

Eriodictyon capitatum
(Lompoc yerba santa)

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



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5-YEAR REVIEW

Eriodictyon capitatum (Lompoc yerba santa)

I. GENERAL INFORMATION

Purpose of 5-Year Review:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing of a species as endangered or threatened is based on the existence of threats attributable to one or more of the five threat factors described in section 4(a)(1) of the Act, and we must consider these same five factors in any subsequent consideration of reclassification or delisting of a species. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process defined in the Act that includes public review and comment.

Species Overview:

Eriodictyon capitatum is an evergreen shrub in the borage family (Boraginaceae). Historically and currently, the species is known only from five populations scattered across the southwestern corner of Santa Barbara County. Two populations occur on Vandenberg Air Force Base (Vandenberg AFB), and the other three occur on private lands. It is found in association with central coast maritime chaparral (maritime chaparral) and stands of *Pinus muricata* (Bishop pine). Although each population appears to be comprised of a number of separate individuals, genetic analyses of several of the populations have determined that they are comprised of only 11 to 20 individuals. Several populations occur in remote areas and are presumably far from human activities that could cause changes in habitat conditions, while populations in closer proximity to human activities are more vulnerable to such changes. Since the time of listing, the most recent surveys for *E. capitatum* were those of the populations on Vandenberg AFB.

Methodology Used to Complete the Review:

This review was prepared by the Ventura Fish and Wildlife Office (VFWO), following the Region 8 guidance issued in March 2008. We used survey information from experts who have been monitoring various localities of this species, and the California Natural Diversity Database (CNDDB) maintained by the California Department of Fish and Game (CDFG). Unpublished reports and personal communications with experts were our primary sources of information used to update the species' status and threats. We did not receive any information from the public in response to our notice in the Federal Register initiating this 5-year review. This 5-year review contains updated information on the species' biology and threats, and an assessment of that

information compared to that known at the time of listing or since the last 5-year review. We focus on current threats to the species that are attributable to the Act's five listing factors. The review synthesizes all this information to evaluate the listing status of the species and provide an indication of its progress towards recovery. Finally, based on this synthesis and the threats identified in the five-factor analysis, we recommend a prioritized list of conservation actions to be completed or initiated within the next 5 years.

Contact Information:

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Federal Register Notice Citation Announcing Initiation of This Review: A notice announcing initiation of the 5-year review of this taxon and the opening of a 60-day period to receive information from the public was published in the Federal Register (FR) on May 21, 2010 (75 FR 28636). No information was received in relation to this species.

Listing History:

Original Listing

FR Notice: 65 FR 14888

Date of Final Listing Rule: March 20, 2000

Entity Listed: *Eriodictyon capitatum* (species)

Classification: Endangered

State Listing

Eriodictyon capitatum was listed as rare by the State of California in 1987.

Associated Rulemakings: Critical habitat was designated in 2002 (67 FR 67968).

Review History: N/A

Species' Recovery Priority Number at Start of 5-Year Review: The recovery priority number for *Eriodictyon capitatum* is 11 according to the Service's 2010 Recovery Data Call for the Ventura Fish and Wildlife Office, based on a 1-18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 FR 43098, September 21, 1983). This number indicates that the taxon is a species that faces a moderate degree of threat and has a low potential for recovery.

Recovery Plan or Outline: None

II. REVIEW ANALYSIS

Application of the 1996 Distinct Population Segment (DPS) Policy:

The Endangered Species Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment (DPS) of any species of vertebrate wildlife. This definition limits listing as distinct population segments to vertebrate species of fish and wildlife. Because the species under review is a plant and the DPS policy is not applicable, the application of the DPS policy to the species' listing is not addressed further in this review.

Updated Information on Current Species Status, Biology, and Habitat:

Species Biology and Life History

Eriodictyon capitatum was first described by Alice Eastwood in 1932 based on a collection made by Ralph Hoffmann a year earlier “5 miles north of Lompoc on the road to Casmalia” (Eastwood 1933). It is an evergreen shrub with narrow, leathery leaves in the borage family (Boraginaceae) and grows to approximately 3 meters (9.8 feet) tall. The lavender flowers are tubular and clustered in heads that bloom from May to August. Research indicates that *E. capitatum* is a self-incompatible species; intentionally cross-pollinated flowers produced a mean of 1.77 seeds per fruit, and intentionally self-pollinated flowers produced a mean of 0.03 seed per fruit (Elam 1994). This species spreads vegetatively through the production of rhizomes (underground stems), and thus producing colonies of ramets (genetically identical stems) from only a few individuals. While pollination ecology has not been specifically studied for *E. capitatum*, other *Eriodictyon* taxa are known to be pollinated by wasps, butterflies, and a variety of bee taxa, especially from the genera *Anthophora*, *Bombus*, *Chelostoma*, *Hylaeus*, *Osmia*, and *Nomadopsis* (Moldenke 1976).

Distribution

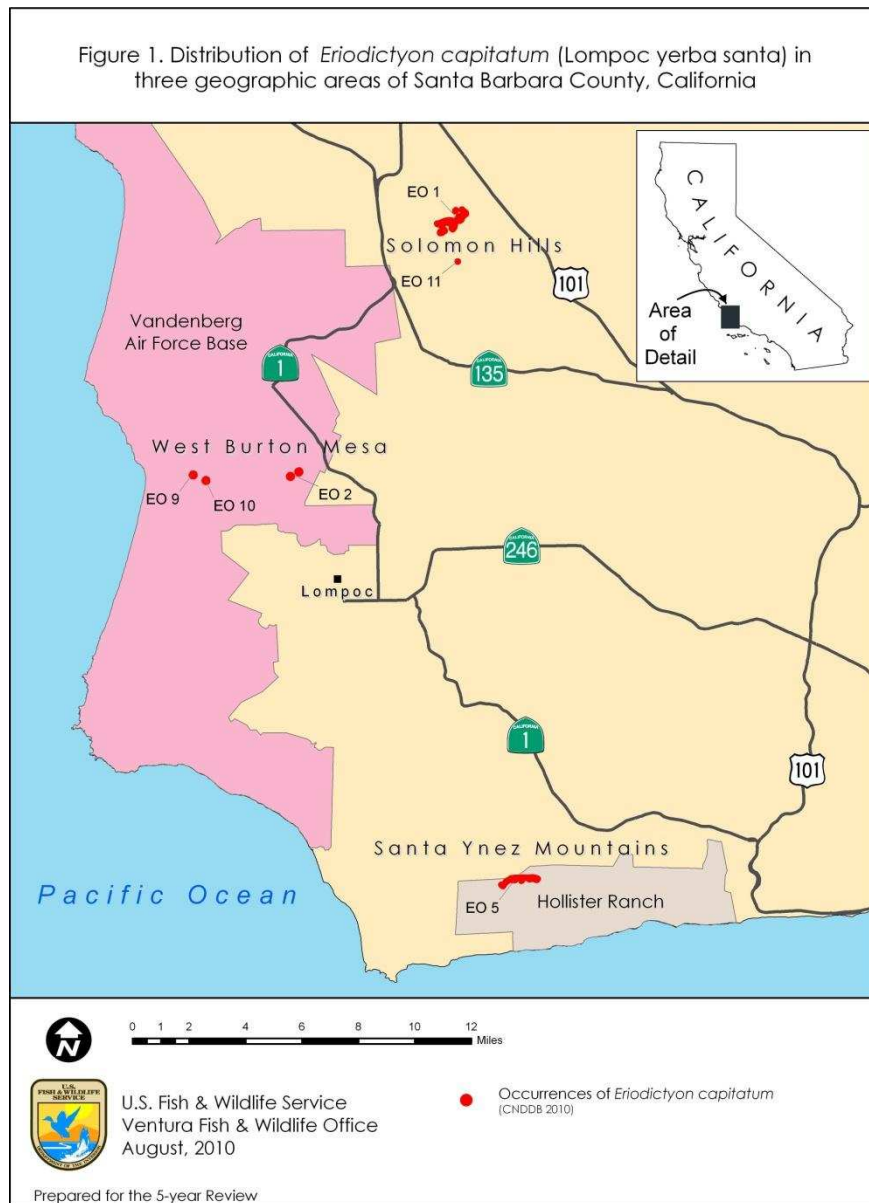
According to records available through the CNDDDB (2010) and the Consortium of California Herbaria (Consortium) (2010), all historical collections and unvouchered observations of *Eriodictyon capitatum* are from the southwestern corner of Santa Barbara County. Other studies (Elam 1994, Jacks et al. 1984) recognized seven populations of *E. capitatum* based on the number of “Element Occurrences” (occurrences) at the time and as defined by CNDDDB criteria. For the purposes of this review, we are recognizing five populations (comprised of six occurrences) based on differences in location and habitat type. These five populations are from three geographically distinct areas referred to here as Solomon Hills, west Burton Mesa, and Santa Ynez Mountains (Figure 1).

The five populations are distributed within these three geographic areas as follows:

1. Solomon Hills: two large populations occur here, approximately 19 kilometers (km) (12 miles (mi)) north of the city of Lompoc. These lands are privately owned and managed for oil extraction by Breitburn Energy Company. One population (occurrence (EO) 1) is

associated with *Pinus muricata*, while the second population (occurrence (EO) 11) occurs in coastal sage scrub and chaparral.

2. West Burton Mesa: two populations encompassing three occurrences are located within the boundaries of Vandenberg AFB. The 35th Street population adjacent to the cantonment area (occurrences (EO) 9 and 10) occurs in maritime chaparral. The Pine Canyon population (occurrence (EO) 2) is on the less-used eastern edge of the base and occurs in chaparral and Bishop pine forest.
3. Santa Ynez Mountains: approximately 16 km (10 mi) south of Lompoc, one population (occurrence (EO) 5) is scattered along an 8-km (5-mi) stretch of the mountains, from the ridgeline to halfway down the south-facing slopes. The land, known as Hollister Ranch, is privately-owned.



Very few surveys have been completed for *Eriodictyon capitatum* since it was federally listed in 2000. The most recent information available on surveys for *E. capitatum* is from those conducted on Vandenberg AFB. In 2006, special status plant surveys were conducted on Vandenberg AFB and included surveys for *E. capitatum* (SRS Technologies (SRS) 2007). In 2010, special status plant surveys were again conducted on Vandenberg AFB. During the 2010 surveys, *E. capitatum* populations surveyed in 2006 were revisited and invasive species were documented (SRS 2010). The 2010 surveys were conducted during the peak blooming period for *E. capitatum* to locate any new populations; however, no new populations were found (SRS 2010).

Table 1 summarizes occurrence data from CNDDDB (2010) and the Consortium (2010). For the most part, the information has remained relatively unchanged since the time of listing. The only updated information available is from the surveys for *Eriodictyon capitatum* conducted on Vandenberg AFB.

Table 1: Occurrence records for *Eriodictyon capitatum* collated from the CNDDDB (2010) and the Consortium (2010).

CNDDDB # ¹	Name (owner)	Current Trend	Year Collected/Observed	Pop Size/Year Surveyed	Reference
Solomon Hills area					
1 (includes former #4)	Orcutt Oil Field, Solomon Hills (private)	Extant	Hoffmann (1932) Tilforth UC839 (1973)	Common (1973) >500 (1986) Common (1993)	CNDDDB 2010
11	Orcutt Oil Field, Solomon Hills (private)	Extant	Vogler & Boinay (2007)	20-30 plants (2007)	CNDDDB 2010
West Burton Mesa area					
2 (includes former #3)	Pine Canyon, Vandenberg Air Force Base (DOD) ² (type locality)	Extant	Hoffmann SBBG #65158 (1932)	68 stems (1982)	CNDDDB 2010
9	Burton Mesa, 35 th x California St, Vandenberg Air Force Base (DOD) ²	Presumed extant	Smith (1982)	>100 stems (1982) <500 plants (1987)	CNDDDB 2010
10	Burton Mesa, 35 th x New Mexico St, Vandenberg Air Force Base (DOD) ²	Presumed extant	Griffiths CDA#105381 (1987)	Several shrubs (1987)	CNDDDB 2010
Santa Ynez Mountains area					
5 (includes former 6,7,8)	Hollister Ranch, Santa Ynez Mountains (private)	Presumed extant	Tucker SBBG# 6086 (1941)	Many (1986)	CNDDDB 2010

¹ CNDDDB # = element occurrence number assigned by the California Natural Diversity Database (CNDDDB 2010)

² DOD = Department of Defense

Population Abundance and Trends

Because of its clonal habit, the number of genetically unique *Eriodictyon capitatum* individuals is difficult to count. Most surveys have counted stems or what appear to be separate shrubs, but without knowing how many different genotypes were represented. A genetic study of several *E. capitatum* populations indicated that one-half of the Pine Canyon population and the 35th Street population were uniclinal (a single genotype), while the other half of the Pine Canyon

population, as well as the Santa Ynez Mountains (i.e., Hollister Ranch) population, were multiclonal (comprised of several genetically unique genotypes) (Elam 1994). Therefore, populations that appear to be comprised of many separate individuals may be one clone.

In an effort to monitor known populations of *Eriodictyon capitatum* on Vandenberg AFB, surveys conducted during 2010 also focused on documenting population health and identifying any potential threats to the populations (SRS 2010). Surveyors also attempted to quantify the number of individual plants instead of counting the number of ramets. The surveyors counted a plant as one individual based on the proximity of ramets to a specific individual or if they could trace the rhizome back to a specific individual (L. Lum, Vandenberg AFB, pers. comm. 2010). During surveys for *E. capitatum*, approximately 1,520 individuals were documented within known populations (SRS 2010). The results of this monitoring effort were used to approximate the percent change in number of individuals between surveys conducted in 2006 and 2010.

As shown in Table 2, the stands located at 35th Street, Lompoc Gate, and two of the four Pine Canyon stands showed a decrease in the number of individuals, while the Lake Canyon and the other two Pine Canyon stands showed an increase. Overall, since 2006, there was an 8.5 percent decrease in the total number of individuals. This decline in the number of individuals has been attributed to low rainfall in previous years (SRS 2010).

Table 2: Percent change in number of individuals at *Eriodictyon capitatum* stands located on Vandenberg AFB from 2006 to 2010 (SRS 2010).

Year of Survey	Stand Location						
	35 th Street Population*		Pine Canyon Population*				
	35 th Street	Lompoc Gate Stand	Lakes Canyon Stand	Pine Canyon Stand A**	Pine Canyon Stand B**	Pine Canyon Stand C**	Pine Canyon Stand D**
2006	1,017	11	20	11	172	59	372
2010	807	5	48	9	149	79	423
Percent change	-21%	-55%	140%	-18%	-13%	34%	14%

*Two populations exist on Vandenberg AFB. To assist in survey efforts, these populations were divided into stands.

**Pine Canyon stands labeled from north to south, with Pine Canyon A located at the northern-most edge.

Although the U.S. Air Force (Air Force) noted an increase or decrease in the *Eriodictyon capitatum* populations, we consider the data inconclusive. The monitoring information for the populations is limited to 2 years; therefore, we cannot conclude that the populations are in decline or increasing. Additionally, because of the species' clonal habit, the number of genetically unique individuals could be less than the number of individuals counted during the survey. Finally, there is no information documenting the consistency in survey protocol between the two survey years.

Habitat or Ecosystem Conditions

Eriodictyon capitatum occurs within two different habitat types. Near the coast, it occurs within maritime chaparral and coastal sage scrub on sandstone soils from the Orcutt, Marina, and Oceano series. In this habitat type, it typically occupies disturbed areas near roads or exposed ridgetops (Jacks et al. 1984). Associated species include *Ceanothus cuneatus* (buckbrush),

Salvia mellifera (black sage), *Baccharis* spp. (coyotebrush), *Artemisia californica* (California sagebrush), *Dendromecon rigida* (bush poppy), *Quercus berberidifolia* (California scrub oak), and *Arctostaphylos* spp. (manzanita) (Jacks et al. 1984).

On sites that are farther inland, *Eriodictyon capitatum* is found on diatomaceous Monterey shales. The structurally dominant *Pinus muricata* is one species that occurs at these sites. These sites have characteristic soils that are highly acidic and have a high water-retaining capacity (Cole 1974).

Both maritime chaparral and Bishop pine forest were identified by Holland (1986) as rare plant communities with a limited distribution. Maritime chaparral has been converted to residential, agricultural, and military uses, with the remaining habitat threatened by development and invasion by weeds such as *Carpobrotus edulis* and *C. chilensis* (iceplant) and *Cortaderia jubata* (D'Antonio et al. 1993, Griffin 1978, Jacks et al. 1984). Originally, there was an estimated 9,000 hectares (ha) (22, 239 acres (ac)) of maritime chaparral on Vandenberg AFB; however, by 1988, approximately 3,500 ha (8,649 ac) remained (Hickson 1988). Surrounded by a dense human population and development, the remaining maritime chaparral has been further degraded and fragmented (Hickson 1988).

Human activities also have the potential to alter important ecosystem processes such as fire. The Burton Mesa fire regime (frequency, intensity, extent, and seasonality of fire) and its effects on the surrounding vegetation have been studied by both Hickson (1988) and Davis et al. (1988). Historically, the vegetation of Burton Mesa has been subjected to varying fire regimes because of fires intentionally started by indigenous people and early settlers (Hickson 1988). Presently, the Air Force is developing a Wildfire Management Plan to implement a controlled burning program with the intended purpose of protecting the surrounding population and development on Burton Mesa. However, in the past, the controlled burning program has been the cause of many wildfires (Hickson 1988). The manipulation of the vegetation (i.e., proliferation of nonnative species concurrent with a reduction in the number of native species) at Burton Mesa may have resulted in a fire regime that is, according to Davis et al. (1988), “entirely anthropogenic.”

Threats to *Eriodictyon capitatum* populations on Vandenberg AFB were documented during the Air Force's 2006 and 2010 surveys. The information on the degree and type of threat to each population helps to inform future management decisions. During the 2006 surveys, extensive damage from feral pigs (*Sus scrofa*) was noted at the 35th Street population; however, little evidence of feral pigs was found during the 2010 surveys. Habitat degradation from erosion and the increasing spread of the invasive species *Cortaderia jubata* (jubata grass) threatens the Pine Canyon population.

Changes in Taxonomic Classification or Nomenclature

Since the time of listing, a phylogenetic study provided evidence supporting the transfer of the genus *Eriodictyon* from the waterleaf family (Hydrophyllaceae) to the borage family (Boraginaceae) (Jepson Online Interchange 2010).

Genetics

No new studies concerning the genetics of this species have been conducted since the time of listing.

Species-specific Research and/or Grant-supported Activities

In 2008, Genevieve Walden obtained a recovery permit (pursuant to section 10(a)(1)(A) of the Act) from the Service to conduct research for her Master's thesis. Her research involved studying phylogenetic relationships within the genus *Phacelia*, with the genus *Eriodictyon* used as an outgroup for comparison. Initially, Walden proposed collecting voucher specimens, fresh pollen and leaves, and mature seeds. Later, Walden indicated that she did not collect any vouchers of *Eriodictyon capitatum* and instead examined vouchers available at other institutions. The results of her study indicated that the molecular marker used in her research provided limited resolution for woody species, such as *E. capitatum*; therefore, she suggested using additional molecular markers and a broader sampling within the genus *Eriodictyon* (Walden 2010).

Five-Factor Analysis

FACTOR A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

At the time of listing *Eriodictyon capitatum* (Service 2000), we discussed that activities related to increased use of Vandenberg AFB as other military bases closed, alteration of habitat due to an increase in nonnative species, and altered fire regimes due to an increase in human-caused fires were threats to the species.

Destruction and Alteration of Habitat Due to Increased Use of Vandenberg AFB

The increased use of the launch facilities at Vandenberg AFB due to nationwide Department of Defense base closures was identified as a threat to this species at the time of its listing (Service 2000). According to the final listing rule (Service 2000), increased use of Vandenberg AFB would potentially result in the loss or alteration of *Eriodictyon capitatum* habitat. Wildfires were cited as one example of how habitat could be lost or altered. In 1993, debris from a missile that was intentionally destroyed shortly after launching caused several fires and burned more than 162 ha (400 ac). In September of 1997, a 200-ha (500-ac) fire and a 600-ha (1,500-ac) fire burned near habitat occupied by *E. capitatum* (Los Angeles Times 1997a). In November of 1997, a 495-ha (1,225-ac) fire was accidentally started on Vandenberg AFB by an Air Force explosives disposal team and was partially contained by setting a backfire through a population of *E. capitatum* (Los Angeles Times 1997b). Although increased use of Vandenberg AFB could result in the loss or alteration of *E. capitatum* habitat (e.g., wildfires), the number of launches per year is restricted.

The Marine Mammal Protection Act of 1972 restricts the number of launches on Vandenberg AFB because of the potential impacts to marine mammals in the area. Every 5 years, the Air

Force must apply to the National Marine Fisheries Service (NMFS)/National Oceanic and Atmospheric Administration (NOAA) for a permit to cover incidental harassment of marine mammals. In 2009, the 30th Space Wing at Vandenberg AFB had their 5-year permit renewed and approved for a maximum of 30 launches per year (NMFS, NOAA 2004). In addition to this restriction, the probability of a launch failing, and potentially impacting the surrounding habitat, is low. The launch success at Vandenberg AFB from 1960 to 2000 was approximately 94 percent with only 6 percent undergoing early flight termination (Air Force 2010a).

Habitat alteration and loss from development for military and commercial purposes was also identified as a threat to this species at the time of its listing (Service 2000). Habitat fragmentation within the Burton Mesa area continues. The original extent of Burton Mesa chaparral was approximately 9,000 ha (22,000 ac); by 1938, the extent had been reduced to 5,890 ha (14,554 ac), and by 1988, less than 3,500 ha remained (8,649 ac) (Davis et al. 1988). The only population of *Eriodictyon capitatum* on Vandenberg AFB that could be threatened by future development would be the 35th Street population. However, at this time, there are no plans to develop this area (Lum pers. comm. 2010). This population is also subject to disturbance from human activities because of its close proximity to paved and unpaved roads and the cantonment area. At present, it appears that the destruction and alteration of habitat due to an increased use of Vandenberg AFB remains a threat to *E. capitatum*.

Nonnative Species

On Vandenberg AFB, *Ehrharta calycina* (veldt grass) was planted to stabilize sand dunes in the 1950s; with the aid of the prevailing onshore winds, it rapidly spread across Vandenberg AFB and onto Burton Mesa between 1979 and 1996 (Air Force 1996). This species spreads rapidly, both vegetatively and through a persistent seedbank, and is extremely difficult to eradicate once it has become established (Bossard et al. 2000). *Carpobrotus edulis* and *C. chilensis* are other nonnative species that threaten to alter the maritime chaparral habitat by forming dense mats (Odion et al. 1992).

The *Eriodictyon capitatum* population located at 35th Street is the only population on Vandenberg AFB whose habitat is actively managed (e.g., removal of nonnative and invasive plant species). This population is located next to paved and unpaved roads and the cantonment area. Nonnative species such as *Cortaderia jubata*, *Pinus radiata* (Monterey pine), and *Eucalyptus globulus* (eucalyptus) have all invaded *E. capitatum* habitat in this area. Methods for management and removal of nonnative species are detailed in Vandenberg AFB's Invasive Plant Species Management Plan and will be included in the Integrated Natural Resources Management Plan (INRMP) (Air Force 2010b). Removal efforts include cutting or girdling invading trees. Herbicide application is required to remove *Cortaderia jubata*. The Air Force is currently investigating the use of a monocot-specific herbicide to avoid killing individual *E. capitatum* plants that may be nearby (Lum pers. comm. 2010). The alteration of habitat due to an increase in nonnative species is still a threat to *E. capitatum* populations located on Vandenberg AFB. There is no information available on nonnative species that may threaten the populations of *E. capitatum* located in the Solomon Hills and Santa Ynez Mountains.

Altered Fire Regime

Habitat for *Eriodictyon capitatum* may be altered by the increase in *Ehrharta calycina* and subsequent increases in the frequency of wildfires. The corresponding type conversion of habitat from scrub with openings to fields of *E. calycina* has been discussed by numerous researchers including D'Antonio and Vitousek (1992), Bossard et al. (2000) and Brooks et al. (2004). Invasive plants such as *E. calycina* can change the fuel properties of a site, which can in turn affect fire behavior, and ultimately alter fire regime characteristics such as frequency, intensity, extent, and seasonality of fire. If the regime changes subsequently promote the dominance of the invaders, then an invasive plant-fire regime cycle may be established, and restoration to preinvasion conditions becomes more difficult (Brooks et al. 2004).

The fire return interval, or fire frequency, on Vandenberg AFB has been estimated in different ways and ranges from 15 to 35 years (Coulombe and Copper 1976, Zedler 1977), while others estimate that, because of the coastal location, the fire return interval in central coastal California could be as long as 100 years (Wells 1962, Keeley and Keeley 1986). Although the natural fire return interval is unknown, because of its low elevation and infrequent lightning strikes, it was probably greater than the 20 to 30-year fire return interval found across most of Vandenberg AFB (Hickson 1988). A shorter fire return interval than the one that naturally occurs could negatively impact native plant species by destroying plants before seed set occurs or destroying the seed bank. The effects of fire on Burton Mesa chaparral (i.e., maritime chaparral) have been specifically studied by Hickson (1988) and Davis et al. (1988).

At least two wildfires have occurred in the vicinity of the Pine Canyon population since the time of listing. In 2006, a wildfire burned directly south of the Pine Canyon population in Oak Canyon. In 2009, another wildfire on Vandenberg AFB ("Highway Incident") burned 250 ha (617 ac) at the head of Lakes Canyon, north of the Pine Canyon population (Air Force 2009). In September of 1997, a 200-ha (500-ac) fire and a 600-ha (1,500-ac) fire burned near habitat occupied by *Eriodictyon capitatum* (Los Angeles Times 1997a). In November of 1997, a 495-ha (1,225-ac) fire was accidentally started by a Vandenberg AFB explosives disposal team and was partially contained by setting a backfire through a population of *Eriodictyon capitatum* (Los Angeles Times 1997b). Because of the dense human population surrounding Vandenberg AFB, a controlled burn program is necessary to reduce fire hazard. Controlled burns are specifically conducted under unnatural fire conditions (i.e., cool, moist conditions) and can negatively impact certain plant species (Parker 1987). Jacks et al. (1984) found that *Eriodictyon capitatum* appeared to respond positively to fire, resprouting vigorously from stem tissue. However, controlled burns should be implemented cautiously because uniclinal populations of *E. capitatum* have poor seed set and under unnatural conditions (e.g., increased fire intensity or frequency), underground stems could be destroyed (Jacks et al. 1984).

As noted previously, the Air Force is currently developing a Wildfire Management Plan that would include a controlled burning program for Vandenberg AFB. The Air Force anticipates completing a draft of the Wildfire Management Plan in April 2011 (L. Lum, Air Force, *in litt.* 2010). Prescribed burns are planned for areas containing potential *Eriodictyon capitatum* habitat (e.g., maritime chaparral, chaparral) on Vandenberg AFB. Pre-burn surveys for *E. capitatum*

would occur prior to prescribed burn activities; in dense habitat that precludes surveys for *E. capitatum*, the Air Force will consult with the Service on potential effects to the species pursuant to section 7(a)(2) of the Act (Lum pers. comm. 2010). An altered fire regime due to an increase in human-caused fires remains a threat to *E. capitatum* populations.

Oil Extraction and Energy Activities

Although we did not discuss it in Factor A in the rule to list *Eriodictyon capitatum*, we discussed elsewhere in the rule that oil extraction and refinement (e.g., maintenance activities, hazardous waste cleanup) are activities taking place at the Solomon Hills site where this species occurs. Since the time of listing, several activities have been conducted within habitat for this species in the Solomon Hills. In 2007 and 2010, projects to maintain well pads and adjacent roads were undertaken by Breitburn Energy Company. The purpose of these projects was to trim or remove *E. capitatum* stems that had encroached onto cleared well pads, oil drilling and processing equipment, wells, power poles, and other areas. During such activities, only stems that are in areas where they pose a fire safety risk or operational constraint are removed.

In February 2009, the final Environmental Impact Report for the Lompoc Wind Energy Farm was certified by the County of Santa Barbara. The wind farm is proposed on 1,194 ha (2,950 ac) of rural, agriculturally zoned land adjacent to Vandenberg AFB and southwest of Lompoc. Although *Eriodictyon capitatum* is located nearby, surveys of the project area did not find *E. capitatum* (County of Santa Barbara Planning and Development Department 2010). At this time, it does not appear that oil extraction and energy development activities are a threat to *E. capitatum*.

Development of Hollister Ranch

At the time of listing, development of Hollister Ranch was not identified as a threat to *Eriodictyon capitatum*. Hollister Ranch is designated as an “agricultural preserve” through the County of Santa Barbara’s Agricultural Preserve Program. The Agricultural Preserve Program enrolls land under the California Land Conservation Act of 1965 (also referred to as the Williamson Act) which allows local governments to enter into contracts with private landowners for the purpose of restricting land to agricultural or open space uses (State of California Department of Conservation 2007). Landowners that are enrolled in the Agricultural Preserve Program receive property tax assessments lower than full-market value because the land use is restricted to farming and open space uses (State of California Department of Conservation 2007). Although the entire ranch is in an agricultural preserve, the 5,666-ha (14,000-ac) ranch has been subdivided into 40-ha (100-ac) parcels. The County of Santa Barbara has since recognized that because of the 40-ha (100-ac) parcelization of the ranch, grazing is no longer a viable economic activity and is secondary to residential uses (County of Santa Barbara Planning and Development Department 2009). While development on Hollister Ranch is considered low-density (approximately 50 single-family homes as of 2009), these residential homes are often associated with other development including accessory buildings, agricultural development, reservoirs and roads, all of which have increased the demand on limited water resources and have resulted in the alteration and degradation of portions of the natural landscape (County of Santa Barbara Planning and Development Department 2009).

In a botanical survey conducted on Hollister Ranch before *Eriodictyon capitatum* was listed, the species was described as occurring in mixed chaparral along a ridge crest west of Bulito Canyon and common in previously disturbed areas (Fletcher 1983). An undated botanical survey (Hollister Ranch Conservancy 2003) indicates that *E. capitatum* occurs on six contiguous parcels in the western portion of Hollister Ranch. Of these six parcels, an undeveloped parcel has been sold and a second parcel has a completed residence and is available for purchase (Hollister Ranch Realty 2010). All six of these parcels are located within designated critical habitat for the species and could be developed. Development on Hollister Ranch is regulated under CEQA and requires the lead agency (i.e., County of Santa Barbara) to avoid or mitigate a project's significant environmental impacts if alternatives or mitigation measures are feasible. However, determination of the adequacy of avoidance or mitigation strategies is at the discretion of the County of Santa Barbara. Therefore, we believe that development is a threat to the population of *E. capitatum* located on Hollister Ranch.

Conservation Activities Undertaken Since the Time of Listing

The Air Force was exempted from having critical habitat designated on Vandenberg AFB. This exemption was granted because their draft INRMP incorporated specific measures that addressed the conservation of *Eriodictyon capitatum* (Service 2002). The INRMP identifies management strategies to protect *E. capitatum* from degradation or destruction of its habitat. These management strategies include: the development of a Fire Management Plan and Invasive Plant Species Management Plan, and disallowing development in *E. capitatum* habitat unless required to fulfill the Air Force's mission. The INRMP does not replace the interagency consultation process required for effects on federally listed species pursuant to section 7(a)(2) of the Act. Currently, the INRMP is in the final draft stage (R. Farris, U.S. Fish and Wildlife Service, *in litt.* 2010).

In summary, all of the threats identified at the time of listing are still considered threats at this time. The destruction and alteration of *Eriodictyon capitatum* habitat due to increased use of Vandenberg AFB remains a threat to this species. Increased use and development in the area has altered the natural fire regime and increased the number of fires. Several fires have burned near the populations on Vandenberg AFB or, in one case, partially through a population. The threat of wildfire has necessitated the completion of a Wildfire Management Plan in order to reduce fuel loads and fire hazard. However, the use of prescribed burns as a management tool is potentially contentious because there is only one study documenting the effects of fire on *E. capitatum* and intense fires could destroy underground stems. Nonnative species are another threat to *E. capitatum* because they alter and degrade *E. capitatum* habitat and compete for resources (e.g., light, space). Currently, we do not have any information about nonnative species impacting *E. capitatum* populations, except for the 35th Street population located on Vandenberg AFB. The 35th street population is actively managed to control nonnative species. The oil extraction activities that occur in the Solomon Hills continue but are restricted to existing areas and trimming and removal of *E. capitatum* does not occur frequently. There is no information indicating that there will be an expansion of the oil extraction activities in the Solomon Hills and any new development would be subject to restrictions by the County of Santa Barbara (see Factor D). Though not identified at the time of listing, development of Hollister Ranch is a threat to the Santa Ynez Mountains population of *E. capitatum*. Although Hollister Ranch is

designated as an agricultural preserve, the parcelization of the land demonstrates that grazing is secondary to residential uses. *Eriodictyon capitatum* is present on six parcels, two of which are available for purchase. Lastly, the Air Force is in the process of finalizing its INRMP that would aid in the conservation of this species. The INRMP does not replace the interagency consultation process; therefore, projects that could affect *E. capitatum* would be subject to regulation under section 7(a)(2) of the Act.

FACTOR B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Overutilization for commercial, recreational, scientific, or educational purposes was not known to be a factor at the time of listing in 2000 (Service 2000). Overutilization for any purpose does not appear to be a threat to the species at this time.

FACTOR C: Disease or Predation

Disease or predation were not considered threats to the species at the time of listing in 2000, and are not currently considered threats.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

At the time of listing, regulatory mechanisms thought to have some potential to protect *Eriodictyon capitatum* included: (1) listing under the Native Plant Protection Act (NPPA) and the California Endangered Species Act (CESA); (2) the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA); and (3) local land use laws, regulations, and policies. The listing rule (Service 2000) provides an analysis of the level of protection that was anticipated from those regulatory mechanisms. For the most part, this analysis appears to remain valid. There may also be future Federal and State involvement through the Environmental Protection Agency, the State Water Resources Control Board, and the California Air Resources Board, due to their regulatory authority over air quality, water quality, and hazardous waste management associated with oil refinery activities.

State Regulations

Eriodictyon capitatum was listed as rare by the State of California in 1987 under the NPPA of 1977. The NPPA directs the CDFG to “preserve, protect and enhance rare and endangered plants” in the state. In 1984, the State legislature enacted CESA, which resulted in three listing categories for plants: rare, threatened, and endangered. The designation of a species as “rare” means the species is not presently threatened with extinction but occurs in small numbers throughout its range and may become endangered if the environment worsens. The State designation of “rare” is not included in CESA; therefore, mitigation measures for impacts to rare plants are specified in a formal agreement between the CDFG and the project proponent (CDFG 2010). Under CEQA the lead agency must prepare environmental documents to disclose the environmental impacts of a project and to identify mitigation measures and project alternatives that may result in a significant effect on the environment. The County of Santa Barbara is the

lead agency responsible for CEQA review for projects on non-Federal lands where this species occurs.

In 2006, Breitburn Energy Company requested approval of an Oil Drilling and Production Plan through the County of Santa Barbara for the purpose of developing the Orcutt Hill Oil Field Diatomite project (County of Santa Barbara Planning and Development Department 2006). This project involved the construction and operation of up to 96 oil wells and other associated equipment. Although most of the project areas had been disturbed by previous oil field operations, native vegetation still exists around the perimeters of oil well pads. As the lead CEQA agency, the County of Santa Barbara required Breitburn Energy Company to develop a plan to protect the population of *Eriodictyon capitatum*. The Tree and Plant Protection Plan developed by Breitburn Energy Company includes several protective measures (e.g., supervision by an approved biologist to reduce impacts to *E. capitatum*, fencing around plants with educational signs, maps of sensitive species in the area) designed to protect the populations of *E. capitatum* during construction and operation of oil wells (Breitburn Energy Company 2006).

Federal Regulations

In 2000, *Eriodictyon capitatum* was listed as endangered under the Act. As a result of its listing status, those projects with a Federal nexus are required to consult with the Service under section 7(a)(2) of the Act. Additionally, under the Sikes Act, as amended, (16 U.S.C. 670 *et seq.*), the Secretary of Defense is directed to “carry out a program to provide for the conservation and rehabilitation of natural resources on military installations.” As noted previously, pursuant to the Sikes Act, the Air Force is developing an INRMP for Vandenberg AFB, which is currently in the final draft stage (Farris, *in litt.* 2010). The Service has consulted with the Air Force under section 7(a)(2) of the Act on activities at Vandenberg AFB that could impact *E. capitatum*. These projects and consultations include a military munitions response program and the development of a base-wide programmatic biological opinion. The Service is also consulting with the Natural Resources Conservation Service under section 7(a)(2) of the Act on implementation of a permit coordination program in the County of Santa Barbara for increasing the efficiency of the permitting process for restoration projects conducted on private land where *E. capitatum* may occur.

Local Land Use Laws, Regulations, and Policies

At the time of listing, protection under the California Coastal Act (CCA) was not discussed under Factor D. According to the CCA, an area located within the coastal zone that supports federally listed species is considered an “environmentally sensitive habitat area.” The CCA requires environmentally sensitive habitat areas be “protected against any significant disruption of habitat values.” The CCA further requires all counties and cities along the California coast to prepare a Local Coastal Program, which consists of land use plans, zoning ordinances, zoning district maps, and other implementing actions. Land use plans and zoning that are approved at the local level are then submitted to the Regional and State Coastal Commissions, who maintain appeal authority. Upon certification by the Coastal Commissions, and if the project is consistent with the Local Coastal Program, then the local government issues a coastal development permit. Furthermore, every 5 years, the State Coastal Commission must review the progress of local

governments in implementing the CCA. The County of Santa Barbara's Coastal Land Use Plan emphasizes expanding public access to County beaches, preserving prime agricultural land, and protecting environmentally sensitive habitats (County of Santa Barbara Planning and Development Department 2009). As required by the CCA, the County of Santa Barbara must submit any proposed projects that would occur on Hollister Ranch to the Coastal Commissions.

In summary, there are State, Federal, and local land use regulatory mechanisms that would potentially apply to projects within *Eriodictyon capitatum* habitat. Since the time of listing, State regulations have been invoked for the Breitburn Energy Company project and for development on Hollister Ranch. Federal regulations have been applied to consultations with the Air Force and the Natural Resources Conservation Service. The Air Force has developed a draft INRMP, as required by the Sikes Act, for Vandenberg AFB to protect and conserve this species. Finally, the County of Santa Barbara has developed a Coastal Land Use Plan that emphasizes the protection of environmentally sensitive habitat areas containing federally listed species such as *E. capitatum*. We believe that pending and future projects will be subject to available regulatory mechanisms.

FACTOR E: Other Natural or Manmade Factors Affecting Its Continued Existence

At the time of listing, we discussed competition with nonnative species and stochastic extinction due to small size of populations and numbers as threats to *Eriodictyon capitatum*. An analysis of these threats is contained in the final rule and appears to remain currently valid.

Nonnative Species

In general, invasion of *Eriodictyon capitatum* habitat by nonnative species (particularly *Ehrharta calycina*) is a threat to populations of native species because individuals cannot compete well for light, water, and resources (D'Antonio and Vitousek 1992). The expansion of *E. calycina*, *Carpobrotus* spp., *Cortaderia jubata*, *Pinus radiata*, and *Eucalyptus globulus* into *E. capitatum* habitat and their effects on the species were discussed in Factor A. We believe that nonnative species are still a threat to populations of *E. capitatum*.

Stochastic Extinction

As stated in the 2000 final listing rule, we continue to believe that the existence of five populations of *Eriodictyon capitatum* and the species' restricted distribution place this species at risk of extinction from stochastic events. The conservation biology literature commonly notes the vulnerability of taxa known from very few locations and/or from small and highly variable populations (e.g., Shaffer 1981, 1987; Groom et al. 2006; Primack 2006). This vulnerability can arise due to uncertainty with stochastic events, such as environmental stochasticity, natural catastrophes, genetic stochasticity, and demographic stochasticity. Populations of *E. capitatum* are subject to all of these stochastic events. Elam (1994) found that two of the six populations she studied were uniclinal. Because *E. capitatum* is self-incompatible and cannot produce viable seed, a uniclinal population can be extirpated by both environmental stochasticity (e.g., prolonged drought) and natural catastrophes (e.g., wildfire). Furthermore, genetic stochasticity can result in a loss of genetic variation and subsequently decrease population viability. While

demographic stochasticity can be viewed as a natural flux of the population, a uniclonal population with a low reproductive and survival rate could be at higher risk of extinction.

Climate Change

At the time of listing, we did not discuss the potential effects of climate change on the long-term persistence of *Eriodictyon capitatum*. Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying (Field et al. 1999, Cayan et al. 2005, Intergovernmental Panel on Climate Change 2007). Recently, the potential impacts of climate change on the flora of California were discussed by Loarie et al. (2008). Based on modeling, they predicted that species' distributions will shift in response to climate change, specifically that the species will "move" or disperse to higher elevations and northward, depending on the ability of each species to do so. Species diversity will also shift in response to these changes with a general trend of increasing diversity shifting towards the coast and northwards with these areas becoming de facto future refugia. However, predictions of climatic conditions for smaller sub-regions such as California remain uncertain. It is unknown at this time if climate change in California will result in a warmer trend with localized drying, higher precipitation events, or other effects. While we recognize that climate change is an important issue with potential effects to listed species and their habitats, we lack adequate information to make accurate predictions regarding its effects to *Eriodictyon capitatum* at this time.

In summary, *Eriodictyon capitatum* populations are threatened by nonnative species that compete with them for light, space, and other resources. Because there are only five populations and the species has a restricted distribution, *E. capitatum* is at risk of extinction from stochastic events. We recognize that climate change may affect the long-term persistence of *E. capitatum* populations. However, at this time, we cannot adequately predict how climatic conditions would change at the sub-region level and consequently, how populations of *E. capitatum* may respond to those climatic changes.

III. RECOVERY CRITERIA

Recovery plans provide guidance to the Service, States, and other partners on ways to minimize threats to listed species and on criteria that may be used to determine when recovery goals are achieved. There are many paths to accomplishing recovery of a species and recovery may be achieved without fully meeting all recovery plan criteria. For example, one or more criteria may have been exceeded while other criteria may not have been accomplished. In that instance, we may determine that, over all, the threats have been minimized sufficiently, and the species is robust enough, to reclassify the species from endangered to threatened or perhaps to delist it. In other cases, new recovery approaches and/or opportunities unknown at the time the recovery plan was finalized may be more appropriate ways to achieve recovery. Likewise, new information may change the extent that criteria need to be met for recognizing recovery of the species. Overall, recovery is a dynamic process requiring adaptive management, and assessing a species' degree of recovery is likewise an adaptive process that may, or may not, fully follow the guidance provided in a recovery plan. We focus our evaluation of species status in this 5-year review on progress that has been made toward recovery since the species was listed (or since the

most recent 5-year review) by eliminating or reducing the threats discussed in the five-factor analysis. In that context, progress towards fulfilling recovery criteria serves to indicate the extent to which threat factors have been reduced or eliminated.

A recovery plan for *Eriodictyon capitatum* has not yet been developed; therefore, no recovery criteria exist.

IV. SYNTHESIS

All of the threats to *Eriodictyon capitatum* identified at the time of listing are still considered threats. Increased use of Vandenberg AFB continues to threaten *E. capitatum* by destroying and altering its habitat. Increased use and development in the area has resulted in an increased number of fires and altered the natural fire regime. A change in the natural fire regime, especially fire intensity, can damage or destroy underground stems, reducing the genetic diversity in the population. The introduction of nonnative species onto the landscape has also altered *E. capitatum* habitat. Nonnatives such as *Carpobrotus edulis* and *C. chilensis* can form dense mats and outcompete *E. capitatum* for resources. The Solomon Hills population is threatened by oil extraction development; however, at this time, there are no plans to expand oil development in the area. The Santa Ynez population is threatened by development of Hollister Ranch. The Santa Ynez population is located on six parcels on Hollister Ranch and two are available for purchase.

There are a few conservation measures that are being developed or are in place to protect *Eriodictyon capitatum*. The Air Force has developed a draft INRMP for Vandenberg AFB to conserve this species and improve management of its habitat. The INRMP will include an Invasive Plant Species Management Plan and a Wildfire Management Plan; the latter will not be available until the summer of 2011 at the earliest. The County of Santa Barbara has required that Breitburn Energy Company implement measures to avoid and minimize impacts to the *E. capitatum* populations located in the Solomon Hills. Projects that would impact the population located on Hollister Ranch are subject to review under CEQA. The County of Santa Barbara's Coastal Land Use Plan provides a level of protection for environmentally sensitive habitat areas containing federally listed species. Finally, State and Federal listings of this species provide some level of protection. State listing as rare requires project proponents to coordinate with CDFG while the federally endangered status requires the lead Federal agency for projects with a Federal nexus to consult with the Service pursuant to section 7(a)(2) of the Act.

The current distribution of *Eriodictyon capitatum* is restricted and only five known populations exist. These factors make *E. capitatum* populations vulnerable and at risk of extinction from stochastic events. Uniclonal populations are especially vulnerable to stochastic events because of limited genetic diversity which consequently, restricts a species' ability to adapt to changing conditions. Climate change and its effects on *E. capitatum* are largely uncertain. Presently, we cannot adequately predict climatic changes at the sub-region level. Research has shown that species will "move" or disperse to higher elevations and northward; however, this depends on the ability of each species to do so.

After reviewing the type and degree of threats to the populations of *Eriodictyon capitatum*, we conclude that this taxon continues to be in danger of extinction throughout its currently known range. Therefore, *E. capitatum* meets the definition of endangered under the Act and no status change is recommended at this time.

V. RESULTS

Recommended Classification:

- Downlist to Threatened
- Uplist to Endangered
- Delist (indicate reasons for delisting per 50 CFR 424.11):
 - Extinction*
 - Recovery*
 - Original data for classification in error*
- No Change

New Recovery Priority Number and Brief Rationale: N/A

VI. RECOMMENDATIONS FOR FUTURE ACTIONS

1. Complete a Recovery Outline and Species Action Plan for *Eriodictyon capitatum* as a first step in preparing a recovery plan for the species.
2. Develop a survey protocol for *Eriodictyon capitatum*. Because of its clonal habit, surveyors may develop their own methods or may avoid counting the number of individuals. Creating a survey protocol would encourage documentation of the number of plants and would allow comparison across the species range.
3. Work with representatives from Breitburn Energy Company, CDFG, and Hollister Ranch to ensure that management of their lands is consistent with the long-term persistence of *Eriodictyon capitatum* at those sites. In addition, maintain contact with these representatives to ensure that survey information is updated on a regular basis.
4. Conduct genetic testing in collaboration with representatives from the Air Force, Breitburn Energy Company, CDFG, and Hollister Ranch. Genetic testing can determine if a population is uniclinal or multiclinal. This information could aid in developing appropriate management decisions and conservation strategies for each population. (See number 5 as an example)
5. Discuss with conservation experts if cross-pollination of uniclinal populations with multiclinal populations would be an appropriate management strategy to increase the amount of viable seed produced. This would aid in increasing genetic diversity within uniclinal populations.

6. In partnership with local botanic gardens or other interested parties, develop a habitat suitability model and based on the results, survey those areas with suitable habitat in an effort to locate additional populations of *Eriodictyon capitatum*. Survey results should then be incorporated into Geographic Information System layers to update the current extent and distribution of known populations.
7. In conjunction with surveys, habitat assessments should also be conducted to determine if habitat quality affects the number of stems produced. This could aid in informing decisions on how to properly manage each population.

VII. REFERENCES

Literature Cited

- Bossard, C., M.C., Hoshovsky, and J.M. Randall (eds.). 2000. Invasive plants of California's wildlands. University of California Press, Berkeley and Los Angeles, California. Species profile for *Ehrharta* spp. on pp. 164-170.
- Breitbart Energy Company. 2006. Tree and plant protection plan. Unpublished report prepared by Holland, V.L. and Tracer Environmental Sciences & Technologies, Inc. 17 pp.
- Brooks, M.L., C.M. D'Antonio, D.M. Richardson, J.B., Grace, J.E. Keeley, J.M. DiTomaso, R.J. Hobbs, M. Pellant, and D. Pyke. 2004. Effects of invasive alien plants on fire regimes. *BioScience* 54(7): 677-688.
- [CDFG] California Department of Fish and Game. 2010. Native plant conservation. Accessed online at: http://www.dfg.ca.gov/wildlife/nongame/t_e_spp/nat_plnt_consv.html. September 29, 2010.
- [CNDDDB] California Natural Diversity Data Base. 2010. Element occurrence reports for *Eriodictyon capitatum*. California Department of Fish and Game, Sacramento, California.
- Cayan, D., M. Dettinger, I. Stewart, and N. Knowles. 2005. Recent changes towards earlier springs: early signs of climate warming in western North America? U.S. Geological Survey, Scripps Institution of Oceanography, La Jolla, California.
- Cole, K.L. 1974. Edaphic restrictions in the La Purisima Hills with special reference to *Pinus muricata* D. Don. Master's thesis, California State University, Los Angeles. 67 pp.
- [Consortium] Consortium of California Herbaria. 2010. Accessed records for *Eriodictyon capitatum* online on March 1, 2010, at <http://ucjeps.berkeley.edu/consortium>.
- Coulombe, H.N. and C.F. Cooper. 1976. Ecological assessment of Vandenberg Air Force Base, California. Vol. 1. Evaluation and recommendations. AFCEC TR-76-15. Air Force Civil Engineering Center. Tyndall Air Force Base, Florida. 187 pp.

- County of Santa Barbara Planning and Development Department. 2006. Revised final mitigated negative declaration (06NGD-00000-00018) Breitburn Energy Orcutt Hill diatomite project phases 1 and 2. Oil Drilling and Production Plan (05PPP-00000-00001).
- County of Santa Barbara Planning and Development Department. 2009. Coastal land use plan. Accessed online at: <http://longrange.sbcountyplanning.org/programs/genplanreformHat/PDFdocs/CoastalPlan.pdf>. October 22, 2010.
- County of Santa Barbara Planning and Development Department. 2010. Final Environmental Impact Report for the Lompoc Wind Energy Farm. Accessed online at: http://www.countyofsb.org/energy/projects/Wind/Lompoc_FEIR.htm. September 10, 2010.
- D'Antonio, C.M. and P.M. Vitousek. 1992. Biological invasions by exotic grasses, the grass/fire cycle, and global change. *Annual Review of Ecology and Systematics* 23: 63-87.
- D'Antonio, C.M., D.C. Odion, and C.M. Tyler 1993. Invasion of maritime chaparral by the introduced succulent *Carpobrotus edulis*. *Oecologia* 19:25-41.
- Davis, F.W., D.E. Hickson, and D.C. Odion. 1988. Composition of maritime chaparral related to fire history and soil, Burton Mesa, Santa Barbara County, California. Department of Geography, University of California, Santa Barbara.
- Eastwood, A. 1933. A new yerba santa. *Leaflets of Western Botany*, Vol 1, No. 5: 40-41.
- Elam, D.R. 1994. Genetic variation and reproductive output in plant populations: effects of population size and incompatibility (*Lilium parryi*, *Lilium humboldtii*, *Raphanus sativus*, *Eriodictyon capitatum*). Ph. D. dissertation, University of California, Riverside. 221 pp.
- Field, C.B., G.C. Daily, F.W. Davis, S. Gaines, P.A. Matson, J. Melack, and N.L. Miller. 1999. Confronting climate change in California. Ecological impacts on the Golden State. A report of the Union of Concerned Scientists, Cambridge, Massachusetts, and the Ecological Society of America, Washington, DC.
- Fletcher, M. 1983. A flora of Hollister Ranch, Santa Barbara County, California. Department of Biological Sciences, University of California, Santa Barbara. Publication number 2. 77 pp.
- Groom, M.J., G.K. Meffe, and C.R. Carroll. 2006. Principles of conservation biology, third edition. Sinauer Associates, Inc., Sunderland, Massachusetts.
- Griffin, J.R. 1978. Maritime chaparral and endemic shrubs of the Monterey Region, California. *Madrono* 25: 65-81.

- Hickson, D.E. 1988. History of wildland fires on Vandenberg Air Force Base, California. NASA (National Aeronautics and Space Administration) Technical Memorandum 100983. The Bionetics Corporation, Kennedy Space Center, Florida.
- Holland, R.F. 1986. Preliminary descriptions of the terrestrial natural communities of California. California Department of Fish and Game, Sacramento, California.
- Hollister Ranch Conservancy. 2003. Hollister Ranch Conservancy Botanical Resources. Accessed online at <http://www.hollister-ranch.com/> on October 20, 2010.
- Hollister Ranch Realty. 2010. Hollister Ranch Realty available properties and recent sales. Accessed online at <http://www.hollister-ranch.com/> on October 18, 2010.
- Intergovernmental Panel on Climate Change. 2007. Climate change 2007: the physical science basis. Summary for policymakers. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, IPCC Secretariat, World Meteorological Organization and United Nations Environment Programme, Geneva, Switzerland.
- Jacks, P., C. Scheidlinger, and P.H. Zedler. 1984. Response of *Eriodictyon capitatum* to prescribed fire on Vandenberg AFB, California. Prepared for U.S. Fish and Wildlife Service, Sacramento, California. Order #11310-0263-81. San Diego State University, San Diego.
- Jepson Online Interchange. 2010. *Eriodictyon capitatum*. Accessed online at http://ucjeps.berkeley.edu/cgi-bin/get_cpn.pl?24666&expand=1 on August 18, 2010.
- Keeley, J.E. and S.C. Keeley. 1986. Chaparral and wildfires. *Fremontia* 14(3): 18-21.
- Loarie S.R., B.E. Carter, K. Haydoe, S. McMahon, R. Moe, C.A. Knight, and D.D. Ackerly. 2008. Climate change and the future of California's endemic flora. *Plos ONE* 3(6): e2502 doi 10.1371/journal.pone.0002502.
- Los Angeles Times. 1997a. Fires burn 7,000 acres near Temecula, 500 acres at Vandenberg Air Force Base. Newspaper article, September 2, p. A20.
- Los Angeles Times. 1997b. Vandenberg brush fire is contained. Newspaper article, November 1, p. B17.
- Moldenke, A.R. 1976. California pollination ecology and vegetation types. *Phytologia*, vol. 34, no. 4. 56 pp.
- [NMFS] National Marine Fisheries Service, [NOAA] National Oceanic and Atmospheric Administration. 2004. Taking and importing marine mammals; taking marine mammals

- incidental to space vehicle and test flight activities from Vandenberg Air Force Base (VAFB), CA. 69 Federal Register 5720.
- Odion, D.C., D.E. Hickson, C.M. D'Antonio. 1992. Central coast maritime chaparral on Vandenberg Air Force Base: an inventory and analysis of management needs for a threatened vegetation type. Prepared for The Nature Conservancy. University of California, Santa Barbara.
- Parker, V.T. 1987. Can native flora survive prescribed burns? *Fremontia* 15(2): 3-6.
- Primack, R.B. 2006. *Essentials of conservation biology* (fourth edition). Sinauer Associates, Sunderland, Massachusetts.
- Shaffer, M.L. 1981. Minimum population sizes for species conservation. *Bioscience* 31: 131-134.
- Shaffer, M.L. 1987. Minimum viable populations: coping with uncertainty. Pp. 69-86. *In*: M.E. Soulé, (ed.) *Viable populations for conservation*. Cambridge University Press, New York, New York.
- [SRS] SRS Technologies. 2007. Survey results for three federally endangered plants on Vandenberg Air Force Base, California. Unpublished report prepared by Mantech SRS Technologies, Mission Services Division, Lompoc, California. 52 pp.
- [SRS] SRS Technologies. 2010. Survey results for three federally endangered plants on Vandenberg Air Force Base, California. Unpublished report prepared by Mantech SRS Technologies, Mission Services Division, Lompoc, California. 17 pp.
- State of California Department of Conservation. 2007. Williamson Act. Accessed online at: <http://www.consrv.ca.gov/DLRP/lca/Pages/index.aspx>. November 24, 2010.
- [Air Force] U.S. Air Force. 1996. Peacekeeper rail garrison and small ICBM mitigation program, San Antonio Terrace, Vandenberg Air Force Base, California. Final report on the successful creation of wetlands and restoration of uplands. Unpublished report prepared by the Earth Technology Corporation, SAIC, and FLx for the Department of the Air Force, Detachment 10, Space and Missile Systems Center, San Bernardino.
- [Air Force] U.S. Air Force. 2009. Burned Area Emergency Response plan. Vandenberg Air Force Base, California. 34 pp.
- [Air Force] U.S. Air Force. 2010a. Draft integrated natural resources management plan for Vandenberg Air Force Base, 2010 - 2014.
- [Air Force] U.S. Air Force. 2010b. Invasive plant species management plan. Unpublished report included in Vandenberg Air Force Base's draft integrated natural resources

management plan. Prepared by Mantech SRS Technologies, Mission Services Division, Lompoc, California. 65 pp.

[Service] U.S. Fish and Wildlife Service. 1983. Endangered and threatened species listing and recovery priority guidelines. 48 Federal Register 43098.

[Service] U.S. Fish and Wildlife Service. 2000. Endangered and threatened wildlife and plants; final rule for endangered status for four plants from south central coastal California. 65 Federal Register 14888.

[Service] U.S. Fish and Wildlife Service. 2002. Endangered and threatened species wildlife and plants; designation of critical habitat for *Eriodictyon capitatum* (Lompoc yerba santa) and *Deinandra increscens* ssp. *villosa* (Gaviota tarplant); final rule. 67 Federal Register 67968.

[Service] U.S. Fish and Wildlife Service. 2010. Endangered and threatened wildlife and plants; initiation of 5-year-reviews of 34 species in California and Nevada; availability of 96 completed 5-year-reviews in California and Nevada, species listing and recovery priority guidelines. 75 Federal Register 28636.

Walden, G. 2010. Phylogeny of infrageneric relationships within *Phacelia* (Boraginaceae) inferred from chloroplast sequence data. Unpubl. Masters Thesis. San Francisco State University.

Wells, P.V. 1962. Vegetation in relation to geological substratum and fire in the San Luis Obispo Quadrangle, California. Ecological Monographs 32: 79-103.

Zedler, P.H. 1977. The status of Bishop pine (*Pinus muricata*) on Vandenberg Air Force Base and recommendations for its management. Report for 1977 Summer Faculty Research Program, Air Force Office of Scientific Research. 42pp.

In Litteris Cited

Farris, R. 2010. Section 7/404 Program Coordinator, U.S. Fish and Wildlife Service, Ventura Fish and Wildlife Office, Ventura, California. Electronic mail regarding the status of the Vandenberg Air Force Base Integrated Natural Resources Management Plan. Dated September 7, 2010.

Lum, L. Botanist, Vandenberg Air Force Base, Lompoc, California. Electronic mail regarding the due date of the draft Wildfire Management Plan for Vandenberg Air Force Base. Dated November 23, 2010.

Personal Communications Cited

Lum, L. October 2, 2010. Botanist, Vandenberg Air Force Base, Lompoc, California.
Telephone conversation with Erin Shapiro (U.S. Fish and Wildlife Service, Ventura, California) regarding the management of *Eriodictyon capitatum* populations on Vandenberg Air Force Base.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Eriodictyon capitatum* (Lompoc yerba santa)

Current Classification: Endangered

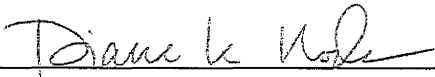
Recommendation Resulting from the 5-Year Review:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Review Conducted By: Erin Shapiro

FIELD OFFICE APPROVAL:

Field Supervisor, U.S. Fish and Wildlife Service

Approve  Date 2/8/11