

**Lompoc yerba santa (*Eriodictyon capitatum*)**  
**5-Year Review: Summary and Evaluation**



Cover photo. Lompoc yerba santa (*Eriodictyon capitatum*) in flower on 24 April 2019 along Cementario Road, on side ridge off Tranquillon Ridge, west end of Santa Ynez Mountains, Hollister Ranch, 490 meters/1,608 feet elevation, southwest Santa Barbara County, California (occurrence 5). Photo courtesy of Heather Schneider, Santa Barbara Botanic Garden, California.

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

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## GENERAL INFORMATION

**Species:** Lompoc yerba santa (*Eriodictyon capitatum*)

**Date listed:** 2000

**FR citation:** 65 FR 14888–14898

**Classification:** endangered

## BACKGROUND

### Most recent status review

U.S. Fish and Wildlife Service. 2011. *Eriodictyon capitatum* (Lompoc yerba santa). 5-year review: summary and evaluation. Ventura, California. 26 pp.

### FR notice citation announcing this status review

Initiation of 5-Year Status Reviews of 66 species in California and Nevada. Notice of initiation of reviews; request for information (85 FR 4692), January 27, 2020.

### Critical habitat

Designation of critical habitat for *Eriodictyon capitatum* (Lompoc yerba santa) and *Deinandra increscens* ssp. *villosa* (Gaviota tarplant). Final rule (78 FR 67968), November 7, 2002.

### State listing

*Eriodictyon capitatum* was listed as rare by the State of California in 1979 (California Department of Fish and Wildlife 2016 [CDFW]).

### Recovery plan

No recovery plan has been prepared for Lompoc yerba santa.

## ASSESSMENT

### Information acquired since last status review

This 5-year review was conducted by the U.S. Fish and Wildlife Service's [USFWS] Ventura Fish and Wildlife Office, California. We solicited information for this review from interested parties through a *Federal Register* notice on January 27, 2020. Additionally, we conducted a literature search and a review of information in our files, and we contacted State agencies, local agencies, species experts, and land managers.

New information has become available since our last 5-year review (USFWS 2011). Six occurrences were recognized in 2011 (occurrences 1, 2, 5, 9, 10 and 11). We now have data to recognize 11 occurrences, of which occurrences 12, 13, 14, 15 and 16 are new. Specifically, occurrence 12 became recorded in California Natural Diversity Database in 2019, and occurrences 13, 14, 15 and 16 became recorded in the database as a result of this review.

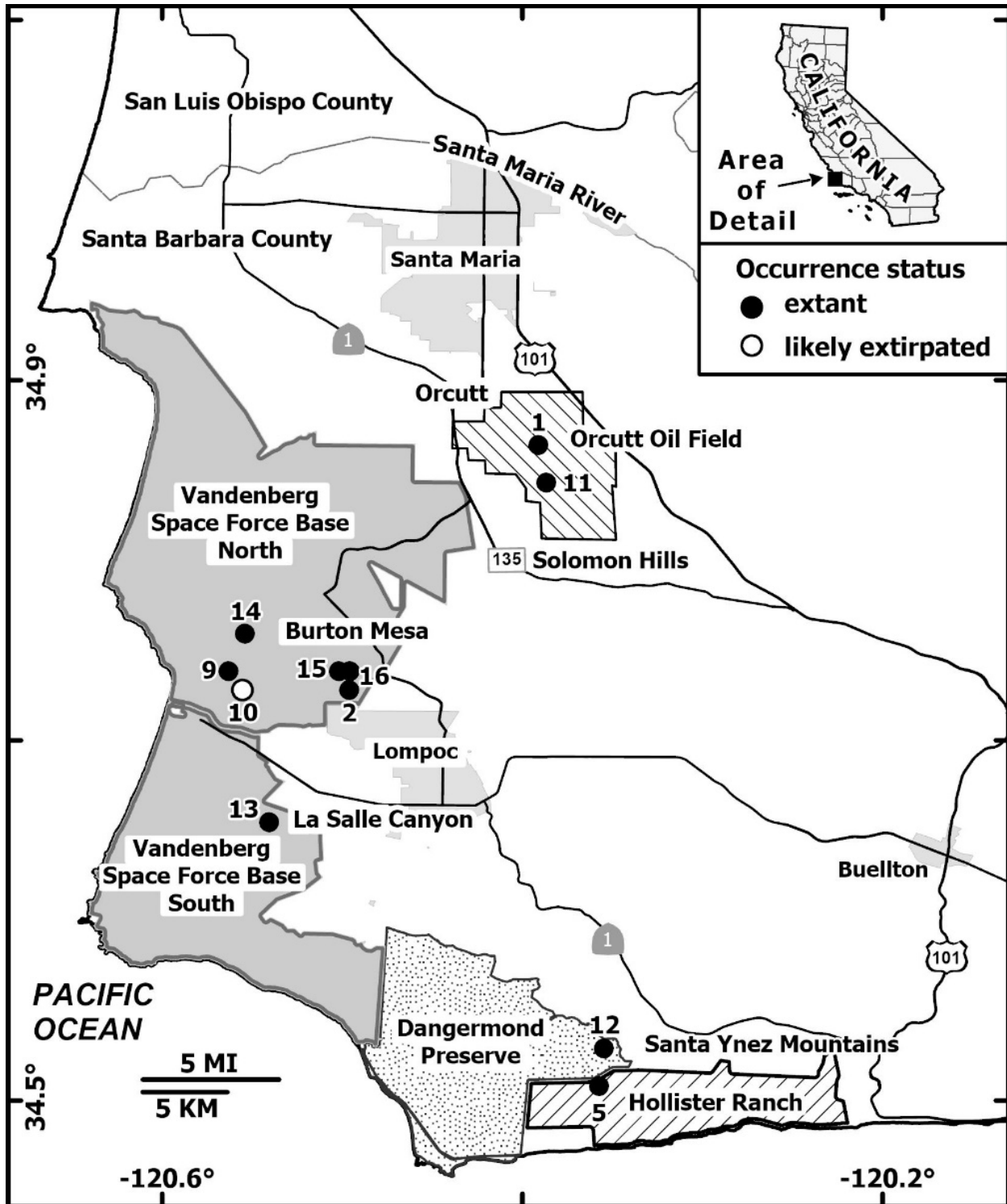
## Biology and ecology

Lompoc yerba santa is one of 11 species (plus additional subspecies and varieties) in the genus *Eriodictyon* (family Namaceae; Luebert et al. 2016, p. 502) that occur in southwest United States and north Baja California, Mexico (Hannan 2016, entire; Maher et al. 2020, p. 7). Lompoc yerba santa is endemic to west Santa Barbara County, California (Figure 1), growing at 47–533 m/154–1,749 ft elevation. The species was described by Eastwood (1933, p. 40–41) based on the holotype specimen CAS194986 collected in 1932 by Ralph Hoffman, “five miles north of Lompoc on the road to Casmalia, Santa Barbara County, California, growing under *Pinus muricata* [bishop pine].” It is a woody evergreen shrub with shredding bark and narrow, linear leaves (4–9 cm/1.6–3.5 inches long, 0.2–0.5 cm/0.08–0.24 inches wide) that are sessile (leaf blade attached directly to branch) on sticky branches with the leaf margin strongly rolled under (Hannan 2016, entire). The species is reported to stand up to 5 m/16.4 ft tall with stems up to 10 cm/3.9 inches diameter (Oyler et al. 1995, p. 55–56; Lum 2021b, entire). The lavender flowers have funnel-shaped corollas (6–15 mm/0.24–0.59 inches long) and are clustered in head-like inflorescences (2.5 cm wide/0.98 inch) at the tips of branches, blooming from April to July. The fruits are capsules with four valves, and each fruit produces up to five seeds. Lompoc yerba santa is distinguished from all other species of *Eriodictyon* by a combination of its linear leaves and head-like inflorescences (Hannan 2016, entire; Jepson Flora Project 2021, entire).

The region in which Lompoc yerba santa is found has a Mediterranean climate with mild, wet winters and moderately warm, dry summers, and it is strongly influenced by the prevailing westerly oceanic winds. A marine layer (fog) advances inland and is heaviest during late spring and early summer mornings (78 FR 64842). The general geology of the region is comprised of remnants of ancient uplifted sand dunes now forming a weakly cemented sandstone that weathers to produce a well-drained, sandy, and nearly infertile soil. The natural vegetation is predominantly central coast maritime chaparral, and a secondary type is bishop pine forest (65 FR 14888).

Lompoc yerba santa is considered an early successional, pioneer and edge species, exhibiting opportunistic resprouting by ramets (genetically identical stems derived from one progenitor), sometimes in response to disturbance (Schneider et al., 2021 p. 7). It is known to grow roadside, along trails, on exposed ridge tops, on slopes and in a canyon bottom, in open areas, at edge of dense vegetation, and in dense vegetation. The species occurs mostly in chaparral and bishop pine forest, and also in sage scrub and oak woodland. Most occurrences are in sandy soil, and parts of two occurrences (1 and 2) are in shale. The primary constituent elements for its critical habitat are: sandy, acidic soil; and maritime chaparral, and bishop pine forests that intergrade with chaparral (78 FR 67976). Associated species include bishop pine, black sage (*Salvia mellifera*), California sagebrush (*Artemisia californica*), ceanothus (*Ceanothus* sp.), chamise (*Adenostoma fasciculatum*), coast live oak (*Quercus agrifolia*), coyote brush (*Baccharis pilularis*) and La Purisima manzanita (*Arctostaphylos purissima*).

Lompoc yerba santa reproduces both sexually and asexually. The species is self-incompatible, meaning pollen from a different genetically-distinct individual is required for fertilization of flowers. Experimentally self-pollinated flowers produced a mean of 0.03 seed per fruit, whereas experimentally cross-pollinated flowers produced a mean of 1.77 seeds per fruit (Elam 1994, p. 146). The following floral visitors to Lompoc yerba santa have been observed (Knapp 2013b, p.



**Figure 1.** Geographic distribution of the 11 known occurrences of Lompoc yerba santa (*Eriodictyon capitatum*), endemic to west Santa Barbara County, California. We recognize four geographic populations, which from north to south are Solomon Hills (2 occurrences), Burton Mesa (6 occurrences), LaSalle Canyon (1 occurrence), and Santa Ynez Mountains (2 occurrences).

1; Schneider et al., 2021, p. 8; Termondt 2021a, p. 1): bee fly (Bombyliidae), carpenter ant (*Camponotus* sp.), small carpenter bee (*Ceratina* sp.), sweat bee (*Agapostemon* sp.), sweat bee (*Halictus* sp.), incomplete sweat bee (*Lasioglossum incompletum*), honey bee (*Apis* sp.), bumblebee (*Bombus* sp.), yellow-faced bumblebee (*Bombus vosnesenskii*), leaf beetle (Chrysomelidae), tumbling flower beetle (Mordellidae), soft-wing flower beetle (Melyridae), and northern checkspot butterfly (*Chlosyne palla*). The species can also spread vegetatively by rhizomes (underground shoots that spread horizontally and send up new vertical stems) (Elam 1994, p. 150), thus producing colonies of ramets from only one or a few genetically-distinct individuals. Several occurrences are comprised of just one to a few colonies suggesting low genetic diversity for the species.

Roof (1988, entire) commented that seedlings of any *Eriodictyon* species are not often observed in the wild. After experimentation he speculated that most seeds of *Eriodictyon* species in the wild do not germinate and most seedlings do not survive. He stated that in attempts to germinate seeds of any *Eriodictyon* species, no seedlings were obtained. Of the eight species he tested, Lompoc yerba santa was the only one with tolerance to shade (Roof 1988, p. 34), whereas seedlings of the other species were easily killed by shading. Two species of *Eriodictyon* (hairy yerba santa (*E. trichocalyx*) and thicket yerba santa (*E. crassifolium*)) are known to be facultative seeders and resprouters in their fire-prone ecosystems (Keeley et al. 2006, p. 241–243). Seed germination of Lompoc yerba santa is stimulated by smoke, with seeds germinating faster and at higher rates when treated with liquid smoke and in darkness (Schneider et al. 2021, p. 2). In some other species of *Eriodictyon*, germination is triggered by combinations of heat shock from fire, smoke, and exposure to charate (wood with leachable chemicals known to stimulate germination) (Keeley and Nitzberg 1984, p. 208–209; Keeley 1987, p. 441; Keeley 1991, p. 90; Keeley et al. 2005, p. 180; Gamboa-deBuen and Orozco-Segovia 2008, entire). Schneider et al. (2021, p. 2) suggested that Lompoc yerba santa is adapted to fire, and that periodic fires could promote genetic diversity within an occurrence by stimulating a flush of germination from the soil seed bank. Occurrences 9, 16 and part of 13 appear to be the only occurrences to have burned in the past 150 years (SB Atlas Admin 2021, entire).

### **Situation at Federal listing as endangered in 2000**

We listed Lompoc yerba santa as endangered in 2000, recognizing four locations in three geographic areas: one location on private land in the Orcutt Oil Field, two locations on Vandenberg Space Force Base, and one location on private land at the west end of the Santa Ynez Mountains. Using 2021 standards (California Department of Fish and Game 2011, p. iii), these four locations comprised five occurrences: occurrence 1 in the Orcutt Oil Field; occurrences 2, 9, and 10 on Vandenberg Space Force Base; and occurrence 5 at west end of Santa Ynez Mountains. At time of listing, we summarized the threats to the species as development, military activities, alteration of natural fire cycles, limited habitat, and invasive plant species, with the latter being considered the most severe threat. We further elaborated by specifically identifying the following specific threats to the species: invasive plant species, fire management practices and altered fire regime, low seed production and loss of reproductive vigor, small population size, natural catastrophic events, lack of protection (none of the occurrences were protected), habitat fragmentation and alteration of species composition and vegetation structure, extremely limited distribution or reduced distribution resulting from loss of

habitat, military activities, facility accidents by oil companies and the military, lack of active management, and lack of a species management plan by the military.

### **Situation at 5-year review in 2011 with recommendation of no status change**

In our 2011 5-year review, we recognized six occurrences of Lompoc yerba santa in three geographic areas, presuming all extant, with three occurrences on Vandenberg Space Force Base (2, 9 and 10) and three occurrences on private lands (Orcutt Oil Field, 1 and 11; Hollister Ranch, 5). Occurrence 11 was newly identified in 2007. We stated that, for the most part, information had remained relatively unchanged since the time of listing. All of the threats identified at the time of listing in 2000 were still considered threats in 2011. We specifically identified the following as threats to the species: destruction and alteration of habitat due to activities at Vandenberg Space Force Base, invasive plant species, altered fire regime, low genetic variability and low reproductive rate, development of six private property parcels with Lompoc yerba santa on Hollister ranch, stochastic events due to small population size and restricted distribution, and climate change. Further, we determined that oil and energy development did not appear to be a threat to the species. Based upon all this information, we concluded that Lompoc yerba santa continued to be in danger of extinction in 2011.

### **Distribution and abundance in 2021**

In 2021, we recognize 11 occurrences of Lompoc yerba santa: 1, 2, 5, 9, 10, 11, 12, 13, 14, 15 and 16. We presume 10 of these occurrences to be extant in 2021, and one occurrence (occurrence 10) to be likely extirpated. Five of these occurrences (occurrence 12, 13, 14, 15, 16) are new since the 2011 5-year review (USFWS 2011 p. 4–5). We recognize four geographic populations based on landscape features, which from north to south are: Solomon Hills (occurrences 1 and 11), Burton Mesa (occurrences 2, 9, 10, 14, 15 and 16), La Salle Canyon (occurrence 13), and Santa Ynez Mountains (occurrences 5 and 12; Figure 1). A summary of the current status of each occurrence can be found in Table 1. A detailed account of each occurrence can be found in Appendix A, and reported numbers of Lompoc yerba santa at each occurrence can be found in Appendix B.

#### ***Solomon Hills***

This geographic population is comprised of occurrences 1 and 11, with occurrence 1 being northmost for the species. Both occurrences are in the Orcutt Oil Field on private properties owned by Pacific Coast Energy Company in west Santa Barbara County, and the properties are used for oil and gas production. It is 1.7–3.1 km/1.0–1.9 mi south of Orcutt and 18.0–19.7 km/11.2–12.3 mi inland east from the Pacific Ocean. More than 7,000 ramets were recorded at occurrence 1 in 2018 (Santa Barbara Botanic Garden 2019, p. 60–62.), making occurrence 1 the largest or second largest for the species, whereas occurrence 11 is small with 100–135 individual plants recorded in 2011 (AECOM, 2011 p. 15). Identified threats in 2021 are: development, oil production and oil spills, dense vegetation, vehicles running over plants, road maintenance, altered fire regime/fire management practices, and climate change effects of severe drought and increased temperatures.

#### ***Burton Mesa***

This geographic population is comprised of occurrences 2, 9, 10, 14, 15 and 16, all on north base (north of Santa Ynez River, west of State Highway 1, south of San Antonio Creek) of

**Table 1.** Summary of current status of the 11 known occurrences of Lompoc yerba santa (*Eriodictyon capitatum*) in west Santa Barbara County, California. Occurrences 12, 13, 14, 15 and 16 are new.

Occurrence	Location	Landowner	Protected Managed		Year last observed	Status in 2021	Threats in 2021
1	Orcutt Oil Field in Solomon Hills	Pacific Coast Energy Company	N	N	>7,000 ramets in 2018	presumed extant	development, oil production and oil spills, dense vegetation, vehicles running over plants, road maintenance, altered fire regime/fire management practices, climate change effects
2	Vandenberg Space Force Base (north base)	U.S. Space Force	N	partially	unknown number in 2019, 9,794 stems in part in 2015	presumed extant	military activities, development, dense vegetation, lack of management, invasive species, erosion, unicolonialism and/or low genetic diversity, low seed production, low number of plants (some locations), altered fire regime/fire management practices, climate change effects
5	Hollister Ranch	multiple private	N	N	observed in 2019, 100+ stems in 1986	presumed extant	development, dense vegetation, lack of management, vehicles running over plants, road maintenance, altered fire regime/fire management practices, climate change effects
9	Vandenberg Space Force Base (north base)	U.S. Space Force	N	partially	743 stems/316 ramets in 2019	presumed extant	military activities, unicolonialism and/or low genetic diversity, low seed production, development, road maintenance, invasive species, altered fire regime/fire management practices, climate change effects
10	Vandenberg Space Force Base (north base)	U.S. Space Force	N	partially	several shrubs in 1987, not found in 2021	likely extirpated	low number of plants, military activities, development, invasive species, altered fire regime/fire management practices, climate change effects
11	Orcutt Oil Field in Solomon Hills	Pacific Coast Energy Company	N	N	unknown number in 2015, 100-135 individual plants in 2011	presumed extant	development, oil production and oil spills, dense vegetation, vehicles running over plants, road maintenance, altered fire regime/fire management practices, climate change effects
12	Jack and Laura Dangermond Preserve	The Nature Conservancy	Y	N	2 individuals in 2014	presumed extant	low number of plants, dense vegetation, lack of management, vehicles running over plants, road maintenance, altered fire regime/fire management practices, climate change effects
13	Vandenberg Space Force Base (south base)	U.S. Space Force	N	partially	281 stems/258 ramets in 2018	presumed extant	military activities, potentially competitive native species, lack of management, altered fire regime/fire management practices, climate change effects
14	Vandenberg Space Force Base (north base)	U.S. Space Force	N	partially	70 individuals/78 ramets in 2019	presumed extant, MQ-9 Wing Beddown project may destroy	military activities, development, low number of plants, dense vegetation, lack of management, altered fire regime/fire management practices, climate change effects
15	Vandenberg Space Force Base (north base)	U.S. Space Force	N	partially	5 stems/4 ramets in 2015	presumed extant	low number of plants, military activities, dense vegetation, lack of management, altered fire regime/fire management practices, climate change effects, invasive species
16	Vandenberg Space Force Base (north base)	U.S. Space Force	N	partially	unknown number in 2019, 28 ramets in 2015	presumed extant	low number of plants, military activities, development, lack of management, altered fire regime/fire management practices, climate change effects

Vandenberg Space Force Base in west Santa Barbara County. The species is included in the installation's Integrated Natural Resources Management Plan (U.S. Air Force 2014, p. 9–10), which is a military planning document with strategies and programs to protect biological resources on the base. This geographic population is 2.6–8.9 km/1.6 mi–5.5 mi inland east from the Pacific Ocean. In 2015, 9,794 stems were recorded in part of occurrence 2 (Spear 2021, entire), making it the largest or second largest occurrence for the species. Lompoc yerba santa has been recorded at occurrence 10 only in 1987 (several shrubs; Griffiths et al. 1987a, p. 1; 1987b, p. 1.), and it now seems likely extirpated. Occurrence 9 is in an area likely desirable for future development. It had 743 stems/316 ramets in 2019 (ManTech 2020b, p. 33; Lum 2021g, p. 1; Spear 2021, p. 3) and is in decline since 2006 with 1,017 ramets (KFS and ManTech 2020, p. 22; ManTech 2020b, p. 9). Occurrence 14 had 70 individuals/78 ramets in 2019 (Spear 2021, entire; ManTech 2020b, 34–35) and may be destroyed by the MQ-9 Wing Beddown project (USFWS 2020, p. 21). Occurrence 15 had 5 stems/4 ramets in 2015 (Spear 2021, entire), and occurrence 16 had 28 ramets in 2015 (ManTech 2015, p. 11.). Identified threats in 2021 are: military activities, development, dense vegetation, lack of management, invasive species, uniclinalism and/or low genetic diversity, low seed production, low number of plants, road maintenance, erosion, altered fire regime/fire management practices, and climate change effects of severe drought and increased temperatures.

### ***La Salle Canyon***

This geographic population is comprised only of occurrence 13, in upper La Salle Canyon on south base (south of Santa Ynez River, west of State Highway 1, north of Cañada Honda Creek) of Vandenberg Space Force Base in west Santa Barbara County (Lum 2021c, p. 1). It is 7.3 km/4.5 mi inland east of the Pacific Ocean, and 6.0 km/3.7 mi west of Lompoc. There are two colonies with a total count of 281 stems/258 ramets in 2018 (Spear 2021, entire). Identified threats in 2021 are: military activities, potentially competitive native species, lack of management, altered fire regime/fire management practices, and climate change with severe drought and increased temperatures.

### ***Santa Ynez Mountains***

This geographic population is comprised of occurrences 5 and 12 at west end of the Santa Ynez Mountains in southwest Santa Barbara County. It is south of Jalama Creek, 3.7–6.3 km/2.3–3.9 mi inland north of the Pacific Ocean, and 3.4 km/2.1 mi southwest of State Highway 1. Both occurrences are on private properties: occurrence 5 on Hollister Ranch with multiple landowners, and occurrence 12 on Jack and Laura Dangermond Preserve owned by The Nature Conservancy. The two occurrences are separated by 2.1 km/1.3 mi. Occurrence 12 is small with two individuals in 2014 (Batiuk 2020, p. 1), and occurrence 5 is larger with 100+ stems in habitat rated excellent quality in 1986 (Myers 1987, p. 5). Identified threats in 2021 are: low number of plants, development, dense vegetation, lack of management, vehicles running over plants, road maintenance, altered fire regime/fire management practices, and climate change effects of severe drought and increased temperatures.

## **Summary of threats in 2021**

Lompoc yerba santa is a habitat specialist with a small geographic range (433 km<sup>2</sup>/167 mi<sup>2</sup> extent of occurrence in 2021), and a relatively small total population size. The combination of the following life history traits of Lompoc yerba santa make it a species considered highly

vulnerable to climate change (Anacker et al. 2013, p. 197): much of its reproduction appears to be vegetative by rhizome production, suggesting low dispersal ability and low genetic diversity; and it is a habitat specialist with apparent dependence on surface disturbance and fire. In 2021, Lompoc yerba santa is known from 11 occurrences in four geographic populations in west Santa Barbara County, of which 10 occurrences are considered extant and one likely extirpated. We identify the following threats in 2021: climate change effects of severe drought and increased temperatures, altered fire regime/fire management practices and dense vegetation, invasive species, potentially competitive native species, unclonality and/or low genetic diversity, low seed production, low number of plants in some locations, development, military activities, oil production and oil spills, road maintenance, vehicles running over plants, lack of management, erosion (bottom of Pine Canyon, Vandenberg Space Force Base), and stochastic events (Table 1). All threats identified at the time of listing in 2000 were considered ongoing to the six occurrences at the time of the 2011 5-year review. Development on Hollister Ranch was considered a new threat in 2011, while oil extraction and energy development activities were specifically not considered threats. Currently, all threats identified at time of listing and the last 5-year review are ongoing and affecting the 11 known occurrences (one likely extirpated). One occurrence in 2021 is protected (none were protected in 2000), some management of the species occurs in 2021 (more than in 2000), and Vandenberg Space Force Base now has a management plan for the species (lacking in 2000; U.S. Air Force 2014, p. 9–10).

## **CONCLUSION**

We reviewed the best available scientific information and evaluated the threats affecting Lompoc yerba santa in 2021 under the factors in 4(a)(1) of the U.S. Endangered Species Act 1973 (as amended). We conclude that Lompoc yerba santa still meets the definition of an endangered species, and we recommend no status change at this time.

## **RECOMMENDATIONS FOR FUTURE ACTIONS**

Throughout this document, our own use of the word stem refers to all vertical vegetative parts including ramets. However, in our analysis of reports prepared by other observers, it was often impossible to determine the intended use of the words “stem,” “ramet,” “individual,” and “plant,” and it was often confusing and not consistent from one observer to the next (e.g., ManTech 2020a, p. 18). In accordance with IUCN (2014, p. 23–24) recommended guidelines for colonial and modular organisms, we recommend counting the number of all vertical stems (including ramets) and reporting that number as vertical stems along with a statement of this method.

Little is known about the biology and ecology of Lompoc yerba santa in 2021. Therefore, coordinated conservation and research are needed to further understand the species, and to restore and maintain the 11 known occurrences.

These efforts should include:

- Implement management actions to reduce threats and benefit the occurrences of Lompoc yerba santa.
- Conserve and protect habitat in vicinity of and near existing occurrences, with particular attention to maritime chaparral on Burton Mesa, Vandenberg Space Force Base.
- Conduct searches for additional locations of Lompoc yerba santa, including use of helicopters and drones for searching large expanses of potential habitat and potential habitat in difficult terrain. Priority should be given to searching in vicinities of occurrences 12 (Jack and Laura Dangermond Preserve) and 13 (Upper LaSalle Canyon, Vandenberg Space Force Base).
- Collect tissue samples from occurrence 12 for genetic analyses.
- Continue seed collection for seed banking. In coordination with Santa Barbara Botanic Garden and contingent upon results of previous sampling, multicolonal locations should be visited to determine if seed production is occurring, in particular at occurrences 2, 13 and 14 as a matter of urgency (these three occurrences are on Vandenberg Space Force Base).
- Collect and cultivate cuttings and seeds to develop protocols for propagation and outplanting for long-term restoration success. In consideration of the threat of climate change with severe drought and increased temperatures, the methods employed for outplanting in arid lands by Abella et al. (2012, entire), Abella et al. (2015, entire), Abella (2017, entire) and Abella et al. (2020, entire) should be considered.
- Study genetic diversity and reproductive biology, pollinator network and potential network disruption, potential barriers to recruitment, and the species' relationship with fire.
- Introduce Lompoc yerba santa into living collections at botanic gardens.

## **APPROVAL**

**Lead Field Supervisor, Fish and Wildlife Service**

Approved \_\_\_\_\_

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## APPENDIX A

A detailed account of each occurrence of Lompoc yerba santa (*Eriodictyon capitatum*) in 2021.

### Solomon Hills Geographic Population

#### *Occurrence 1 (includes previous occurrence 4)*

Graciosa Ridge and several adjacent ridges at Newlove Hill in Orcutt Oil Field, Solomon Hills; 34.833663/-120.406974, 219 ha/541 ac extent of occurrence, 287–390 m/942–1,280 ft elevation. IUCN (2014, p. 33) defines extent of occurrence as the area contained within the shortest continuous imaginary boundary that can be drawn to encompass all known locations with the species. This occurrence is 1.7 km/1.0 mi south of Orcutt and 2.0 km/1.2 mi west of Highway 101 (a major freeway). It is on three parcels of private property, mostly APN 101-020-074, and also APN 101-020-043 and APN 101-020-041. It is the northmost occurrence of Lompoc yerba santa. Mooney (1986a, entire) surveyed and mapped the occurrence in 1986, reporting it on Careaga sandstone and Paso Robles formation (sandstone and shale, Arnold and Anderson 1907, p. 88). She reported >500 individuals with the plants "scattered to abundant" along ridgetop roads, some growing over old surface pipelines and small structures. The species appeared to prefer little to no developed soil, and the "healthiest" plants were under bishop pine. Sage Institute (2014, entire) reported Lompoc yerba santa and La Purisima manzanita as the two species dominating the central maritime chaparral at occurrence 1 in 2013, each providing 30% of absolute cover in the rough broken landscape of sandy soil (up to 12 inches deep) with a restrictive layer of tar beneath. Lompoc yerba santa was prevalent, and it was growing also in disturbed/ruderal areas where it was common, and in mixed Bishop pine stands and coast live oak woodlands. Sage Institute (2014, p. 41) provided a map of the occurrence. Knapp (2013b, p. 1) reported hundreds of individuals, some very large along with many young plants. Knapp (2015, p. 1) observed the species as locally common with 500–1,000 individuals, and 90% of these with fruit in late September. Most recently, Santa Barbara Botanic Garden (2019, p. 60–62) observed >7,000 ramets in 2018. Two records in Consortium of California Herbaria (2021b, p. 1) state common on slopes of Graciosa Ridge with bishop pine in 1973. Several records in CDFW (2020, p. 3) report the following: shrub to 2 m tall in a cleared staging area; along roads, roadside, and in openings in tar sand roads; near and at oil pump pads; in formerly disturbed places in the oil field; and up to 4 m/13.1 ft tall. Santa Barbara Botanic Garden (2019, p. 60–65) identified excessive disturbance and habitat loss as threats, including roads, oil production and oil spills, and Knapp (2015, p. 1) identified fire suppression as a possible threat. We identify the following threats: development, oil production and oil spills, dense vegetation, vehicles running over plants, road maintenance, altered fire regime/fire management practices, and climate change with severe drought and increased temperatures.

#### *Occurrence 11*

South edge of Orcutt Oil Field (Careaga Lease), Solomon Hills; 34.812419/-120.403018, 3.2 ha/7.9 ac extent of occurrence, 190–206 m/623–676 ft elevation; APN 101-020-074. It is 4.3 km/2.7 mi south of Orcutt and 4.7km/2.9 mi west of Highway 101. AECOM (2011, p. 15) recorded 100–135 individual plants in 2011 and showed three separate groups in its fig. 2: 11A (our designation; occupied area 0.4 ha/1.0 ac) centered at 34.812101/-120.403082; 11B (occupied area 376 m<sup>2</sup>/0.1 ac) centered at 34.811709/-120.402995 with "50 to 70 individuals

plants;” and 11C (occupied area 0.48 ha/ 1.18 ac) centered at 34.812313/-120.399577 with “a few individuals.” However, their stated distances and compass directions (AECOM 2011, p. 15) appear erroneous because they do not coincide with their figure 2. Using Google Earth aerial imagery (dated 27 July 2016) and tools, this occurrence is 70–450 m/230–1,476 ft south and southeast of intense industrial activity. The three occupied areas are on sandy soil (Vogler 2021b, entire) and mostly intact with scrub and chaparral. We identify the following threats: development, oil production and oil spills, dense vegetation, vehicles running over plants, road maintenance, altered fire regime/fire management practices, and climate change with severe drought and increased temperatures. Vogler and Boinay (2007, p. 1) first observed 20–30 “individuals” at 11A in July 2007 with “80% flowering,” in coastal sage scrub and chaparral dominated by coyote brush, chamise and black sage. This group of plants is between the private, primary access road to the active oil field and an incised ephemeral creek. The slope between road and creek bank is moderately steep in the western part and gently sloping in the eastern part. Shortly after discovery, Santa Maria Pacific placed signs roadside alerting to a restricted area with sensitive habitat and Lompoc yerba santa, and also placed barriers at strategic locations to prevent vehicles leaving the road. Branches of Lompoc yerba were extending over the road, and a few stems were growing up through cracks in the asphalt. This group is situated south of the road, and a search was conducted north of it but no plants were seen (Vogler 2021a, p.1). Using Google Earth aerial imagery (dated 27 July 2016) and our stated coordinates, we observe this group at the base of a hill and above the upper reaches of a dry creek bed, 67 m/221 ft south of several industrial buildings, 249 m/817 ft east of row crops, and 88 m/288 ft west of a pipe storage facility (plants extend to 30 m of the concrete pads; Vogler 2021a, p. 1). AECOM (2011, p. 15) reported this elongate area with 50–60 “individual plants.” 11B is immediately south of 11A and across the creek channel. AECOM (2011, p. 15) reported this circular area with “a few individuals.” 11C is 198 m/651 ft west of 11A, and it is on hilly land on north side of the upper reach of the same ephemeral creek. A metal guard rail separates it from most of the intense industrial activity. AECOM (2011, p. 15) reported this elongate area with 50–70 “individuals.” AECOM (2012, entire) presented a subset of the information in AECOM (2011, entire) for this occurrence. This occurrence was last observed in 2015 (Vogler 2021a, p. 1).

## **Burton Mesa Geographic Population**

### ***Occurrence 2 (includes previous occurrence 3)***

Santa Lucia Canyon and Lower Pine Canyon (and area between), Vandenberg Space Force Base (north base); 34.702655/-120.507479 center of occurrence, 32 ha/79 ac extent of occurrence, 43–112 m/141–367 elevation. This occurrence is comprised of eight groups that we refer to as 2A, 2B, 2C, 2D, 2E, 2F, 2G and 2H. Details for each group are provided below. Threats include military activities, development, dense vegetation, lack of management, altered fire regime/fire management practices, invasive species, erosion (bottom of Pine Canyon), uniclinalism and/or low genetic diversity (some locations), low seed production, low number of plants (some locations), and climate change with severe drought and increased temperatures. Vandenberg Space Force Base is targeting non-native, invasive plants for removal in and near some locations (Lum 2021f, p. 1). We assign herbarium specimens with collecting location as 5 miles north Lompoc on road to Casmalia to this occurrence.

### **2A Lompoc Gate, Santa Lucia Canyon Stand #1 (occurrence 2 in 1983 and 1994)**

West side of Santa Lucia Canyon near Lompoc Gate (also known as Pine Canyon Gate); 34.706328/-120.504170 (Spear 2021, p. 3), 195 m<sup>2</sup>/234 yd<sup>2</sup> extent of occurrence, 75–81m/246–266 ft elevation. Smith (1983, p. 3–4, 8) observed 27 stems of Lompoc yerba santa under bishop pine in chaparral dominated by manzanita on a steep slope with shale in Santa Lucia Canyon, 307 m/336 yd northwest of the intersection of Washington Avenue and Santa Lucia Canyon Road. The vegetation cover was thin with large areas of bare ground, which is where he observed most plants. Smith (1983 entire) marked his general location on a map (34.706206/-120.504435 our determination). He presumed this to be the type locality because in 1983 it was the only known location with Lompoc yerba santa: “five miles north of Lompoc on the road to Casmalia...growing under *Pinus muricata*” (Eastwood 1933, p. 40–41). However, since then, the species has been identified nearby at 2G, which likewise meets description for type locality and could just as well be it (see also Riecker 1889, map). Smith observed many stems connected by rhizomes and a lack of seeds, hypothesizing the colony was uniclonal. Elam (1994, p. 150–174) reported the 18 stems/ramets here with few seeds in 1993 to be uniclonal, indicating low genetic diversity. Her metal tags were observed on some plants in 2006. The following numbers have been recorded at 2A: 1987, 27 stems; 1993, 18 ramets; 2006, 11 ramets; 2010, 5 ramets; 2015, 3 stems/3 ramets (plus several dead); and 2019, 0 plants. The largest recorded "area" is 121 m<sup>2</sup>/145 yd<sup>2</sup> in 2006 and 2015, and with high quality habitat in 2015 (ManTech SRS Technologies [ManTech], 2015 p. 11–13; Spear 2021, p. 3). ManTech (2015, p. 12) identified low number of plants and drought as primary threats at this location. The counts have declined steadily since 1983 (Smith 1983, p. 3), and the species may now be extirpated here (Lum 2021a, p. 1).

### **2B Santa Lucia Canyon Stand #2**

Upper west slope of Santa Lucia Canyon; 34.704452/-120.505808, 1.1 ha/2.6 ac extent of occurrence, 80–112 m/262–367 ft elevation. The Lompoc yerba santa are situated sparsely in gaps among a dense canopy of Burton Mesa chaparral (ManTech 2015, p. 11–14), dominated by La Purisima manzanita with bishop pine and coast live oak. ManTech (2015, p. 15) observed new growth of ramets in the understory of chaparral die-back due to drought, leading them to remark that Lompoc yerba santa appeared to fair well under drought condition relative to other chaparral species such as La Purisima manzanita. However, they speculated that small colonies on dry open slopes are likely susceptible to decline over time while colonies occurring within a dense matrix of other chaparral species may benefit. This location was identified in 2015 by helicopter surveys for Lompoc yerba santa in potential habitat, with confirmation of 56 ramets in at least 10 colonies by ground visitation (ManTech 2015, p. 11–16).

### **2C Santa Lucia Canyon Stand #3**

Floor of side canyon off Santa Lucia Canyon (west side); 34.702522/-120.505976, 0.11 ha/0.27 ac extent of occurrence, 47–60 m/154–197 ft elevation. The Lompoc yerba santa are in an open area surrounded by dense coast live oak. This location was identified in 2015 by helicopter surveys for the species in potential habitat, with confirmation of 134 ramets by ground visitation (ManTech 2015, p. 11–16).

### **2D Pine Canyon Rim Stand**

An area spanning across a ridge onto the upper east slope of Pine Canyon and upper west slope of Santa Lucia Canyon; 34.702447/-120.507877, 1.64 ha/4.00 ac extent of occurrence, 80–99

m/262–325 ft elevation. This location was identified in 2015 by helicopter surveys for Lompoc yerba santa in potential habitat, with confirmation of 691 ramets by ground visitation. The Lompoc yerba santa are sparsely situated in gaps among dense Burton Mesa chaparral (ManTech 2015, p. 9-16) dominated by La Purisima manzanita with bishop pine and coast live oak. ManTech (2015, p. 15) observed new growth of ramets in the understory of chaparral dieback likely due to drought.

#### **2E Upper East Slope Pine Canyon (part of former occurrence 3 in 1983 and 1994)**

Upper east slope of Pine Canyon; 34.704071/-120.509654, 100 m/328 ft elevation, 58 m/190 ft below the ridge crest. Smith (1983, entire) identified this colony of 41 stems in diatomaceous shale. He marked the general location on a map, which we used to make the latitude/longitude determination. The plants were in chaparral with dominant species manzanita and occasional bishop pine. The vegetation cover was thin with large bare areas, which is where the Lompoc yerba santa primarily occurred. Smith observed many stems connected by rhizomes and a lack of seeds in 1982, hypothesizing this colony is uniclonal. Lum (2021d, p. 1) visited the location in 2021 and saw no Lompoc yerba santa. Based upon similar details, she suggested Smith may have erred in marking his map and the colony is actually part of 2D, which is 152 m/167 yd to the south. Likewise, ManTech (2015, p. 12–13) surveyed the Pine Canyon area from helicopter without detecting Lompoc yerba santa at Smith's marked location in 2015.

#### **2F Pine Canyon Stand North Group (part of former occurrence 3 in 1983 and 1994)**

Floor and lowermost east slope of Pine Canyon, 0.87–1.05 km/0.54–0.65 mi northwest of junction with Santa Lucia Canyon; 34.702814/-120.510876, 0.43 ha/1.10 ac extent of occurrence, 45–61 m/148–200 ft elevation. Howald (1987, entire) reported a colony of large, healthy plants at the northern extent (34.703592/-120.511155, our determination from old map) of our polygon for this group. She observed eight individuals adjacent to a newly-graded dirt road (for heavy equipment to construct an oil pipeline nearby; Mooney 1986d, p. 2), along with scattered coast live oak and coastal sage scrub species. A fence was subsequently erected to protect this colony. Myers (1987, p. 2) reported some plants appeared to have benefited by the grading that occurred a few years earlier, growing from sprouts to 2.4 m/8 ft tall. She speculated that crowding in the understory could subsequently suppress further sprouting and lead to local decline. In the southern half of our polygon for this group, Wilken (Consortium of California Herbaria 2018, p. 1–2) observed 200 ramets on Monterey shale at 34.702411/-120.510625 (47 m/154 ft elevation) with shrubs 2–3 m/6.6–9.8 ft tall in 2011. Then Wilken (2012b, p. 1) in 2012 and Knapp (2013c, p. 1) in 2013 reported 150 individuals (stems <1 m/3.3 ft not counted) here, with many large plants up to 3 m/9.8 ft tall and many young ramets in open sites. They described the habitat as mixed oak woodland/coastal sage scrub with coast live oak, black sage and western poison oak (*Toxicodendron diversilobum*) on sandy soil. They identified no immediate threats but observed evidence of rooting by feral pigs and trail-bike activity at edge of the colony, which Wilken (2012b, p. 1) believed to be the largest colony on the base. ManTech (2010, p. 11) identified purple pampas grass (*Cortaderia jubata*) at the north end of Pine Canyon as a threat to Lompoc yerba santa downstream, and also erosion. Three additional records for 2F are the following (Spear 2021, p. 3).

- **34.703085/-120.511023 Pine Canyon Stand A, 50 m/164 elevation:** 11 ramets in high quality habitat of mixed oak woodland and sage scrub (California sagebrush, coast live oak: Burton Mesa chaparral) on sandy shale in a deep layer of oak leaf litter in 2006. Most

Lompoc yerba santa were rooted under oaks, with basal stems 1.25–2.5 cm/0.5–1.0 inch diameter, and arced into the sagebrush. In 2010, nine ramets were observed, with habitat rated high quality. ManTech (2010, p. 8) and USFWS (2011, p. 7) referred to this group as Pine Canyon Stand A (Termond 2021b, p. 1).

- **34.702656/-120.510761 Pine Canyon Stand B, 48 m/157 ft elevation:** 172 ramets in 2006 in high quality habitat of mixed oak woodland and sage scrub (California sagebrush, coast live oak, coyote brush: Burton Mesa chaparral) on sandy shale, some in a deep layer of oak leaf litter. The Lompoc yerba santa extended into the dirt road beyond barbed wire protective fencing. Because some plants bore metal tags (like 2G), we conclude this location to be part of Elam's (1994 entire) study site for former occurrence 3 (see also Elam 2021, p. 1–4 ). In 2010, 149 ramets were observed with habitat rated high quality. ManTech (2010, p. 8) and USFWS (2011, p. 7) referred to this group as Pine Canyon Stand B (Termond 2021b, p. 1).
- **34.702060/-120.510575 Pine Canyon Stand C, 47 m/154 elevation:** 59 ramets in high quality habitat of mixed oak woodland and sage scrub (Burton Mesa chaparral) on sandy shale, some in a deep layer of oak leaf litter in 2006. In 2010, 79 ramets were observed here, with habitat rated high quality. ManTech (2010, p. 8) and USFWS (2011, p. 7) referred to this group as Pine Canyon Stand C (Termond 2021b, p. 1).

### **2G Pine Canyon Stand South Group (Pine Canyon Stand D, part of former occurrence 3 in 1983 and 1994**

Pine Canyon, 0.75 km/0.47 mi northwest of junction with Santa Lucia Canyon; 34.701528, -120.509944, 0.52 ha/1.28 ac extent of occurrence, 46–71 m/151–233 ft elevation. The information is from ManTech (2015, entire) and Spear (2021, p. 3). This location was identified as Pine Canyon Stand D in 2006 with 372 ramets (ManTech 2010, p. 8; USFWS 2011, p. 7; Termond 2021b, p. 1) sparsely distributed in high quality habitat on soil described as sandy, shaley loam. It is the southmost location for the species in Pine Canyon. Lompoc yerba santa are in the canyon bottom and extend up the lower east slope, growing in the understory of oak woodland and ending at transition to mixed Burton Mesa chaparral and Bishop pine forest that dominate the upper slope. Several plants upslope were growing through thick leaf litter, and many stems had diameters >7.6 cm/3.0 inches. Because one plant bore a metal tag (like others at 2F), we conclude this location also was part of Elam's (1994, entire) study site for former occurrence 3 (see also Elam 2021, p. 1–4 ). In 2010 and 2015, 423 ramets and 513 stems/428 ramets were reported in high quality habitat, respectively.

### **2H South Santa Lucia Canyon (Santa Lucia Canyon Stand #4)**

Upper half of west slope (including ridge crest) of Santa Lucia Canyon, 0.39 km/0.24 mi north of junction with Pine Canyon; 34.698924/-120.506723, 1.35 ha/3.34 ac extent of occurrence, 43–98 m /141–322 ft elevation. The information for this location is mostly from Hasenstab-Lehman (2019, entire) who collected tissue samples here in 2019. She described the location as sandy, loose slopes (tar sand) with chaparral (chamise ), grass, coyote brush, La Purisima manzanita and coast live oak showing scars of having burned. ManTech (2015, p. 11) referred to this group as Santa Lucia Canyon Stand #4, which was so dense (estimated 6,000 ramets on 0.88 ha/2.18 ac) they could not access it without damaging plants. This location is documented by herbarium specimen KE Hasenstab-Lehman 2133 in Santa Barbara Botanic Garden.

### **Occurrence 9**

35th Street and California Boulevard, Vandenberg Space Force Base (north base); 34.705430/-120.571230, 1.2 ha/2.9 ac extent of occurrence. This occurrence is 137 m/450 ft northwest of the junction of 35th Street and California Boulevard. ManTech (2020b p. 35) reported two groups separated by 35 m/116 ft in 2019: 9A (our designation; 116–119 m/381–390 ft elevation), an eastern group with 89 ramets on 0.11 ha/0.28 ac; and 9B (114–116 m/374–381 ft elevation), a western group with 227 ramets on 0.66 ha/1.63 ac. The following numbers have been observed: 1987, <500 individuals?; 1993, >100 ramets; 2006, 1,017 ramets; 2010, 807 ramets; 2015, 958 stems/733 ramets; 2016, 651 stems/616 ramets; 2017, 627 stems/507 ramets; 2018, 804 stems/617 ramets; and 2019, 743 stems (plus 83 dead stems)/316 ramets (Bittman and Berg 1987, p. 2; Elam 1994, p. 150; ManTech 2015, p. 11; ManTech 2020b, p. 9; Lum 2021g, p. 1; Spear 2021, p. 3). The occurrence is 11 m/35 ft north of 35th Street and 105 m/344 ft west of California Boulevard (ManTech 2015, p. 11). The plants are sparsely distributed on sandy, rocky loam in Burton Mesa chaparral (predominant species *La Purisima manzanita*, Santa Barbara ceanothus (*Ceanothus impressus*), chamise), which was rated high quality in 2006, 2010, 2015 and 2019 (Spear 2021, p. 3). Based upon the data, in particular the counts of 1,017 ramets in 2006 and 316 ramets in 2019, the occurrence is in decline, which KFS and ManTech (2020, p. 22) attribute to prolonged periods of drought. This occurrence is managed. In 2019, iceplant, purple pampas grass, Monterey pine (*Pinus radiata*) and Tasmanian bluegum (*Eucalyptus globulus*) were threats in the habitat (ManTech 2020a, p. 4–7). Vandenberg Space Force Base is targeting invasive plant species for removal in and near the occupied area (Lum 2021f p. 1). Using Google Earth aerial imagery (dated 9 July 2016), we observe the occurrence is in a flat and level landscape in an area likely desirable for future development, and 0.64 km/0.40 mi northwest of occurrence 10. It is reported to be uniclonal with low genetic diversity (Elam, 1994 p. 163) and low seed production (Smith 1983, p. 3; Knapp, 2013a). In 1982, an experimental burn of one-half of this occurrence resulted in vigorous sprouting from underground rhizomes of Lompoc yerba santa along with death of some stems and invasion by hottentot fig (*Carpobrotus edulis*; Jacks et al. 1984, entire). Fire had stimulated expansion by outward spreading of the root system with production of new stems (Jacks et al. 1984, p. 13). Threats include military activities, uniclonalism and/or low of genetic diversity, low seed production, development, road maintenance, invasive species, altered fire regime/fire management practices, and climate change with severe drought and increased temperatures.

### **Occurrence 10**

35th Street and New Mexico Avenue, Vandenberg Space Force Base (north base); 34.702700/-120.564000 (Consortium of California Herbaria 2021a, p. 1–3), 126 m/413 ft elevation, somewhere near this location. The coordinates are 70 m/230 ft southwest of the junction of 35th Street and New Mexico Avenue, which is not a precise location but instead indicate the likely undeveloped parcel of land where the species was collected in 1987 (Walden 2021, p. 1). This occurrence is based solely on two herbarium specimens and their labels collected by Griffiths et al. (1987a, p. 1; 1987b, p. 1): CDA17708, and OBI69622. CDA105381 (Consortium of California Herbaria 2008a, p. 1) was previously considered a third specimen collected by Griffiths and colleagues at this occurrence, but it is actually a prior accession number for specimen CDA17708 (Alexander 2021, p. 1). Griffiths et al. (1987a, p. 1; 1987b, p. 1) described the occurrence as “several open, laxly spreading shrubs with upright branches.” Using Google Earth aerial imagery (dated 27 July 2016), we observe the stated coordinates are in a flat and

level landscape at the north edge of an area of undeveloped land and immediately south of the general area intended for development at the base, and 0.64 km/0.40 mi southeast of occurrence 9. This occurrence is likely extirpated. Searches in 2005, 2006, 2015, 2019 and 2021 did not find any Lompoc yerba santa (Lum 2021e, entire). The stated coordinates are in a grove of invasive Monterey pine and *Eucalyptus* with invasive grasses on sandy soil, including perennial veldt grass (*Ehrharta calycina*) and riggut brome (*Bromus diandrus*). Vandenberg Space Force Base is targeting non-native, invasive plant species for removal in and near the area (Lum 2021f, p. 1). In particular, the Monterey pine are girdled to help conserve nearby chaparral. Threats include low number of plants, military activities, development, invasive species, altered fire regime/fire management practices, and climate change with severe drought and increased temperatures.

#### ***Occurrence 14 (new)***

Airfield, Vandenberg Space Force Base (north base); 34.72951/-120.56286, 1.0 ha/2.6 ac extent of occurrence, 111–114 m/364–374 ft elevation. This occurrence is 240 m/787 ft east of the south end of the airfield. It is a new occurrence first identified in 2019 (Lum 2019b, p. 1; Schneider 2020a, p. 21) during landscape surveys for Lompoc yerba santa in potential habitat. The combined mapping of ManTech (2020b, p. 34) and Schneider (2020b, p. 3) show eight groups of plants in Burton Mesa chaparral (U.S. Air Force 2019, p. 20–21) with predominant species being La Purisima manzanita, coyote brush, chamise and black sage (ManTech 2020b, p. 33). The distribution of the eight groups suggests multiclonality for the occurrence. It is in a relatively flat landscape with sandy soil in dense chaparral, with many plants along a trail. ManTech (2020b, p. 34–35) and Spear (2021, p. 3) reported 78 ramets/70 individuals in 2019, and Schneider (2020b, p.1–4) collected tissue samples from 57 stems in 2019 for genetic analyses. A potential military project (MQ-9 Wing Beddown) may totally remove this occurrence along with 1.8 ha/4.5 ac of habitat (U.S. Air Force, 2020 p. 28; York 2020, p. 1; USFWS 2020, p. 21). Although the project would include relocating Lompoc yerba santa to another location and outplanting individuals grown from collected seed (USFWS 2020, p. 25), this would be only experimental because a previous attempt to relocate was not successful (ManTech 2020a, p. 18). Threats include military activities, development, low number of plants, dense vegetation, lack of management, altered fire regime/fire management practices, and climate change with severe drought and increased temperatures. Vandenberg Space Force Base is targeting non-native, invasive plant species for removal in and near the occupied area (Lum 2021f, p. 1).

#### ***Occurrence 15 (new)***

Upper Pine Canyon (North Pine Canyon), Vandenberg Space Force Base (north base); 34.707560/-120.512927, 417 m<sup>2</sup>/499 yd<sup>2</sup> extent of occurrence. Two colonies: 15A, 34.707731/-120.512940, 96 m/315 ft elevation (2 stems/2 ramets on 1 m<sup>2</sup>/1.2 yd<sup>2</sup> in 2015); 15B, 34.707416/-120.512907, 85 m/279 ft elevation (3 stems/2 ramets on 50 m<sup>2</sup>/1.2 yd<sup>2</sup>) in 2015). The coordinates and information are from ManTech (2015, entire) and Spear (2021, p. 3). This new occurrence was identified in 2015 by helicopter surveys for Lompoc yerba santa in potential habitat, with confirmation by ground visitation. It is the northmost location for the species in Pine Canyon, 1.54 km/0.96 mi beyond its junction with Santa Lucia Canyon. The two colonies are separated by 35 m/116 ft in high quality habitat: Burton Mesa chaparral, with predominant species being coast live oak, chamise, La Purisima manzanita and bishop pine. The soil is fine sand and white rocks, some under heavy leaf litter. The occurrence is across the steep incline of the northeast

slope of upper Pine Canyon and 1/3 of the way up to the ridge crest. The genetic diversity is unknown because tissues have not been sampled (Hasenstab-Lehman 2021, entire). This occurrence appears to have not burned in the past 150 years (SB Atlas Admin 2021, p. 5). Threats include low number of plants, military activities, dense vegetation, lack of management, altered fire regime/fire management practices, climate change with severe drought and increased temperatures, and invasive species (purple pampas grass; ManTech 2010, p. 11).

#### ***Occurrence 16 (new)***

Lake Canyon, Vandenberg Space Force Base (north base); 34.713555/-120.507173; across gentle incline at top edge of southwest canyon wall overlooking lower Lake Canyon, 1.1 km/0.67 mi northwest of junction of Washington Avenue and Santa Lucia Canyon Road (near Lompoc Gate); 176 m<sup>2</sup>/210 yd<sup>2</sup> 'area' (ManTech 2015, p. 11; Spear 2021, p. 3), 119 m/391 ft elevation. This new occurrence was identified in 2006 during landscape surveys for Lompoc yerba santa in potential habitat. There appears to be one colony of plants that we calculate to be over 181 m<sup>2</sup>/216 yd<sup>2</sup> using combined data from Hasenstab-Lehman (2021, entire), Lum (2021a, entire) and Spear (2021, p. 3). The habitat is rocky sand in chaparral with La Purisima manzanita as predominant species, rated high quality in 2006, 2010 and 2015 (Spear 2021, p. 3). Recorded numbers are the following: 2006, 20 ramets; 2010, 48 ramets; and 2015, 28 ramets (ManTech 2015, p. 11). Tissue samples were collected in 2019 for genetic analyses (Hasenstab-Lehman 2021 entire). This occurrence is reported to have burned in the Azalea Fire in 1997 (SB Atlas Admin 2021, p. 5). Threats include low number of plants, military activities, development, lack of management, altered fire regime/fire management practices, and climate change with severe drought and increased temperatures.

### **La Salle Canyon Geographic Population**

#### ***Occurrence 13 (new)***

Upper La Salle Canyon, on ridge above tributary on north side, 74 m/241 ft east of Santa Ynez Ridge Road, Vandenberg Space Force Base (south base); 34.627353/-120.549724, 0.20 ha/0.48 ac extent of occurrence, 220–233 m/722–764 ft elevation. Two locations separated by 53 m/172 ft: 13A (north), 34.627561/-120.549869, 233 m/764 ft elevation; and 13B (south), 34.627211/-120.549481, 220 m/722 ft elevation. This occurrence was first observed in 2018 (Lum 2019a, p. 1; Spear 2021, p. 3) with 281 stems/258 ramets on sandy soil: 37 stems/36 ramets at the north location on 221 m<sup>2</sup>/264 yd<sup>2</sup>, and 244 stems/222 ramets at the south location on 603 m<sup>2</sup>/721 yd<sup>2</sup>. The occurrence is in maritime chaparral with dominant species being La Purisima manzanita, and other associated species including chamise and bishop pine. Part of the occurrence was burned by the Canyon Fire in 2016 (SB Atlas Admin 2021, p. 7). The habitat was rated high quality in 2018, with the tallest Lompoc yerba santa standing 1.3 m/4.3 ft. Vandenberg Space Force Base is targeting non-native, invasive plant species for removal in and near the occupied area (Lum 2021f, p. 1). Known threats are military activities, lack of management, potentially competitive native species (deerweed [*Acmispon glaber*] ManTech 2020b, p. 33), altered fire regime/fire management practices, and climate change with severe drought and increased temperatures.

## Santa Ynez Mountains Geographic Population

### ***Occurrence 5 (includes former occurrences 6, 7 and 8)***

Hollister Ranch, 34.49438/-120.37509 center of occurrence, along Cresta Road and Cementerio Road on crest of west end of Santa Ynez Mountains (Tranquillon Ridge) and its slope immediately below, above the heads of four canyons (Bullito Canyon, Canyon de Cojo, Canyon del Gato, west fork of Barranca Honda have been mentioned) leading down to Pacific Ocean in southwest Santa Barbara County; 87 ha/214 ac area of occurrence. The Santa Ynez Mountains and its crest are oriented in an east–west direction, and likewise this occurrence of Lompoc yerba santa, extending from 34.493633/-120.362501 to 34.490091/-120.386147 for a straight-line distance of 2.21 km/1.37 mi. Elevational records of the species here range from 274 m/900 ft (at head of west fork of Baranca Honda; 1941) to 838 m/2,750 ft (at the head of Canyon del Cojo; 1957), although these extremes may be erroneous because such elevations do not exist in the mapped area (414–533m/1,358–1,749 ft) under consideration. Most of what is known about the occurrence is from Mooney (1986b, p. entire; 1986c, p. 1, d entire) who mapped much of its distribution in 1986, reporting the species on Matilija sandstone. Mooney (1986b, entire; 1986c, p. 1; 1986d, entire) saw many individuals on the main ridge (Cresta Road), comprised mostly of juveniles and with a few adults, and fewer individuals on a side ridge (Cementario Road) at lower elevation. She reported the species as scattered all along the higher ridge top, sometimes in cracks of rocks, and away from the road, near the road, in the road and in graded areas, and locally common on the lower ridge top. The occupied area spanned over several parcels of private property, including the intersections of parcels 43, 46 and 47, and also further west on parcel 22 (map, Hollister-Ranch.com 2021, entire). USFWS (2011, p. 13) reported the species on six contiguous parcels. Other records (CDFW 2020, entire) report the species growing as shrubs up to 2.4 m/8 ft tall in disturbed, rocky, sandy soil on the sandstone ridge and slopes in disturbed areas of chaparral among chamise, La Purisima manzanita, buck brush (*Ceanothus cuneatus*), black sage, *Baccharis* sp., and mugwort (*Artemisia* sp.). At Elam's (1994, p. 163) three sampling sites for occurrence 5, she found multiclonal genetic diversity to be high: sample size 49 stems, comprised of 20 clones (diversity 0.87); sample size 26 stems, comprised of 17 clones (0.97 diversity); and sample size 30 stems, comprised of 11 clones (0.93 diversity). Hollister Ranch (5,666 ha/14,000 ac) is privately owned with multiple landowners. There are 133 parcels, each at least 40 ha/100 acres, with options for residential development and agriculture subject to approval by County of Santa Barbara. Access to the ranch is gated, strictly controlled, and generally considered exclusive. The ranch is mostly undeveloped, with 2% of its area devoted to residential use (primary use) and the remainder a working cattle ranch (secondary use; Hollister-Ranch.com 2021, entire). USFWS (2011, p. 13) considered Lompoc yerba santa at risk by development of the six parcels on which the species was known to occur, and we have no additional information. We identify the following threats: development, dense vegetation, lack of management, vehicles running over plants, road maintenance, altered fire regime/fire management practices, and climate change with severe drought and increased temperatures.

### ***Occurrence 12***

Jack and Laura Dangermond Preserve, 34.514073/-120.372431 (Batiuk 2020, p. 10), 140 m<sup>2</sup>/167 yd<sup>2</sup> extent of occurrence, 355 m/1,165 ft elevation, near boundary in eastmost part of preserve. The private property was previously a cattle ranch and is mostly undeveloped. This occurrence with one colony was first observed in 2012 with a total of five or six individuals (WRA 2017,

entire): three small sprouts in the dirt road, and two or three mature individuals at 3 m/10 ft south of it. Batiuk (2020, entire) observed only two mature individuals in May 2013 and May 2014, which he described as “robust and healthy” with flowers amid a small, dense patch of coyote brush with buck brush on sandstone-derived soil. Batiuk (2020, p. 1) stated that his work group searched for more *Lompoc yerba santa* in the area but found none; further, “we’ve been all over the ranch over the years we were on that project, and I would suspect that if there are more, it’s going to be 1–few individuals at most.” The location is 60 m/197 ft below the top (west side) of a north/south oriented foothill on the north side of the Santa Ynez Mountains, below Tranquillon Ridge (location of occurrence 5). The Jack and Laura Dangermond Preserve (99 km<sup>2</sup>/38 mi<sup>2</sup>) is owned by the Nature Conservancy since 2017 (Butterfield et al. 2019, p. 6). Threats include low number of plants, dense vegetation, lack of management, vehicles running over plants, road maintenance, altered fire regime/fire management practices, and climate change with severe drought and increased temperatures.

## APPENDIX B.

Reported numbers of Lompoc yerba santa (*Eriodictyon capitatum*) in the 11 known occurrences in west Santa Barbara County, California.

Year	Occurrence										
	1	2	5	9	10	11	12	13	14	15	16
2021	not found <sup>F</sup>										
2020											
2019		unknown number <sup>U</sup>	observed <sup>LL</sup>	743 stems <sup>Y</sup> 316 ramets <sup>E</sup>	not found <sup>F</sup>				70 individuals <sup>T</sup> 78 ramets <sup>D</sup>		unknown number <sup>U</sup>
2018	>7,000 ramets <sup>JJ</sup>			804 stems <sup>E</sup> 617 ramets <sup>E</sup>				281 stems <sup>T</sup> 258 ramets <sup>T</sup>			
2017				627 stems <sup>E</sup> 507 ramets <sup>E</sup>							
2016	>200 plants in part <sup>W</sup>			651 stems <sup>E</sup> 616 ramets <sup>E</sup>							
2015	500-1,000 individuals <sup>S</sup>	9,794 stems in part <sup>T</sup>		958 stems <sup>E</sup> 733 ramets <sup>E</sup>	not found <sup>F</sup>	unknown number <sup>H</sup>				5 stems <sup>T</sup> 4 ramets <sup>T</sup>	28 ramets <sup>X</sup>
2014								2 individuals <sup>B</sup>			
2013	common <sup>O</sup> , 100's of individuals <sup>R</sup>	150 individuals in part <sup>G</sup>		250+ ramets <sup>EE</sup>			2 individuals <sup>B</sup>				
2012	150 individuals in part <sup>Q</sup>			80 individuals <sup>CC</sup>			5-6 individuals <sup>A</sup>				
2011	200 ramets in part <sup>P</sup>			80 ramets <sup>DD</sup>	100-135 individual plants <sup>I</sup>						
2010	665 ramets in part <sup>X</sup>			807 ramets <sup>X</sup>						48 ramets <sup>X</sup>	
2007	20-30 individuals <sup>C</sup>										
2006	645 ramets in part <sup>X</sup>			1,017 ramets <sup>X</sup>	not found <sup>F</sup>					20 ramets <sup>X</sup>	
2005	not found <sup>F</sup>										
1998											
1995	>100 stems in part <sup>BB</sup>			>100 stems <sup>BB</sup>							
1993	common <sup>II</sup>	63 ramets in part <sup>N</sup>		>100 ramets <sup>N</sup>							
1992	observed <sup>N</sup>										
1987	8 individuals in part <sup>L</sup>			<500 individuals <sup>AA</sup>	several shrubs <sup>J,K</sup>						
1986	>500 individuals <sup>GG</sup>		100+ stems <sup>MM</sup>	locally common <sup>FF</sup>							
1983				56 clumps in part <sup>Z</sup>							
1982	68 stems in part <sup>M</sup>			>100 stems <sup>M</sup>							
1973	common <sup>HH</sup>										
1960			common <sup>KK</sup>								
1957			common <sup>KK</sup>								
1932	observed <sup>V</sup>										

- <sup>A</sup> WRA 2017, entire.
- <sup>B</sup> Batiuk 2020, p. 1.
- <sup>C</sup> Vogler and Boinay 2007, p. 1.
- <sup>D</sup> ManTech 2020b, 34–35.
- <sup>E</sup> ManTech 2020b, entire.
- <sup>F</sup> Lum 2021e, p. 3–4.
- <sup>G</sup> Knapp 2013c, p. 1.
- <sup>H</sup> Vogler 2021a, p. 1.
- <sup>I</sup> AECOM 2011, p. 15.
- <sup>J</sup> Griffiths et al. 1987a, p. 1.
- <sup>K</sup> Griffiths et al. 1987b, p. 1.
- <sup>L</sup> Howald 1987, p. 1.
- <sup>M</sup> Smith 1983, p. 3.
- <sup>N</sup> Elam 1994, entire.
- <sup>O</sup> Sage Institute 2014, p. 1.
- <sup>P</sup> Consortium of California Herbaria 2018, p. 1–2.
- <sup>Q</sup> Wilken 2012b, p. 1.
- <sup>R</sup> Knapp 2013b, p. 1.
- <sup>S</sup> Knapp 2015, p. 1.
- <sup>T</sup> Spear 2021, entire.
- <sup>U</sup> Hasenstab-Lehman 2021, entire.
- <sup>V</sup> Eastwood 1933, p. 40–41.
- <sup>W</sup> Santa Barbara Botanic Garden 2017, p. 13.
- <sup>X</sup> ManTech 2015, p. 11.
- <sup>Y</sup> Lum 2021g, p. 1.
- <sup>Z</sup> Jacks et al. 1984, p. 37.
- <sup>AA</sup> Bittman and Berg 1987, p. 2.
- <sup>BB</sup> Oyler et al. 1995, p. 56.
- <sup>CC</sup> Wilken 2012a, p. 1.
- <sup>DD</sup> Wilken and Painter 2011, p. 1.
- <sup>EE</sup> Knapp 2013a, p. 1.
- <sup>FF</sup> Keil et al. 1986, p. 1.
- <sup>GG</sup> Mooney 1986a, p. 1.
- <sup>HH</sup> Consortium of California Herbaria 2021b, p. 1.
- <sup>II</sup> Consortium of California Herbaria 2008b, p. 1.
- <sup>KK</sup> CDFW 2020, entire.
- <sup>LL</sup> Schneider 2020a, p. 1.
- <sup>MM</sup> Myers 1987, p. 5.