Final Species Report

Eriodictyon altissimum
(Indian Knob Mountainbalm)

California Native Plant Society, 2002

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

Eriodictyon altissimum (Indian Knob mountainbalm) is a perennial shrub species in the borage family (Boraginaceae) endemic to western San Luis Obispo County, California. The species first received State protection when listed as endangered under the California Endangered Species Act (CESA) in 1979. The Service proposed to list *E. altissimum* as endangered under the Endangered Species Act in 1991 (56 FR 66400, December 23, 1991), with the final listing rule publishing in 1994 (59 FR 64613, December 15, 1994). The Service determined that designation of critical habitat was not prudent at the time of the final listing rule and no critical habitat has been designated for *E. altissimum* since that time. A recovery plan for the Morro shoulderband snail (*Helminthoglypta walkeriana*), *Arctostaphylos morroensis* (Morro manzanita), *Eriodictyon altissimum*, *Cirsium fontinale* var. *obispoense* (Chorro Creek bog thistle), and *Clarkia speciosa* ssp. *immaculata* (Pismo clarkia) was completed in September 1998 (Service 1998). In the 5-year review completed in February, 2009, the Service recommended downlisting *E. altissimum* from endangered to threatened, primarily because the primary threat at the time of listing (habitat loss as a result of development) had been substantially reduced as a result of purchase and securing conservation protections on lands where the species occurred in the Los Osos and Indian Knob areas.

On December 21, 2011, the Service received a petition from The Pacific Legal Foundation requesting that we delist the Inyo California towhee (*Pipilo crissalis*) and reclassify from endangered to threatened *Eriodictyon altissimum*, *Astragalus jaegerianus* (Lane Mountain milk-vetch), *Cupressus abramsiana* (Santa Cruz cypress), arroyo toad (*Anaxyrus californicus*), and Modoc sucker (*Catostomus microps*) based on the analysis and recommendations contained in the most recent 5-year reviews for these taxa. In a 90-day finding published in 2012 (107 FR 32922, June 4, 2012), the Service determined that substantial scientific or commercial information indicated that each of these petitioned actions may be warranted and, therefore, initiated status reviews for each of these taxa to determine whether the petitioned action of delisting or reclassifying is warranted.

Species Information

In this report, various terms for different assemblages of *Eriodictyon altissimum* are used. The term element occurrence (EO) is used consistent with the California Department of Fish and Wildlife's (Department) Natural Diversity Data Base (CNDDB) definition: a group of plants that occurs a minimum of 0.25 mile (mi) (0.4 kilometer; km) from each other and not separated by habitat discontinuities (CNDDB 2012, 6 pp.). The term EO is also used by NatureServe (2002), a non-profit conservation organization whose mission is to provide the scientific basis for effective conservation action, defines individual EOs by a separation distance of at least 0.62 mi (1 km). As all references to EOs in the existing literature and knowledge shared by local individuals rely upon the CNDDB EOs, we use their definition in this report to avoid confusion. The term EO (also referred to as occurrences in this document), cross-referenced to a site name, is used in this report as the primary reference point for the aboveground expression of *E. altissimum*. When using location, we refer to a particular site, area, or region that represents a

physical place. Note that there can be one or more discrete subgroups of plants mapped within a single occurrence. In this report, we discuss occurrences in two geographic areas within western San Luis Obispo County: Los Osos and Indian Knob.

Description and Taxonomy

Eriodictyon altissimum was originally placed in the waterleaf family (Hydrophyllaceae) (Halse 1993, pp. 683-708) but is now included in the borage family (Boraginaceae) (Kelley *et al.* 2012, pp. 450–511). It is a relatively weak-stemmed evergreen shrub arising from a trunk-like main stem. While some individuals can achieve heights in excess of 13 feet (4 meters), most are observed in the height range of 5 to 6 feet (ft) (1.5 to 2 meters (m)). The root system is shallow, with multi-branching rhizomes (underground stems). The narrow, linear leaves are alternate (although sometimes opposite below), strongly revolute (curled under), glutinous (sticky) above and densely white tomentose (hairy) below. Mature leaves are sometimes blackened by a sooty fungus (Munz 1973, p. 548; Sayers *in litt*. 2012) but this fungus is not believed to result in permanent harm (Sayers *in litt.*2012). The funnel-shaped flowers are arranged in coiled clusters and are lavender in color. Resultant fruits are capsules that contain numerous, minute seeds (Wells 1962, pp. 184–186; Bittman 1985, p. 1; CNPS 1987, p. 2). This species is differentiated from two other narrow-leaved species of *Eriodictyon* that occur in southern California, *E. angustifolium and E. capitatum,* by its distribution and floral characteristics. *Eriodictyon angustifolium* (narrow-leaved yerba santa) is a desert species with markedly smaller flowers than *E. altissimum,* and *E. capitatum* (Lompoc yerba santa) is a Santa Barbara County endemic with a wholly capitate (head-like) inflorescence (Service 1994).

Wells first noticed what he believed to be a new species of *Eriodictyon* on a sandstone ridge at Indian Knob located in southwestern San Luis Obispo County, California, in 1960. A collection was made on June 20, 1960, in chaparral at an elevation of 880 ft (268 m) (*P.V. Wells 75* [OBI75688, RSA522505, and UC1218864] Consortium of California Herbaria 2012). Wells subsequently described the collected individuals as a new species, *Eriodictyon altissimum*, and this name was published in 1962 (Wells 1962, pp. 184–186).

Life History

Not much is known about the life history for *Eriodictyon altissimum.* Even considering information provided in the listing rule and recovery plan, very little specific scientific information exists in the literature for this species. Much of what we know is from anecdotal observations made by wildlife agency staff, local botanists, and Wells' 1962 description. The following sections include inferences from information available for the genus *Eriodictyon,* for *E. capitatum,* and for *E. californicum* (California yerba santa; Howard, 1992) in an attempt to augment our understanding of *E. altissimum.*

Like most species in the genus, *Eriodictyon altissimum* displays an open growth pattern and embodies those characteristics typical of a pioneer (early successional) species (e.g., shade-intolerant, poor competitor). It appears to be a rapid-growing, short-lived shrub most often

observed along roadsides or trails or within open areas of chaparral (CNPS 1978, p. 1; Wells 1962, p. 186; Vanderwier pers. obs. 2006, 2009). *Eriodictyon californicum* is both a residual colonizer and a survivor in disturbed communities, establishing either from seed or by sprouting from rhizomes (underground stems). The same is likely true for *E. altissimum*. Colonizing plant species are found in early seral communities and gradually die out as they are displaced in maturing climax communities by chaparral shrub species. When associated with climax vegetation, *E. altissimum* is most often observed growing at the edges of habitat. Only rarely are individuals observed in the midst of surrounding vegetation (Wells 1962, p. 186; Vanderwier, pers. obs. 2006). *Eriodictyon californicum* becomes sexually mature in 2 to 3 years, and this may also be the case for *E. altissimum*. While pollination ecology has not been specifically studied for *E. altissimum*, other *Eriodictyon* species 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, p. 356). Bequaert (1929, p. 69) observed the pollen wasp *Pseudomasaris wheeleri* on *E. tomentosum* in Riverside County.

The flowers of *Eriodictyon altissimum* produce capsules that contain numerous, small, polyhedral-shaped seeds (Wells 1962, p. 185). When the capsules dehisce, it is presumed that the seeds fall beneath the parent plant to become part of the seedbank. Seed longevity for *Eriodictyon altissimum* is unknown. Seeds likely germinate after fires or some other disturbance that breaks dormancy. Seedlings of *E. californicum* have been observed to experience high mortality and are considered to be poor competitors and sensitive to competition from other emerging herbaceous species (Howard 1992, pp. 4–5). The same may be true for *E. altissimum* seedlings. *Eriodictyon altissimum* also reproduces asexually through the production of rhizomes.

Eriodictyon altissimum, like *E. capitatum*, likely evolved in communities where fire is an integral ecological process, therefore, fires are presumed to play an important role in the persistence and reproduction of populations (Service 2002, p. 67969). Similar to other species in the genus, *E. altissimum* is thought to be a pioneer, or early successional, species and similarly adapted to periodic fire in its associated community (Service 1998, p. 23). A variety of short-lived subshrubs (including *Eriodictyon* spp.) germinate the first year following a fire and form an important element of stand structure in the first few years of succession. These species commonly senesce within 5 to 10 years following a fire and are replaced by a rapidly closing canopy of the original pre-fire dominant shrubs (Rundel 1986, p. 6) that constitute a climax community (e.g., *Arctostaphylos* spp., *Adenostoma fasciculatum, Ceanothus cuneatus*). Fire cues, such as heat and charred wood, have been found to significantly increase the germination of *Eriodictyon* species (Keeley 1987, p. 438; Service 2002, p. 67969). Absent fire to cue seed germination, *Eriodictyon* species most often reproduce, or spread, via rhizomes.

Distribution

While *Eriodictyon altissimum* was once considered to be a highly localized endemic found only on “Indian Knob Ridge between San Luis Obispo and Pismo Beach” (Hoover 1970, p. 238), its range was expanded upon the discovery of individuals in Montaña de Oro State Park in the Los Osos area in 1972 (*L.W. Edge 138* [CHSC69826] Consortium of California Herbaria 2012) and

Los Osos in 1982 (*Messick 1984* [HSC77146] Consortium of California Herbaria 2012).

At the time of its listing in 1994, *Eriodictyon altissimum* was known from six recorded occurrences (called "stands" in the listing rule and 1998 recovery plan) that correspond to the following CNDDB EOs: EO-1 (Broderson), EO-2 (Ridge Trail), EO- 3 (Hazard South), EO-4 (Morro Dunes), and EO-6 (Water Tank) from the Los Osos area, and EO-5 (Indian Knob) from the Indian Knob area. Additional individuals of *E. altissimum* were identified in Baron Canyon, approximately 1 mi (1.6 km) northwest of the Indian Knob occurrence in 1991 (Oyler *in litt*. 1991) as part of botanical surveys conducted for a proposed estate residential development project. A CNDDB form providing information on these individuals, considered at that time to be an extension of the Indian Knob occurrence, was completed but not submitted to the Department. If it had been submitted, using CNDDB standards, it would be considered a seventh occurrence that, combined with the Indian Knob occurrence, was estimated to contain approximately 500 individuals. For purposes of this report, and to be consistent with how the CNDDB would assign occurrences, we will refer to this as the Baron Canyon occurrence (*de facto* EO-7). Figure 1 depicts the locations of each occurrence of *E. altissimum*.

The Indian Knob and the Los Osos areas are separated by a linear distance of approximately 13 mi (20.9 km), much of which consists of large intact areas of undeveloped oak woodland, chaparral, and grasslands known as the Irish Hills (Figure 1). At the time of listing and in the recovery plan, there was speculation that additional populations of *Eriodictyon altissimum* might occur in this area of rugged, largely unsurveyed, habitat (Service 1994, p. 64614; Service 1998, p. 21). In 2011, pre-activity surveys were performed along roads and dirt trails in portions of the Irish Hills in support of seismic investigations in and around Diablo Canyon; however, *E. altissimum* was not identified (Ganda *in litt*. 2012, 4 pp.). The predominant soils in the area of the Irish Hills between Indian Knob and Los Osos-Montaña de Oro are shaly clay loams derived from weathered acid shale (USDA 1984, pp. 138, 147) rather than the marine sandstone-derived series upon which the known occurrences of *E. altissimum* are typically found. At least 30 soil series were identified within the Irish Hills as part of a generalized mapping exercise. Four soil series derived from weathered acid shale soils make up over 90 percent of an approximately 18,700-acre (ac) (7,566-hectare; ha) area. Remaining soil series comprise less than 10 percent of the area and are found in substantially smaller areas, none of which individually comprises more than 1 percent of the area (Vanderwier, *in litt*. 2012; NRCS Web Soil Survey 2012). Based upon what is known about the locations where *E. altissimum* has been found, only a few of these series are considered to be likely substrate for the species. As such, while scattered individuals may be present within the Irish Hills, we conclude that larger occurrences are not likely to be identified in this area.

When the 5-year status review for *Eriodictyon altissimum* was completed in 2009, the known distribution of the species was the same as at the time of listing: six occurrences, with additional individuals identified in 1991 considered an extension of the Indian Knob occurrence. The current known extant distribution of *E. altissimum* is considered to be five occurrences: two in the Indian Knob area (Indian Knob and Baron Canyon [the former extension]) and three in the Los Osos-Montaña de Oro area (Ridge Trail, Hazard South, and Water Tank). Based upon

additional survey work conducted by Service staff and information obtained from local knowledgeable persons, it is our conclusion that the Broderson (EO-1) and Morro Dunes (EO-4) occurrences in the Los Osos area are extirpated (Walgren *in litt*. 2009; Vanderwier pers. obs. 2009; Chestnut *in litt.* 2012a; Chestnut *in litt.* 2012b, 2 pp.) or, at best, "possibly extirpated" as defined by NatureServe (see Numbers of Plants section below). The status of the Hazard South occurrence (EO-3) is unclear (see below). Table 1 provides historic and current information on all of the occurrences discussed herein.

Habitat

A species' habitat consists of both abiotic and biotic factors. *Eriodictyon altissimum* is found as a constituent of maritime chaparral found along the central California coast where a Mediterranean climate (warm dry summers, cool wet winters) prevails. As discussed in the Distribution section, *E. altissimum* occurs in only two areas in western San Luis Obispo County: near the community of Los Osos (inclusive of Montaña de Oro State Park), approximately 11 mi (17 km) west of the city of San Luis Obispo (City), and the Indian Knob area, approximately 5 mi (8 km) south-southeast of the City.

Maritime chaparral in the Los Osos area is underlain by soils derived from old, stabilized sand dune deposits of the Oceano-Duneland-Baywood complex (USDA 1984, p. 11). *Eriodictyon altissimum* occurs as localized individuals in maritime chaparral underlain predominantly by Baywood fine sands; however, occurrences are also recorded on Conception loam and, uncharacteristically, Santa Lucia shaly clay loam (USDA 1984, map sheet 8). This maritime chaparral is dominated by *Arctostaphylos morroensis* (Morro manzanita), *Adenostoma fasciculatum*, or *Ceanothus cuneatus*. Other co-occurring species include *Salvia mellifera*, *Mimulus aurantiacus*, and *Baccharis pilularis* var. *consanguinea* (coyotebrush). In the Los Osos area, some individuals occur in transitional areas between maritime chaparral and coastal dune scrub (Walgren *in litt*. 2009; Vanderwier pers. obs. 2009).

Maritime chaparral at Indian Knob and the immediately surrounding areas occurs on soils of the Edna member of the Pismo Formation, which are derived from siliceous marine sandstone. Two major components of this member are bituminous (tarsands) and non-bituminous quartz sandstones (Vanderwier 1987, p. 4). Soils at Indian Knob upon which the species has been observed include Gaviota fine sandy loam series, Briones-Pismo loamy sands and Pismo-Rock outcrop complexes, and Xerothents, eroded (USDA 1984, map sheet 12, pp. 22, 46, 80, 99; Vanderwier *in litt*. 1987, pp. 23–24, 27, 30; Vanderwier pers. obs. 2006). Indian Knob proper consists of a Xerothent outcrop that includes areas of Briones, Gaviota, and Pismo soils (USDA 1984, p. 99). *Eriodictyon altissimum* is a constituent of chaparral where it is found on and off the tarsands of Indian Knob as part of chaparral dominated by *Arctostaphylos pilosula* ssp. *pismoensis* (Edna manzanita) or *Adenostoma fasciculatum* (chamise). Other common co-occurring species include *Salvia mellifera* (black sage), *Mimulus aurantiacus* (sticky

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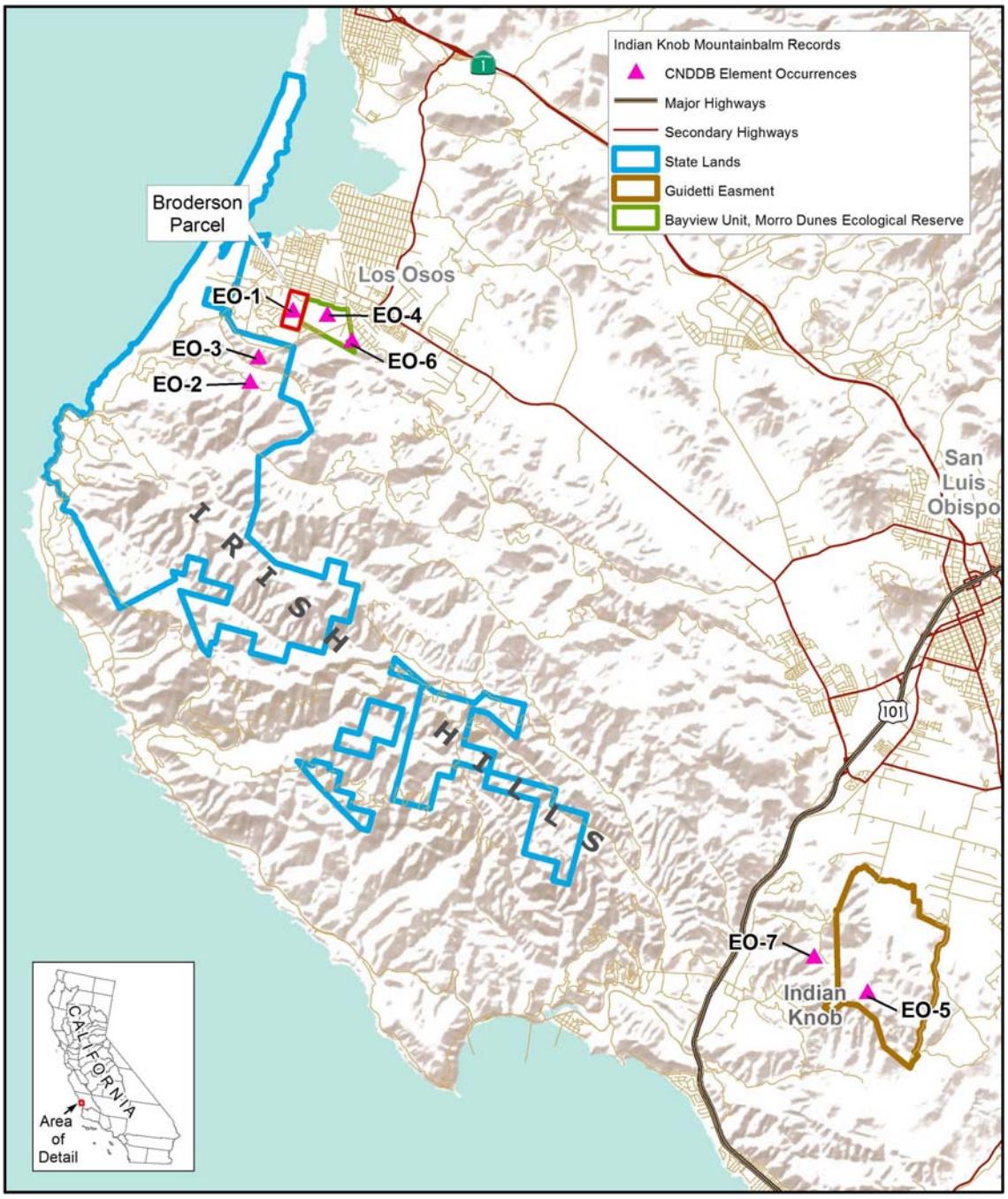

Ventura Fish and Wildlife Office
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February 2013
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Occurrence Records from USFWS files and the California Natural Diversity Database (01/2013).
Please Note: The occurrences shown on this map represent the known locations of the species listed here as of the date of this version (EO-7 is not in the 01/2013 version). There may be additional occurrences within this area which have not yet been surveyed or mapped. Lack of information in the CNDDB about a species or an area can never be used as proof that no special status species occur in an area.

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Datum: NAD 83

monkeyflower), *Heteromeles arbutifolia* (toyon), and *Ceanothus cuneatus* (buckbrush (Vanderwier 1987, pp. 22–34).

Numbers of Plants

An accurate metric regarding the abundance, or number of plants, of *Eriodictyon altissimum* at any given occurrence is difficult to determine because this species, as with others in the genus *Eriodictyon*, commonly produces aboveground stems asexually from rhizomes (Wells 1962, p. 184; Howard 2012, p. 4; Service 1998, p. 21). Some aboveground stems that arise from rhizomes are often counted as genetically distinct individuals; however, they actually represent a genetically identical expression (clone) of the source plant. Compounding this is that what may appear to be separate individuals may actually be multiple clonal stems from the same individual. The numbers provided in this report reflect those reported by the observer; we cannot assess whether or not these actually represent genetically distinct individuals or clones. NatureServe (2002, p. 45) recognizes that it is important to consider whether genetic individuals can and (or) should be counted for clone-forming organisms and recommends that, in such cases, a more practical and repeatable unit be specified, if more appropriate. For the practical purposes of this report, we use the numbers of "individuals" reported but make no determination regarding their genetic status.

The 1994 listing rule stated that the total known population of *Eriodictyon altissimum* at that time was fewer than 600 individuals; however, the listing rule did not provide a number for the individuals in each of the *Eriodictyon altissimum* occurrences. Rather, the rule stated that, with the exception of the Indian Knob area occurrences, each of the occurrences consisted of fewer than 50 individuals. At the time of the 5-year status review, we noted that the Morro Dunes occurrence was visited, but a count of individuals was not made. The statement regarding the Morro Dunes occurrence was made in error as we searched but were unable to locate this occurrence in 2005. The Water Tank occurrence was the occurrence relocated during this site visit in 2005; however, only an estimate of individuals was made (Vanderwier, *in litt*. 2005, 2006).

The following discussion and Table 1 presents distribution and abundance information for each of the occurrences, inclusive of the Baron Canyon occurrence, organized by the geographic area where each is located. Formal (e.g., transect) surveys were not conducted at these occurrences; rather, surveys consisted of local botanists and others familiar with the species visiting those areas where the species had been documented to occur and looking for plants there and in the nearby vicinity.

Table 1: Distribution and Abundance for *Eriodictyon altissimum* Occurrences

Occurrence	Habitat-Location	Manager-Owner	Conservation Status	Number of Plants and Citation
Los Osos Area				
Broderson (EO-1)	South terminus of Broderson Avenue, Los Osos	County of San Luis Obispo	Conserved by the County of San Luis Obispo in 2009	30 (CNDDB 1979) 0; extirpated (McLeod 1985, Vanderwier 2006, County 2008, Vanderwier 2009, Walgren 2009, Chestnut 2012, Vanderwier 2012)
Ridge Trail (EO-2)	Ridge trail in Hazard Canyon, Montaña de Oro State Park	California State Parks, South SLO Coast District	Conserved as part of Montaña de Oro State Park	50-100 (Bittman 1985) ~40 (Hillyard and Hickson 1998 in CNDDB) 37 (Walgren 2009)
Hazard South (EO-3)	South-facing slope of Hazard Canyon, Montaña de Oro State Park	California State Parks, South SLO Coast District	Conserved as part of Montaña de Oro State Park	7 (Bittman 1985) 0 (Walgren 2009)
Morro Dunes (EO-4)	East of the southern terminus of Broderson Avenue, Los Osos	California Department of Fish and Wildlife	Conserved as part of Morro Dunes Ecological Reserve	30 (Bittman 1985) 0 (Walgren 2009) 0; extirpated (Vanderwier 2006,2009,2012)
Water Tank (EO-6)	Southwest of the paved terminus of Calle Cordoniz, Los Osos	California Department of Fish and Wildlife	Conserved as part of the Department's Morro Dunes Ecological Reserve	10-50 (Bittman 1985) 11 (Walgren 2009) 20-25 (Vanderwier 2009) 15 (Vanderwier 2012)
Indian Knob Area				
Indian Knob (EO-5)	Southern terminus of Davenport Creek Road, Indian Knob, Guidetti Ranch, City of San Luis Obispo	City of San Luis Obispo-Guidetti Family	Conserved in a conservation easement held by the City of San Luis Obispo	100+ (Bittman 1985) ~350; includes Baron Cyn[1] (Service 1994)
Baron Canyon (EO-7)	Baron Canyon extension, northwest of Indian Knob, City of San Luis Obispo	Private	private ownership	~500; includes of Indian Knob[1] (Oyler 1991)

1. Uncertainty exists for the total number in the Indian Knob area. For purposes of this report, we consider the total to be between 350 and 500.

Los Osos Area

- Broderson Occurrence (EO-1): This occurrence was previously documented in Los Osos on land locally known as the Broderson parcel. These 80 ac (32.4 ha) are owned by the County of San Luis Obispo (County). In 1979, it was estimated that approximately 30 individuals were present; however, none have been subsequently identified as part of searches conducted in 1985, 2005, 2006, 2008, 2009, and 2012 (McLeod 1986; Walgren *in litt*. 2009; Vanderwier pers. obs. 2006, 2009; County of San Luis Obispo 2010, p. 28; Vanderwier *in litt.* 2012). As the presence of the Broderson occurrence has not been documented for over 30 years, we conclude that it is extirpated.

- Ridge Trail Occurrence (EO-2): This occurrence is documented along a ridge trail in Hazard Canyon within Montaña de Oro State Park. Bittman (1985, p. 5), estimated that there were between 50–100 individuals (as two subgroups) in this area. In 1998, Hillyard and Hickson (CNDDB 2012) estimated the occurrence to consist of approximately 40 individuals in 4 subgroups. While there is some uncertainty as to the number of subgroups associated with the Ridge Trail occurrence, a survey conducted by Walgren along this trail in 2005 identified approximately 37 individuals. Sayers (*in litt.* 2012) notes that "the plants are still there" and that several individuals were affected by a small erosive landslide but have been observed to sprout up through the soil.

- Hazard South Occurrence (EO-3): This occurrence is documented from Montaña de Oro State Park and described as occurring on a south-facing slope of Hazard Canyon (CNDDB 2012). The original record for the number of individuals for this occurrence is 7 (Bittman 1985, p. 5). During a survey conducted by Walgren in 2009 no plants were observed; however, the occurrence has not been visited frequently enough to determine if it is extirpated. There is some discrepancy regarding the location of this occurrence, as the coordinates used by the CNDDB represent a "best guess" based on a verbal description. The coordinates provided in the CNDDB (and corresponding map location) locate the occurrence outside of the U.S. Geological Survey Township, Range, and Section description provided in the occurrence record. Chestnut (2012a) considers that it may be part of the Morro Dunes occurrence, but absent more information, we consider it to be a separate occurrence.

- Morro Dunes Occurrence (EO-4): This occurrence was documented from lands that were privately owned at the time of listing but are now part of the Bayview Unit of the Morro Dunes Ecological Reserve owned and managed by the Department. In 1985, approximately 30 individuals were identified at this occurrence (McLeod *in litt*. 1985, p. 8); however, surveys conducted in 2005, 2006, 2009, and 2012 did not relocate any plants (Walgren *in litt.* 2009; Vanderwier, pers. obs. 2006, 2009; Vanderwier *in litt.* 2012). As the presence of the species at this occurrence has not been documented for over 25 years, we conclude that it is extirpated.

- Water Tank Occurrence (EO-6): This occurrence is found in the southwest corner of the Department's Morro Dunes Ecological Reserve. Between 10 and 50 individuals were reported in 1985 (Bittman 1985, p. 5; McLeod, *in litt.* 1986; p. 13). During a site visit by Vanderwier in 2005, the species was present but a count of individuals was not made. As part of a survey conducted that same year by Walgren (Walgren 2009), 11 individuals were observed in two locations within approximately 175 feet (53 m) of the waypoint recorded in the CNDDB for the Water Tank occurrence. These 11 individuals are considered to be part of the Water Tank occurrence. As part of a survey conducted in 2009, at least 20 individuals were observed in the area of this occurrence (Vanderwier pers. obs. 2009). Approximately 15 individuals were observed during a site visit made on October 8, 2012 (Vanderwier *in litt.* 2012)

Indian Knob Area

- Indian Knob Occurrence (EO-5): This occurrence is documented from in and around Indian Knob on the private lands of the Guidetti Ranch. This occurrence represents the type locality for the species and, along with the Baron Canyon occurrence, represents the largest population with an estimated 350 to 500 individuals (Service 1994, p. 64614; Service 1998, p. 21). A site visit was conducted on May 18, 2006, and, while a count of individuals was not made, a casual observation of the occurrence indicated that abundance and distribution of *Eriodictyon altissimum* appeared to approximate what was observed during fieldwork conducted at Indian Knob and surrounding areas between 1978 and 1980 (Vanderwier pers. obs. 2006).

- Baron Canyon Occurrence (EO-7): Botanical surveys conducted in Baron Canyon (an area near Indian Knob) in 1991 identified what was considered, at the time, to be an extension of the Indian Knob occurrence (Oyler *in litt.* 1991; Service 1994, p. 64614). Because these individuals were located over 0.5 mi (0.8 km) away, they would have been identified as a new occurrence by the CNDDB if the data form had been submitted. It also would qualify as a separate occurrence in accordance with the data standards recommended by NatureServe (2002). For purposes of this report, we consider these individuals to constitute EO-7. The estimated number of individuals noted on the CNDDB form prepared to document this observation was approximately 500; however, this number includes those individuals already identified as part of the Indian Knob occurrence. As stated above, we estimate that between 350 and 500 individuals were present at the Baron Canyon and Indian Knob occurrences in 1991.

Threats Analysis

Threats at the Time of Listing

The primary threat identified at the time of Federal listing in 1994 was loss of habitat that was anticipated to result from residential development, surface mining, and oil well drilling. At that

time, and up to the completion of the recovery plan that addressed *Eriodictyon altissimum* and other species from western San Luis Obispo County, the loss of a substantial amount of habitat occupied by the species was reasonably anticipated to occur as a result of surface mining and oil well drilling in the Indian Knob area and residential development in the Los Osos area. Since the time of listing, these threats have been substantially reduced.

Those individuals in the Indian Knob occurrence are protected as part of habitat conserved within a conservation easement entered into between the Guidetti Family and the City. The easement, which protects almost 1,500 acres, is recorded with the County of San Luis Obispo (County) and was established to ensure the subject property be preserved forever in its natural, scenic, and open space condition (County *in litt*. 1996, 13 pp.; County 2001, 19 pp.). Easement language specifically precludes both residential or other development and surface mining activities in those areas where *Eriodictyon altissimum* is found.

Habitat occupied by *Eriodictyon altissimum* in Los Osos that was once at risk from proposed residential development as part of the Morro Palisades development project is now conserved as part of the Morro Dunes Ecological Reserve. The recorded occurrences of *E. altissimum* (Morro Dunes and Water Tank occurrences) were included in the 237-ac (96-ha) Bayview portion of this reserve owned and managed by the Department. Pursuant to section 630, Title 14, of the California Code of Regulations, all ecological reserves are maintained for the primary purpose of developing a statewide program for the protection of rare, threatened, or endangered native plants, wildlife, aquatic organisms, and specialized terrestrial or aquatic habitat types. General rules and regulations for ecological reserves as a whole are enumerated in section 630 (a)(1-22). Examples of those rules and regulations relevant to the protection of *E. altissimum* at the Bayview Unit preclude the following: disturbance of natural resources; collection of specimens of native plant and animal species; use of motor vehicles, bicycle, tractor, or other type of vehicle except in designated areas; equestrian use except upon established trails or paths; introduction or release of any fish or wildlife species, including domestic or domesticated species, or the introduction of any plant species; use of pesticides unless authorized; grazing of livestock except as allowed for habitat or vegetation management purposes under permit from the Department; presence of pets unless they are retained on a leash of less than 10 ft (3 m) or are inside a motor vehicle; and camping.

Contiguous with Morro Dunes Ecological Reserve is approximately 80 ac (32.4 ha) known locally as the Broderson parcel. Both maritime chaparral and coastal dune scrub communities are present on this parcel that is zoned for residential development. At the time of listing, this put the Broderson occurrence at risk of extirpation from habitat loss. A minimum of 73 ac (30 ha), inclusive of that area where this occurrence was documented in the past, is to be preserved in perpetuity as mitigation required for loss of coastal dune scrub habitat resulting from the construction and operation of the Los Osos Wastewater Project (California Coastal Commission 2010, p. 13). This portion of the Broderson parcel is conserved and will be managed to maintain and enhance its natural resource values. The County is currently pursuing the transfer of this

parcel to an appropriate conservation agency but, in the interim, serves as the responsible land management entity (Hutchinson 2012, *in litt.*).

Still at risk from residential or other types of development are an unknown number of *Eriodictyon altissimum* individuals present in the Baron Canyon occurrence, as they occur on private lands outside of the conservation easement at Guidetti Ranch. Development appears to have continued in this area absent permitting of any take authorized by the Department or coordination with the Service. There also appears to be clearing of habitat in the vicinity of this occurrence (Vanderwier, pers. obs. 2012).

In summary, the threat to *Eriodictyon altissimum* as a result of habitat loss from residential development and surface mining or oil well drilling activities has been substantially abated since the time of listing and preparation of the recovery plan. This is attributed to the acquisition and transfer of lands to the Department to protect habitat for the former Morro Dunes and extant Water Tank occurrences and through the establishment of a conservation easement held by the City to protect the Indian Knob occurrence. Since the time of the 5-year status review, the Broderson parcel has also been secured and is being conserved by the County to maintain and enhance its natural resource values, including habitat for the former Broderson occurrence of *E. altissimum*. Currently, the only occurrence at potential risk from development activities is the Baron Canyon occurrence.

Current Threats

Four threats that have been identified since the time of listing: Competition from nonnative plant species, small population size and limited distribution, lack of fire, and climate change. These are discussed below.

Competition from Nonnative Plant Species

Habitat degradation resulting from the spread of invasive, nonnative plant species was not identified as a specific threat to *Eriodictyon altissimum* in the listing rule, although it was discussed for other species. The recovery plan does provide information on the encroachment of several nonnative species into native habitats of western San Luis Obispo and identifies the presence of *Eucalyptus globulus* (blue gum), *E. camaldulensis* (red gum), *Carpobrotus edulis* (fig-marigold), *Conocosia pugioniformis* (narrowleaf iceplant), *Ehrharta calycina* (perennial veldt grass), and other nonnative grasses (e.g., *Bromus* spp., *Lolium* spp., *Avena* spp.) for the Los Osos area. The recovery plan specifically identifies encroachment of these species into either coastal dune scrub or maritime chaparral plant communities. The effects of competition with nonnative species is most problematic immediately adjacent to urban areas and in habitat that is isolated or fragmented by development (Alberts *et al*. 1993, pp. 103–110). With the exception of the Indian Knob occurrence, all occurrences of *Eriodictyon altissimum* are proximal to development, and the locations of the extirpated Broderson and Morro Dunes occurrences and the extant Water Tank occurrence are in habitat fragmented from its original landscape

configuration. *Ehrharta calycina* is considered by local botanists to pose the most substantial threat to *E. altissimum* in the Los Osos area and, therefore, much of the following discussion will focus on this species.

While we noted in the 1998 recovery plan that *Ehrharta calycina* was not a problem in mature *Arctostaphylos morroensis* (i.e., maritime) chaparral, it was already observed to be an aggressive invader of coastal dune scrub and other sandy substrate habitats. We predicted that because *E. calycina* is wind-dispersed, it was more likely to become prevalent in openings in local chaparral in the future (Service 1998, p. 6). Habitat degradation by *E. calycina* was discussed specifically as a threat to *Eriodictyon capitatum* during the rulemaking process for designation of critical habitat for the species, noting that the "fast-spreading species is difficult to control, particularly after an area has been denuded by wildfire" and that, "controlling veldt grass poses a special management need" for this species (Service 2002). In the 5-year status review for *E. altissimum* completed in 2009, we noted that only the habitat in which the Broderson (EO-1) historically occurred had been affected by competition from nonnative invasive plant species, particularly *E. calycina*. This was based solely on anecdotal observations and not as a result of data collected as a part of monitoring or management activities.

Since the time of listing and the 5-year status review, we have not collected any site-specific scientific information as part of the implementation of management and monitoring programs to address the status of *Eriodictyon altissimum.* As part of the 5-year status review, we noted, but did not investigate, the potential effect of invasive, nonnative species on *E. altissimum*. Since that time, as a result of information provided during discussions among local biologists during ongoing meetings of the Morro Bay National Estuary Invasives Network, and in response to the Service's 90-day finding (107 FR 32922; June 4, 2012), it now appears that the spread of *Ehrharta calycina* is having a negative effect on habitat that supports the *E. altissimum* in the Los Osos area (Chestnut *in litt*. 2012b, 2 pp.). *Ehrharta calycina* has a California Invasive Plants Council ranking of "A" that denotes the highest level of impact on native habitats (Cal-IPC 2011, p. 4). As a pioneer species, seedlings of *E. altissimum* would likely be in direct competition with, and could be overwhelmed by, *E. calycina*, as *E. calycina* responds aggressively after fires or other disturbance activities (CalIPC 2011, p. 4). This competition could result in poor seedling survival and low recruitment rates. *Ehrharta calycina* is a perennial species that spreads rapidly from a persistent seedbank as well as vegetatively. It is extremely difficult to eradicate once it has become established (Bossard *et al*. 2000 pp. 164–170). A local botanist considers the presence of *E. calycina* in and around the Los Osos area to constitute a threat to extant occurrences of *E. altissimum* (Chestnut *in litt.* 2012a, 2012b) currently and post-fire. *Ehrharta calycina* is prevalent in coastal dune scrub that transitions into maritime chaparral at the site of the extirpated Broderson occurrence, and is beginning to encroach into maritime chaparral near the location of the extirpated Morro Dunes occurrence (Vanderwier, pers. obs. 2012). Currently, there is no long-term strategy being implemented to control or manage *E. calycina* (Chestnut *in litt.* 2012a).

In addition to competing with and displacing native vegetation, nonnative grass species can increase both the volume of readily ignitable fuel and the seasonal duration when fuels are susceptible to ignition (Lambert *et al.* 2010, p. 31) in maritime chaparral in which *Eriodictyon altissimum* is found. Mediterranean grasses such as *Bromus* spp. (brome) and *Avena barbata* (slender wild oat) are particularly implicated since they act as wicks that spread fire into the canopies of larger shrub vegetation where it otherwise would not have reached (Lambert *et al.* 2010, p. 31). Thus, the presence of nonnative plants could change the frequency of fire due to increased biomass of fuels, changes in the distribution of flammable fuels biomass, and increased fuels flammability (Lambert *et al.* 2010, p. 29). Nonnative grasses could increase the fire frequency, change the timing of fires, and increase fire intensity and its impacts on chaparral. *Ehrharta calycina* is a fire-adapted species that quickly germinates and re-establishes after fires. As such, it could out-compete seedlings of *E. altissimum* that would be emerging after a fire. This is a likely scenario that could affect the persistence of *E. altissimum* in the Los Osos area. It could also affect the Indian Knob and Baron Canyon occurrences; however, the presence of invasive nonnative species is not currently identified as a substantial issue in the Indian Knob area.

Small Population Size and Limited Distribution

When *Eriodictyon altissimum* was listed, we did not discuss small population numbers and limited species distribution as they might relate to its vulnerability to stochastic events leading to the extirpation of an occurrence or extinction of the species. In the 5-year status review, we did recognize that taxa known from very few locations, from small and highly variable populations, or both are considered to be vulnerable to stochastic extinction (Shaffer 1981, pp. 131–134; Primack 1998, pp. 279–308). According to the criteria put forth by the World Conservation Union, as modified for plants, a species that has life history, population, and distribution attributes similar to those of *Eriodictyon altissimum* is considered to have a high risk of extinction in the wild in the immediate future (Keith 1997, pp. 1085–1087). Species with few populations and individuals are vulnerable to the threat of naturally occurring random events that can cause extinction through mechanisms operating at either the genetic, population, or landscape level (Shaffer 1981, pp. 131–134; Primack 1998, pp. 279–308). Species with few populations or a limited distribution face a greater likelihood that all of the populations or individuals within the populations will be affected by the same event. With few populations, there may also be a lower likelihood of recolonization or recovery of extirpated occurrences because there are a limited number of source individuals or source populations. The genetic characteristics of *E. altissimum* occurrences have not been investigated and so the degree to which this factor may contribute to the vulnerability of the species to extirpation events or extinction for this reason is unknown. Elam (1994, pp. 146–194) discusses the relationship between clonal diversity and seed production for *E. capitatum*, a species found in similar habitat. Low seed production in this species has been attributed to the combined effects of self-incompatibility and single-clone populations. That is, single clone (one genotype) populations exhibit low seed set relative to multiclonal (several genotype) populations. Plants present in a population that consists of a single clone probably only receive compatible pollen through long-

distance gene flow whereas plants in multiclonal populations are more likely to receive some compatible pollen from nearby genotypes in the population. If *E. altissimum* is also self-incompatible, the distance between occurrences could make it difficult for cross-pollination to occur, resulting in limited seed set that could have an effect on the establishment of a viable seedbank and species recovery after fires. Loss of genetic diversity due to small population sizes can result in reduced fitness of individuals and may reduce the adaptive capability of the species to respond to changing environmental conditions.

Random events operating at the population and landscape levels may increase the chance of extinction for *Eriodictyon altissimum*. Although no data are available to determine population trends, the best available information regarding the occurrences of *E. altissimum* currently known (see Table 1) indicate that only 2 of the extant occurrences (the occurrences in the Indian Knob population) have more than 50 individuals. Combined with this is the fact that *E. altissimum* has a restricted range of five extant occurrences in two separate geographic areas. Species with few populations or those with low numbers of individuals may be subject to forces at the population level that affect the ability of individuals to complete their life cycle successfully. Although we do not have specific information for *E. altissimum*, studies on other plant-pollinator relationships point out the importance of pollinators that are likely applicable to the species. For example, reduced numbers of individuals may lead to a reduction in abundance of pollinators and subsequent seed set and fitness of seed progeny (Menges 1991, p. 162). The number and density of flowering plants in a population can be important determinants of pollinator abundance and behavior (Jennersten 1988, pp. 361–363; Bernhardt *et al.* 2008, p. 948). While we do not have information regarding a threat from reduction of insect pollinators, *E. altissimum* is currently found as five occurrences in two geographic areas approximately 13 mi (20.9 km) apart. With the exception of the occurrences in the Indian Knob area, all occurrences currently consist of less than 50 individuals. As such, it is possible that this species could experience reduced reproduction because of reduced insect pollinator visitation that, in turn, could result in reduced viable seed set.

Lack of Fire

At the time of listing and in the recovery plan, we assumed that, as a constituent of chaparral, fire was necessary for the persistence of *Eriodictyon altissimum* in its natural habitat. It is generally accepted that fire is the natural disturbance process that *E. altissimum* and other maritime chaparral plant species evolved with and that serves as a cue for seedbank germination (The Nature Conservancy, *in litt.* 1985; California Native Plant Society, *in litt.* 1987; Keil, *in litt.* 1997). Plant species that comprise the chaparral plant community are resilient to fire and known to regenerate by resprouting of perennial root crowns or seedbank germination in response to heat or exposure to smoke (Lambert *et al.* 2010, p. 31). Many species found in fire-adapted communities are dependent on fire to trigger germination (Zedler *et. al*. 1983, p. 809; Tyler 1995, pp. 1012–1015). Fire cues, such as heat and charate (charred wood) have been found to increase germination in *E. californicum* (Keeley 1987, p. 485). For many chaparral species, fire breaks seed dormancy and also creates open areas where seedlings can germinate and become

established. For seeds to be an effective reproductive strategy, the interval between fires needs to be long enough to accumulate that quantity of seeds necessary to replace the parent generation (Odion and Tyler 2002, 12 pp.). These authors estimate that *Arctostaphylos morroensis*, a species that co-occurs with *E. altissimum*, may require longer than 40 years to establish an adequate seed bank to compensate for mortality and prevent population decrease or local extinction after fires." The number of accumulated seeds in the soil must be high, as seed mortality has been found to be substantial in chaparral burns (Tyler 1996, p. 2189).

Determining fire frequency is an important means of assessing ecosystem tolerances to fire return intervals; however, such calculations can be challenging as until the 20th century, records were not systematically kept (Keeley *et al*. 2012, p. 41). It is believed that the fire cycle was historically relatively long and likely was limited more by the number of ignition events than by fuels (Keeley *et al*. 2012, p. 119). Estimates of historic fire return intervals for the Monterey Bay area range from as short as 10 years to as long as 100 years or more (Greenlee and Langenheim 1990, p. 124) or between 50–85 years for fires recorded in coastal southern California and northern Baja California Mexico (Moritz *et al*. 2004, p. 68). Although chaparral is widely reported to be dependent on periodic burning for renewal, the cool and foggy central coast has one of the lowest rates of lightning-caused fire in California (Van Dyke *et al*. 1987, p. 2). Understanding fire frequency is essential to assessing a species' needs. Alterations to the historic fire frequency, either increasing or decreasing the time between events, can affect a species' viability and persistence. Too long of a fire return interval could lead to the development of climax, closed canopy chaparral stands that would eventually have an adverse effect on populations of *Eriodictyon altissimum* by precluding expansion into otherwise suitable habitat and development of even-aged, senescent stands (stands in which the individuals are so old that their reproductive potential has been reduced) (Ne'eman *et al.* 1999, pp. 235–242). Too frequent of fire events could kill individuals before they have had an opportunity to flower, set seed, and contribute to a seedbank.

Relative to the Indian Knob and Baron Canyon occurrences of *Eriodictyon altissimum*, no naturally-occurring or prescribed fires have been recorded in an area bounded to the west and south by State Highway 101, to the south by Price Canyon Road, and to the east by State Highway 227 (an area of approximately 15,000 ac or 6,069 ha) for at least 50 years (California Division of Forestry and Fire Protection 2012). It is possible that since the discovery of *E. altissimum* in 1961, we are still within a single fire frequency return interval in this area. In the Los Osos area, two naturally ignited fires have been recorded since the 1980s: one that occurred in 1984, approximately 2.3 mi (0.9 km) east of the Water Tank occurrence; and one that occurred in 1997, approximately 2 mi (0.8 km) southwest of the Ridge Trail occurrence. A number of prescribed burns have been conducted between 1982 and 2003; however, only two were in the proximity of a known occurrence of *E. altissimum*. The northern perimeter of a prescribed fire conducted in 2003 came within an estimated 0.2 mi (0.08 km) of the Water Tank occurrence. While the locations and dates of these fires in the vicinity of Los Osos are accurate, no post-fire data on vegetation response are available (Veneris, *in litt*. 2012). In recent years, California State Parks has considered conducting prescribed burns in Montaña de Oro State Park; however,

broadcast burning is not considered to be feasible near the Ridge Trail and Hazard South occurrences due to their proximity to residential communities, heavy fuel loads, and potential impacts to the federally threatened *Arctostaphylos morroensis* (Walgren *in litt*. 2012, 2 pp.). Staff from California State Parks consider impacts to this plant species when considering prescribed burns in Montaña de Oro State Park, as adult *A. morroensis* do not survive fire and regeneration from the seedbank that was observed after a prescribed burn in Montaña de Oro State Park in 1998 was not adequate to replace the pre-burn adult population (Odion and Tyler 2002, 12 pp.).

Fires that could occur in the vicinity of the Indian Knob, Baron Canyon, Ridge Trail, and Hazard South occurrences would likely burn at high intensity because of heavy fuel loads. In the series description for Gaviota fine sandy loam soils (underlying areas around the Indian Knob population), the characteristic vegetation identified on this soil series is "old growth brush...that is susceptible to wildfire." The description also states that "wildfires on this soil are extremely hot and destroy the vegetation." The USDA states that "brushland management and properly engineered fuel breaks and access roads are necessary to limit wildfires and soil erosion" (USDA 1984, p. 46). Similar language is contained for soil series found in Montaña de Oro State Park: "Wildfire is a hazard because dense brush stands of manzanita and chamise are common" (USDA 1984, p. 55). While we are not aware of specific fires that have been suppressed in recent years in those areas where *Eriodictyon altissimum* is present, due to the flammable nature of the chaparral that provides habitat for this species, precautions are taken to create defensible space in the wildland-urban interface area near these occurrences. According to Chestnut (*in litt*. 2012b), the plants in the Indian Knob area (most likely EO-07) have been affected by the construction of Baron Canyon Ranch, an estate home development. He states that landscaping, fire suppression treatments and similar development driven activities are continuing to occur in this portion of the population with minimal oversight, based on his direct observations from the conserved lands at Guidetti Ranch adjacent to the Baron Ranch. Prescribed fires could potentially benefit the Water Tank occurrence; however, surrounding habitat contains *Arctostaphylos morroensis.* In addition to carrying a heavy fuel load, this occurrence is adjacent to existing residential areas where residents are extremely concerned about fire risks. Populations of the federally endangered Morro shoulderband snail (*Helminthoglypta walkeriana*) exist proximal to the Broderson, Morro Dunes, and Water Tank occurrences; any actions that could result in impacts to the snail would need to be authorized or exempted pursuant to requirements of the Act before any prescribed burn could move forward. The area around Indian Knob is largely undeveloped, but large-parcel estate development is encroaching from Baron Canyon and other areas to the west.

While we do not possess specific information on the role fire plays in the persistence of *Eriodictyon altissimum* or the post-fire behavior for this species, inference from other species in the genus and other co-occurring species indicate that fire is likely a necessary habitat component. Absence of fire to cue seedbank germination and maintain a mosaic pattern of vegetation with open areas that favor *Eriodictyon altissimum* may contribute to its limited distribution and reduced numbers. Keeley (1992, p. 441) also noted the importance of variable

fire regimes to maintain equilibrium in species composition. Although demographic models have become increasingly important tools in plant conservation, few models have considered the implications of seedbanks in population persistence. Seed viability in a seedbank, post-fire, is also an important factor. In *Arctostaphylos morroensis*, a species that co-occurs with *Eriodictyon altissimum* in maritime chaparral, post-fire densities can be relatively high (e.g., 45,000 seeds/m^2), seed viability is generally very low (1-5 percent) (Odion and Tyler 2002). This may also be the case with *E. altissimum*.

The presence of invasive nonnative grass species is related to the fire issue in that species such as *Ehrharta calycina* can change the fuel properties of a site in ways that affect fire behavior and fire regime characteristics such as frequency, intensity, extent, and seasonality. Increases in fire frequency may promote the establishment and dominance of invasive species while making restoration to the original habitat conditions more difficult (CalIPC 2011, p. 4) as a result of changes in soil chemistry. In addition, the preponderance of seeds produced by the nonnative species can result in the site becoming quickly colonized by invasive nonnative plant species; in contrast, it may take a number of years before typical chaparral species (e.g., *Arctostaphylos morroensis*) are mature enough to produce seed. If an assertive nonnative plant species control program is not instituted immediately after fires in the areas that support *E. altissimum*, the spread of *E. calycina* could swamp emerging seedlings, resulting in the depletion of the seedbank and possible subsequent extirpation of occurrences.

Climate Change

Our analyses under the Endangered Species Act include consideration of ongoing and projected changes in climate. The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). "Climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

In an effort to consider potential climate changes on a regional level, we used ClimateWizard (2012) to estimate what changes in rainfall and temperature, if any, have occurred in the Los Osos and Indian Knob areas over the last 50 years. ClimateWizard (2012) makes accessible historical trend data on temperature and rainfall, and projections of future climate conditions. Historical trends for the last 50 years are geographically extrapolated based on existing climate

data. Values for both historical data and future projections are compared to baseline values, which are defined as the average of that value (rainfall or temperature) between 1961 and 1990 (ClimateWizard 2012).

For rainfall, ClimateWizard (2012) indicates that for the period from 1951 to 2006 average annual rainfall remained essentially unchanged for the Los Osos and Indian Knob areas, with the annual average for that time period being approximately 25 inches (63.5 cm). Average rainfall is projected to decrease by an average of 8 to 12 percent by the 2050s. For temperature, ClimateWizard (2012) indicates that between 1951 and 2006, the average temperature increased from approximately 52 to 54°F (11 to 12°C) and is projected to rise to 57°F (14°C) by the 2050s. The Los Osos and Indian Knob areas are located proximal to the coast, so we expect that both precipitation and temperature changes will be moderated. Due to its physiographic location, populations of *Eriodictyon altissimum* are not expected to be affected by sea level rise in the foreseeable future.

A growing body of literature discusses the specific mechanisms by which climate change could affect the abundance and distribution of plant species over time. In a changing climate, conditions could change in a way that would allow both native and nonnative plants to invade the habitat where *Eriodictyon altissimum* now occurs. Examples of how a changing climate may affect the long-term viability of this species in its current habitat configuration include the following (Root *et al.* 2003, Parmesan and Yohe 2003, Visser and Both 2005):

(1) Drier conditions may result in less suitable habitat, or a lower percent germination and smaller population sizes;
(2) Higher temperatures may inhibit germination, dry out soil conditions, or affect pollinator services;
(3) The timing of pollinator life-cycles may become out-of-sync with timing of flowering;
(4) A shift in the timing and nature of the annual precipitation may favor nonnative species; and
(5) Drier conditions may result in increased fire frequency, making the ecosystems in which *Eriodictyon altissimum* currently grows more vulnerable to the threats of invasion from additional nonnative plant species.

While we recognize that climate change is ongoing and will likely affect a wide range of plant and animal species and their habitats, we lack adequate information to make specific projections regarding its effects to *Eriodictyon altissimum* and its habitat at this time.

Summary of Threats

Loss of occupied habitat, the primary threat identified at the time of listing, has been substantially abated since 1994 when *Eriodictyon altissimum* was listed as federally endangered. With the exception of the Baron Canyon occurrence, all extant occurrences (and habitat for two

extirpated, or possibly extirpated, occurrences) now occur on lands that are conserved and managed for their natural resource values. As such, they are now secure from the threat of habitat loss from development or other activities. Since the time of listing, four new potential threats have been identified: competition from invasive nonnative plant species, small populations and limited species distribution, lack of fire, and climate change. These are summarized below.

Competition from Invasive Nonnative Plant Species: Observations of local botanists and other knowledgeable persons indicate that the habitat surrounding the Los Osos area occurrences are being negatively affected by competition from nonnative invasive plant species, in particular *Ehrharta calycina*. The scope of competition from nonnative plant species is considered to be large as it affects three of the five extant occurrences. This threat is considered to be current in the Los Osos area because of the aggressive spread of *Ehrharta calycina* on the sandy soils that provide substrate for the Water Tank, Ridge Trail, and Hazard South occurrences. The impact of invasive plants on *Eriodictyon altissimum* at the Indian Knob and Baron Canyon occurrences is less than at occurrences in the Los Osos area because *E. calycina* and other invasive plants are currently less abundant in the Indian Knob area, and the consolidated sandstone soils of the Indian Knob area do not provide suitable habitat for *E. calycina.*

Small Population Size and Limited Distribution: The scope of threats associated with small populations and limited distribution is considered to be large as one or more of the effects discussed above could affect most or all of the extant occurrences. This threat is considered to be substantial as it is likely to degrade an affected occurrence or reduce the species' population. As all of the occurrences in the Los Osos area currently consist of less than 50 individuals and the entire range of the species is estimated to be 90 mi^2 (233 km^2) or less, this threat is considered to be high. The combined effect of small population sizes and a limited distribution makes *Eriodictyon altissimum* vulnerable to stochastic events that could result in the extirpation of additional occurrences.

Lack of Fire: The issue of whether or not fire constitutes a threat to the continued existence of *Eriodictyon altissimum* is complicated by its synergistic relationship with the presence of invasive nonnative species and unknown effects of climate change. At this time, we observe that natural succession to a climax (or stable) plant community has likely created habitat conditions that are not conducive to the persistence of *Eriodictyon altissimum*.

Climate Change: We lack adequate information to make specific and accurate predictions regarding how climate change, in combination with other factors such as small population size, will affect *Eriodictyon altissimum*; however, small range species, such as *E. altissimum*, are more vulnerable to extinction due to these changing conditions.

Inadequacy of Existing Regulatory Mechanisms: While Federal, State, and local regulations have helped protect habitat for the species, other threats to the species, such as competition with

nonnative plants, small population size, and limited distribution can not necessarily be reduced or eliminated through the use of existing regulatory mechanisms.

Combination of Effects: The threats discussed undoubtedly work in combination with each other to exacerbate the overall degree of threat to the continued survival and recovery of *Eriodictyon altissimum*. For instance, habitat alteration due to an increase in veldt grass cover, a nonnative species that is wind-pollinated and does not require insect pollinators, may affect the extent to which pollinators are available in the surrounding habitat to pollinate *Eriodictyon altissimum* and contribute viable seed to the seedbank. There is a synergistic relationship between fire and nonnative plant species such as *Ehrharta calycina*. The presence of this grass may serve as a ladder fuel bringing fire into the chaparral and, in turn, the fire creates conditions that are favorable to the spread of the species.

Regulatory Mechanisms

At the time of listing, the inadequacy of regulatory mechanisms was not considered to be a threat to the survival of *Eriodictyon altissimum* because the following were believed to have varying abilities to protect the species: (1) its listing as endangered under the California Endangered Species Act (CESA) and (2) consideration of impacts to the species pursuant to the California Environmental Quality Act (CEQA). The listing rule included a brief analysis of the level of protection anticipated from these two regulatory mechanisms and that information remains valid. Additional information regarding these two mechanisms, as well as the identification of additional mechanisms that may afford protection to *Eriodictyon altissimum*, is provided below.

Federal

- Federal Endangered Species Act of 1973, as amended (Act): *Eriodictyon altissimum* was listed as endangered under the Act in 1994. Section 7(a)(2) of the Act requires Federal agencies to consult with the Service to ensure any project they fund, authorize, or carry out is not likely to jeopardize the continued existence of a species or destroy or adversely modify its critical habitat. Critical habitat has not been proposed or designated for *E. altissimum*. The Act has only limited ability to protect *Eriodictyon altissimum* on non-Federal lands. Where the species occurs on private land, protections afforded by section 7 of the Act are triggered only if there is a Federal nexus (i.e., an action funded, permitted, or carried out by a Federal agency). Section 9 of the Act and Federal regulations pursuant to section 4(d) prohibit take of federally endangered wildlife; however, the take prohibition does not apply to plants. Instead, plants are protected from harm in two particular circumstances. Section 9 prohibits the removal and reduction to possession (collection) of endangered plants from lands under Federal jurisdiction and the removal, cutting, digging, damage, or destruction of endangered plants on any other area in knowing violation of a state law or regulation or in the course of any violation of a state criminal trespass law. Section 9 also makes illegal the international and interstate transport, import, export, and sale or offer for sale of endangered plants and animals.

With one exception (that protections do not extend to the seeds of cultivated specimens), the protections of section 9 afforded to endangered species are generally extended to threatened species by regulation (50 CFR § 17.71) so downlisting of *E. altissimum* from endangered to threatened would not substantively change its protection under the Act.

- National Environmental Policy Act (NEPA): This act provides some protection for listed species that may be affected by activities undertaken, authorized, or funded by Federal agencies. Prior to implementation of such projects, the Federal action agency must analyze the project for its potential to effect identified aspects of the human environment, including natural resources. In cases where that analysis reveals significant environmental effects, the Federal agency must identify alternatives that would avoid or minimize adverse effects including adverse effects to listed species such as *Eriodictyon altissimum*; however, NEPA does not require that adverse impacts be mitigated but rather that impacts be assessed and the analysis disclosed to the public. *Eriodictyon altissimum* is proposed as a species to be covered in a community-wide habitat conservation plan and, as such, issuance of an incidental take permit would trigger compliance with NEPA.

State of California

- California Endangered Species Act (CESA): *Eriodictyon altissimum* was listed as endangered under CESA in June of 1979. Pursuant to CESA and California Fish and Game Code section 2080 *et seq*., it is unlawful to import or export, take, possess, purchase, or sell any species or part or product of any species listed as endangered or threatened absent authorization provided by an incidental take permit. The State may authorize permits for scientific, educational, or management purposes, and to allow take that is incidental to otherwise lawful activities. Among other requirements for a State incidental take permit, a project proponent must demonstrate that any such take will be fully mitigated. Due to its low numbers and limited distribution, the Department, (responsible for ensuring compliance with the CESA) recommends that proposed take of *E. altissimum* be avoided altogether (Hillyard pers. comm. 2012).

- California Environmental Quality Act (CEQA): If a species is listed by the State of California or the Federal government it is typically considered in the impact analyses required for projects pursuant to CEQA. Pursuant to CEQA, lead agencies are required to consider and disclose the environmental impacts of discretionary actions that are considered projects (e.g., subdivision of land, conditional use permit, grading permit) as defined in §21065. Conditions that require a lead agency to make mandatory findings of significance are provided in §15065. One condition that automatically triggers a higher level of review is if the "project has the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, substantially reduce the number or restrict the range of an endangered, rare, or threatened species… (§15065(a))." Unless overriding considerations are made for a

project, all significant impacts must be mitigated to a level that is less than significant. As *Eriodictyon altissimum* is both State and federally listed as endangered, the City and County of San Luis Obispo consider project-related impacts to this species as part of their CEQA compliance, with the County advising the applicant to try to avoid any impacts to this species (Hillyard pers. comm. 2012, Keith pers. comm. 2012). Absent Federal protection, as a species listed as endangered by the State of California, potential effects to *Eriodictyon altissimum* individuals or the habitat in which they occur would still need to be addressed as part of the lead agency's CEQA compliance.

- The California Coastal Act: The California Coastal Act regulates the use of land and water in the coastal zone. Development activities, which are broadly defined by the Coastal Act, include but are not limited to the following: construction of buildings, divisions of land, and activities that change the intensity of use of land or public access to coastal waters. Development within the coastal zone may not commence until a coastal development permit has been issued by either the Coastal Commission (Commission) or a local government that has a Commission-certified local coastal program. The Commission considers the presence of State or federally listed species in determining environmentally sensitive habitat areas (ESHA) subject to section 30240 of the California Coastal Act of 1976. The County of San Luis Obispo has a Local Coastal Program (LCP) that was approved by the Coastal Commission in 1988. Within this document, Morro Bay and Los Osos are found within the Estero Area Plan (County 1988). This plan establishes zoning for all properties within the plan area; planning area standards; policies for dealing with environmentally sensitive habitat, flood hazards, and historic sites; circulation plans, including roads, bikeways, and public transportation; and general policies for parks, recreation, libraries, and other public services. Areas where *Eriodictyon altissimum* is known to occur in the Los Osos area are considered to be ESHA in this plan. As such, impacts to *E. altissimum* (considered to constitute ESHA) are evaluated by the County of San Luis Obispo for conformance with their LCP as part of the Coastal Development Permit process (Keith pers. comm. 2012).

- California State Parks: California State Parks has guidelines for the management of natural resources and sensitive species in Montaña de Oro State Park (California State Park and Recreation Commission 1988, p. 185). The plan includes a policy relative to the control and eradication (where possible) of invasive nonnative species that have become established in this park unit (California State Park and Recreation Commission, p. 47). While the general plan recognizes the presence of *Eriodictyon altissimum* in this park unit, no species-specific management policies or recommendations have been developed for this species (California State Park and Recreation Commission 1988, pp. 26, 185).

City and County of San Luis Obispo

- City and County: Both the City and County of San Luis Obispo consider impacts to *Eriodictyon altissimum* as part of their CEQA compliance. As *E. altissimum* is listed under both CESA and the Act, the City and County of San Luis Obispo consider impacts to this species to be significant. Given its very limited distribution, few projects have been proposed in areas where *E. altissimum* is known to occur. If suitable habitat is present, surveys are typically required. If individuals are identified and project implementation would result in impacts to the species, the City and County coordinate with the Service and Department on the need for permits and adequacy of avoidance, minimization, and mitigation measures (Eliason *in litt.* 2006; Keith pers. comm. 2012).

Recovery Progress

The final recovery plan was published in 1998 (Service 1998); the known range of *Eriodictyon altissimum* has not expanded since this time. The recovery objective for this species is its downlisting to threatened status; there are currently no delisting criteria. According to the recovery plan, *E. altissimum* can be considered for downlisting when all three of the following have been achieved: (1) at least five occurrences from throughout its range are on lands secure from human-induced threats; (2) surrounding habitat is protected in amounts adequate to permit management of the vegetation community using prescribed fire, if it is deemed beneficial to the species; and (3) populations are projected to be self-sustaining and either stable or increasing as determined by long-term monitoring and research results. These criteria are discussed below.

Downlisting Criterion 1: At least five occurrences from throughout the range are on lands secure from human-induced threats.

This criterion was intended to indicate when the threat of extinction due to habitat loss had been sufficiently ameliorated such that recovery of the species in the wild would not be precluded.

Of the six occurrences of *Eriodictyon altissimum* identified in the listing rule, four occurrences have been secured and are now protected from direct habitat loss that could result from residential development, surface mining, and oil well drilling activities. These occurrences are Indian Knob (EO-5), Ridge Trail (EO-2), Hazard South (EO-3), and Water Tank (EO-6). Habitat that once supported the extirpated Broderson (EO-1) and Morro Dunes (EO-4) occurrences has also been secured and is protected. Only the Baron Canyon occurrence (EO-7), which was considered part of the Indian Knob occurrence at the time of listing, currently exists in habitat that has no permanent conservation status. It appears that development and clearing of habitat that could be affecting *E. altissimum* is ongoing in this area (Vanderwier, pers. obs. 2012). Despite the extirpation of two occurrences, the areas that once supported all six of the historic occurrences of the species have been secured. Only the habitat for the Baron Canyon occurrence (identified in this report as a 7th occurrence based upon both CNDDB and NatureServe data standards) remains unprotected. The following paragraphs provide greater detail on each of the occurrences.

The Broderson occurrence was once found on a parcel that is now owned by the County. While we have concluded that the occurrence is extirpated, the physical location is conserved as part of mitigation for impacts to coastal dune scrub habitat required in the final environmental impact report prepared for the Wastewater Project and included as condition 60 in Coastal Development Permit A-3-SLO-09-055-069 (California Coastal Commission 2010, p. 13). As such, if a seedbank exists and is expressed post-fire, this occurrence will be protected from any type of development activity. While approximately 8 ac (3.2 ha) will be used as leachfields for the Wastewater Project, at least 72 ac (29 ha) will remain intact and managed to maintain and enhance its resource values. This includes the area where the Broderson occurrence was formerly present. In addition to the land acquisition, there is a requirement to allocate monies annually for management of these lands to include habitat restoration as necessary. While the parcel has yet to be transferred to a conservation or management entity, the County continues its search for an appropriate land manager (Hutchinson *in litt*. 2012).

The extant Ridge Trail and presumed extant Hazard South occurrences are found in the northwestern region of Montaña de Oro State Park. This park unit is owned and managed by California State Parks as part of the San Luis Obispo South Coast Division. While there is a general plan that directs management actions for this park unit, it contains no species-specific management measures that are being implemented for *Eriodictyon altissimum*. Park staff does respond with actions such as erosion control and trail maintenance when *E. altissimum* are affected (Sayers, *in litt.* 2012).

The locations of the extirpated Morro Dunes and extant Water Tank occurrences are on lands that were privately owned at the time of listing but are now part of the Morro Dunes Ecological Reserve owned and managed by the Department. Specifically, the lands are within the Bayview Unit of this reserve. There is currently no active management plan for this area but inclusion of lands formerly occupied by *Eriodictyon altissimum* (the Morro Dunes occurrence) and currently occupied by *E. altissimum* (the Water Tank occurrence) within this ecological reserve removes the direct threats of habitat loss that could have resulted from residential development.

The Indian Knob occurrence, representing the type locality for the species, is found in and around Indian Knob on the privately owned lands of Guidetti Ranch. All of those individuals of *Eriodictyon altissimum* found on the Guidetti property are protected in a 1,500-ac (607-ha) conservation easement granted to the City (County of San Luis Obispo 1996, 2001; 13 pp.). As the purpose of the easement is to ensure the subject property is preserved forever in its natural, scenic, and open space condition, it precludes both development and surface oil exploration or extraction activities. There are currently no specific management actions identified for *E. altissimum* within the conservation easement.

Surveys on a nearby property conducted in 1991 identified additional individuals of *E. altissimum* in the area of Baron Canyon. At the time of listing, these individuals were considered to be part of the "stand" found at Indian Knob. Impacts to *E. altissimum* at this site that would have occurred as part of the development of Parcel Map CO 90-080 were avoided by project

redesign (Oyler, *in litt*. 1991, 1 page; Althouse and Meade 1999, p. 17); however, it is uncertain that this would be the case with other future development proposals in this area. As previously mentioned, a number of residences have been constructed in this area; however, we have no information on whether the species was avoided as part of project approvals.

Considering all of the above information, we conclude that this downlisting criterion has been achieved.

Downlisting Criterion 2: Surrounding habitat is protected in amounts adequate to permit management of the vegetation community using prescribed fire, if it is deemed beneficial to the species.

Some form of disturbance is considered necessary to maintain areas of open habitat necessary for long-term persistence of *E. altissimum*, and fire is believed to be the natural disturbance mechanism with which *E. altissimum* evolved. The intent of the second downlisting criterion is for habitat surrounding the known occurrences to be protected in amounts that would be adequate to permit management of the chaparral community using prescribed fire. This criterion is intended to ensure that those ecosystem processes deemed necessary for the continued existence of *E. altissimum* continue to ensure species persistence and recovery.

All of the occurrences of *E. altissimum* occur within 1 mi (1.6 km) of existing residential development. The Ridge Trail occurrence is the farthest from development, being located approximately 0.8 mi (1.3 km) south of Alamo Drive in Cabrillo Estates, Los Osos. Habitat to the south of the Ridge Trail and Hazard South occurrences is protected as part of Montaña de Oro State Park. California State Parks has conducted prescribed burns within this 8,000-ac park; however, these are typically away from residential areas. It is unlikely that prescribed fire could be used at any of the Los Osos occurrences because of their proximity to residential areas and heavy fuels. The Water Tank occurrence is the closest to development being within 150 ft (46 m) of a water tank and approximately 300 ft (107 m) from residences along Calle Cordoniz in the community of Los Osos. This occurrence is bounded immediately to the north and east by the residential development, to the west and south by protected habitat within the Department's Bayview Unit of the Morro Dunes Ecological Reserve and the County's Broderson parcel for a distance of at least 1 mi (1.62 km), and to the south by at least 7 mi (11.3 km) of chaparral and other habitat protected within Montaña de Oro State Park. The Indian Knob occurrence is within 0.5 mi (0.8 km) of Balm Ridge Way where large estate residential development exists in very close proximity to the Baron Canyon occurrence. Habitat surrounding the Indian Knob and Baron Canyon occurrences, with the exception of that area within the Guidetti conservation easement, is largely privately owned native plant communities that are not protected in any formal way.

While the Ridge Trail and Indian Knob occurrences are found as part of a landscape that is likely large enough in size to allow for the use of prescribed burns for *Eriodictyon altissimum*, the public is concerned about the threat of fire, whether it is from natural causes or prescribed as a

management tool. For these occurrences, we consider that prescribed burns could be used as a management tool for habitat that supports *E. altissimum*; however, because it has not been used at any of the occurrences, we do not consider this downlisting criterion to have been achieved.

Downlisting Criterion 3: Populations are projected to be self-sustaining and either stable or increasing as determined by long-term monitoring and research results.

The third downlisting criterion for *Eriodictyon altissimum* is for populations (occurrences) to be self-sustaining and either stable or increasing, as determined by long-term monitoring and research results. It is intended to provide that information necessary to determine the status of the species relative to its recovery.

Despite searches conducted by local botanists and agency personnel familiar with the locations, *Eriodictyon altissimum* has not been detected at the Broderson occurrence since 1979 or at the Morro Dunes occurrence since 1985. The number of individuals reported for each of the extant Los Osos occurrences (Ridge Trail, Hazard South, and Water Tank occurrences) has not increased since their detection in the area in 1972 and it appears, from only anecdotal information, that the Indian Knob occurrence did not increase noticeably between the 1990s and 2006 (Vanderwier pers. obs. 2006). In Table 1 we provide survey estimates from Oyler (1991) and the Service (2004).

As we do not possess data from long-term monitoring or research, it is not possible for us to know if the existing occurrences are self-sustaining, stable, or increasing. We do believe, however, that two of the occurrences known at the time of listing are likely now extirpated.

Based upon the above information, we conclude that this downlisting criterion has not been achieved.

Summary of Progress Towards Recovery**:** The most substantial progress towards recovery of this species is the result of meeting downlisting criterion 1 – securing habitat supporting at least five occurrences of the species. Since the time of listing in 1994, habitat for *Eriodictyon altissimum* has been conserved within the 238-acre Bayview Unit of the Morro Dunes Ecological Reserve, the 80-acre Broderson parcel, and the 1,480-acre Guidetti Ranch conservation easement. Two occurrences conserved at the time of listing within Montana de Oro State Park remain conserved. While amounts of habitat surrounding the Ridge Trail and Hazard South occurrences within Montana de Oro State Park and the Indian Knob occurrence are large enough to permit vegetation management using prescribed fire, we conclude that the intent of downlisting criterion 2 has not been met because prescribed fire has not been used to manage vegetation at any of the *E. altissimum* occurrences. We conclude that downlisting criterion 3 has not been met because information from long-term monitoring or research is not available to evaluate whether *E. altissimum* populations are self-sustaining, stable, or increasing.

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