to *Arctostaphylos glandulosa* subsp. *crassifolia* since the 2010 5-year review. The amount of conserved habitat has increased but the subspecies remains threatened by development and human-caused impacts. Furthermore, altered fire regime is a rangewide threat, likely limiting adult health and seedling recruitment. The low numbers of individuals reported at some sites coupled with a lack of evidence of reproduction suggests that the subspecies could experience declines in the near future. Therefore, *A. g.* subsp. *crassifolia* still faces a high degree of threat.

The new information and updated occurrence status does not substantially alter the subspecies' status or the results of our five-factor analysis in the 2010 5-year review. Therefore, we conclude that *Arctostaphylos glandulosa* subsp. *crassifolia* remains a federally endangered subspecies and recommend no change in listing status.

RECOMMENDATIONS FOR FUTURE ACTIONS

The recommended actions listed below are to be initiated over the next 5–10 years. Successful implementation of these actions will provide a better understanding of *Arctostaphylos glandulosa* subsp. *crassifolia* population health, reproductive output, and factors affecting the low rate of establishment. Additional genetic information will also help to better understand relatedness between the listed entity and the other six subspecies and provide more clarity of the geographic distribution of the listed entity. We recognize that conservation of this taxon will require cooperation and coordination with partners to minimize impacts from current threats and aid future restoration efforts.

1. Work with partners to identify opportunities for conservation or preservation of *Arctostaphylos glandulosa* subsp. *crassifolia* occurrences on private lands. Support land acquisition to meet Habitat Conservation Plan goals. Work with local, State, and Federal partners to identify and leverage funding (i.e., section 6) to acquire *A. g.* subsp. *crassifolia* habitat.
2. Assess the taxonomic status of *Arctostaphylos glandulosa* subspecies (and similar species) in California and Mexico such that the endangered entity (*A. g.* subsp. *crassifolia*) can be clearly identified.
 - a. Determine the geographic distribution of the endangered entity and hybridization zones.
 - b. If necessary, revise circumscriptions for *Arctostaphylos glandulosa* subspecies and related taxa.
3. Evaluate the status of *Arctostaphylos glandulosa* subsp. *crassifolia* in Mexico.
4. Assess the reproductive output of *Arctostaphylos glandulosa* subsp. *crassifolia* occurrences, including seed production and viability.
5. Determine causes and likely remedies for apparent low rate of establishment of new plants. This should include establishing the role of fire in the subspecies' biology and exploration of an acceptable alternative.
6. Determine the extent to which herbivory or disease may be affecting survival, reproduction, or recruitment of *Arctostaphylos glandulosa* subsp. *crassifolia*.

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APPENDIX A

Table A1. *Arctostaphylos glandulosa* subsp. *crassifolia* (Del Mar manzanita) occurrences, threats and conservation status in 2010.¹

Location Description	CNDDDB Element Occurrence Number (EO)	Known at listing	Extant (2010)	Current Threats	Owner	Conserved (Yes, Partially, No)
South of Barham Dr., east of La Moree Rd.	10		PE	Factor A: development, fuel modification, altered fire regime Factor E: altered fire regime, small population size	Private	No
San Marcos	-		PE	Factor A: development, altered fire regime Factor E: altered fire regime	City of San Marcos	No
Mt Whitney	12		PE	Factor A: development, altered fire regime Factor E: altered fire regime	Private	No
S of San Dieguito River, SW of Lake Hodges	15	Y	E	Factor A: fuel modification, altered fire regime Factor E: altered fire regime	Private	Yes
Rancho Santa Fe	16	Y	PE	Factor A: development, altered fire regime Factor E: altered fire regime	Private	No
San Dieguito County Park	17	Y	E	Factor A: altered fire regime, nonnatives Factor E: altered fire regime	County of San Diego	Yes
Northern slopes of La Zanja Canyon	42		PE	Factor A: development, altered fire regime Factor E: altered fire regime	Private	No

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Location Description	CNDDDB Element Occurrence Number (EO)	Known at listing	Extant (2010)	Current Threats	Owner	Conserved (Yes, Partially, No)
South of Rancho Santa Fe	43		PE	Factor A: development		No
Rancho Santa Fe	45		PE	Factor A: development, altered fire regime Factor E: altered fire regime	Private	No
La Zanja Canyon	49		E	Factor A: development, altered fire regime Factor E: altered fire regime	Private	No
Canyons N of Lusardi Creek	58		E	Factor A: altered fire regime Factor E: altered fire regime	County of San Diego	Yes
Upper Agua Hedionda drainage	1	Y	PE	Factor A: development, fuel modification, altered fire regime, nonnatives, human access Factor E: altered fire regime, small population size	City of Carlsbad, Private, County of San Diego	Partially
Southeast of Evans Point	2	Y	PE	Factor A: fuel modification, altered fire regime Factor E: altered fire regime, small population size	City of Carlsbad, Private	Yes
North of Batiquitos Lagoon, West of El Camino Real	4		PE	Factor A: fuel modification, altered fire regime Factor E: altered fire regime, small population size	Private	Yes

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Location Description	CNDDDB Element Occurrence Number (EO)	Known at listing	Extant (2010)	Current Threats	Owner	Conserved (Yes, Partially, No)
South of Encinitas Creek, East of Rancho Santa Fe Rd	13		PE	Factor A: fuel modification, altered fire regime Factor E: altered fire regime, small population size	Private	Yes
Carlsbad Municipal Golf Course	35	Y	E	Factor A: altered fire regime Factor E: altered fire regime, small population size	City of Carlsbad	Yes
Carlsbad Raceway	40		PE	Factor A: development, altered fire regime Factor E: altered fire regime	Private	No
Kelly Ranch	-		E	Factor A: altered fire regime, nonnatives, human access Factor E: altered fire regime, small population size	Private	Yes
Hills west of Green Valley	5	Y	PE	Factor A: development, fuel modification, altered fire regime Factor E: altered fire regime	City of Encinitas; Private	Partially
East of El Camino Real, south of La Costa Ave, north of Encinitas Blvd	6	Y	PE	Factor A: fuel modification, altered fire regime Factor E: altered fire regime, small population size	City of Carlsbad, Private	Yes
Oak Crest Park	7	Y	E	Factor A: development, altered fire regime, nonnatives Factor E: altered fire regime, small population size	City of Encinitas, School Districts	Partially

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Location Description	CNDDDB Element Occurrence Number (EO)	Known at listing	Extant (2010)	Current Threats	Owner	Conserved (Yes, Partially, No)
Lux Canyon	8	Y	PE	Factor A: development, fuel modification, altered fire regime Factor E: altered fire regime	Private	Partially
South of Encinitas Blvd., west of Manchester, Olivenhain	14	Y	E	Factor A: fuel modification, altered fire regime Factor E: altered fire regime	Private	Yes
Near Whisper Wind Lane	44		PE	Factor A: development, altered fire regime Factor E: altered fire regime		No
East of El Camino Real, just south of intersection of Calle Ryan and Calle Christopher	-		PE	Factor A: fuel modification, altered fire regime Factor E: altered fire regime, small population size	Private	Yes
Eden Gardens	18	Y	PE	Factor A: development, fuel modification, altered fire regime Factor E: altered fire regime, small population size	Private	No
San Elijo Lagoon	-		PE	Factor A: fuel modification, altered fire regime Factor E: altered fire regime, small population size	County of San Diego	Yes

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Location Description	CNDDDB Element Occurrence Number (EO)	Known at listing	Extant (2010)	Current Threats	Owner	Conserved (Yes, Partially, No)
South of San Dieguito River, north of Carmel Valley Rd., east and west of I-5	22	Y	E	Factor A: development, fuel modification, altered fire regime, nonnatives Factor E: altered fire regime, small population size	City of Del Mar, City of San Diego, California State Parks, Private	Partially
N of Del Mar Heights Rd and Carmel Canyon Rd.	23	Y	PE	Factor A: development, altered fire regime Factor E: altered fire regime, small population size	Private	No
Carmel Mountain	25	Y	E	Factor A: development, altered fire regime, nonnatives Factor E: altered fire regime, small population size	City of San Diego	Partially
Torrey Pines State Reserve (south)	27	Y	E	Factor A: altered fire regime Factor E: altered fire regime	California State Parks	Yes
Mesa west of Torrey Pines Science Park	28		PE	Factor A: altered fire regime Factor E: altered fire regime, small population size	California State Parks	Yes
North of Miramar Lake	29	Y*	PE	Factor A: development, altered fire regime Factor E: altered fire regime	City of San Diego	No
Northeast of Miramar Lake	30	Y*	PE	Factor A: development, altered fire regime Factor E: altered fire regime	City of San Diego	Partially

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Location Description	CNDDDB Element Occurrence Number (EO)	Known at listing	Extant (2010)	Current Threats	Owner	Conserved (Yes, Partially, No)
West of Pomerado Rd	31	Y*	PE	Factor A: development, altered fire regime Factor E: altered fire regime, small population size	City of San Diego	No
East of Miramar Lake	32	Y*	PE	Factor A: development, altered fire regime Factor E: altered fire regime, small population size	City of San Diego	No
Los Penasquitos Canyon/Del Mar Mesa Preserves	38	Y	E	Factor A: development, altered fire regime, nonnatives Factor E: altered fire regime	City of San Diego, Private	Partially
Del Mar Mesa Preserve	41		E	Factor A: altered fire regime, nonnatives Factor E: altered fire regime	City of San Diego; County of San Diego	Yes
Mission Trails	46		E	Factor A: altered fire regime Factor E: altered fire regime	City of San Diego	Yes
Deer Canyon Mitigation Preserve	56		E	Factor A: altered fire regime Factor E: altered fire regime	City of San Diego	Yes
Deer Canyon Mitigation Preserve	57		E	Factor A: altered fire regime Factor E: altered fire regime	City of San Diego	Yes
Peñasquitos Canyon South	-		PE	Factor A: altered fire regime Factor E: altered fire regime	City of San Diego	Yes
San Clemente Canyon	47		E	Factor A: development, fuel modification, altered fire regime Factor E: military training	Department of Defense	No

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Location Description	CNDDDB Element Occurrence Number (EO)	Known at listing	Extant (2010)	Current Threats	Owner	Conserved (Yes, Partially, No)
MCAS Miramar	50		E	Factor A: development, fuel modification, altered fire regime Factor E: military training	Department of Defense	No
MCAS Miramar	51		E	Factor A: development, fuel modification, altered fire regime Factor E: military training	Department of Defense	No
MCAS Miramar	52		E	Factor A: development, fuel modification, altered fire regime Factor E: military training	Department of Defense	No
MCAS Miramar	53		E	Factor A: development, fuel modification, altered fire regime Factor E: military training	Department of Defense	No
MCAS Miramar	54		E	Factor A: development, fuel modification, altered fire regime Factor E: military training	Department of Defense	No
MCAS Miramar	55		E	Factor A: development, fuel modification, altered fire regime Factor E: military training	Department of Defense	No
MCAS Miramar Training Areas	-		E	Factor A: development, fuel modification, altered fire regime Factor E: military training	Department of Defense	No

¹ Prepared for the 2010 5-year review. Y* = known at listing but not evaluated as part of the listing rule because their subspecific status was questioned.

APPENDIX B

Table B1. Adapted from Center for Natural Lands Management table titled “Del Mar manzanita surveys and trends in San Diego County.”¹

Preserve	CNDDDB Element Occurrence Number (EO)	Acres	Surveys/Comments
S024 Kelly Ranch	68	62	Census every 5 years. 2014: 3 individuals in 2 small occurrences; 2018: 5 plants; 2019: 13 plants (3 dead) with an ~50% leaf dieback (note: many of these plants may share a root structure and should be considered a single individual).
S042 Carlsbad Open Space	35	610	2012: 6 plants at the Crossings Golf Course.
S006 Manchester	14	123.5	Census every 5 years. 2005: 150 plants, 2008: 222 plants, 2019: 244 plants (note: many of these plants may share a root structure and should be considered a single individual)
S034 Carlsbad Oaks North	1	327	Currently not surveyed. 1 plant located by Center for Natural Lands Management between 2007-2012.
S045 La Costa Glen	5	108	Census every 5 years. Last monitored in 2017 to determine presence of powdery mildew. No mildew was observed, and plants condition appears stable.
S020 Rancho La Costa	1	1,640	Census every 5 years. Fire in 2014. 2015: 19 plants resprouting. 2016: No new seedlings.

¹ Center for Natural Lands Management 2021, *in litt.* p. 4 .

FIELD OFFICE APPROVAL

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Approved

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