

Palos Verdes Blue Butterfly
(Glaucopsyche lygdamus palosverdesensis)

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



Palos Verdes blue butterfly (*Glaucopsyche lygdamus palosverdesensis*). Photocredit: Jane Hendron, USFWS.

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

January 09, 2014

5-YEAR REVIEW
Palos Verdes Blue Butterfly
(Glaucopsyche lygdamus palosverdesensis)

I. GENERAL INFORMATION

Purpose of 5-year Reviews:

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. 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.

Subspecies Overview:

The Palos Verdes blue butterfly (*Glaucopsyche lygdamus palosverdesensis*) is endemic to the Palos Verdes Peninsula in Los Angeles County, California; it is a subspecies of the wide-ranging silvery blue butterfly (a species distributed throughout western North America). The Palos Verdes blue butterfly is differentiated from other subspecies primarily through geographic isolation, hostplant use, and the typical pattern of spots on the bottom side of its wings. The Palos Verdes blue butterfly was federally listed as endangered under the Act in 1980, due primarily to the threats of habitat destruction and small population size. Three populations were identified in the listing rule, and six more discovered over the next 2 years; however, all these historical populations were extirpated prior to 1994. The two currently remaining historical populations (only one is known to be extant for certain) were discovered in 1994 and 2001. There are three sites not known to be historically occupied that have undergone introduction of captive stock, only one is currently considered extant, and introduction was ongoing at that site through 2013. While conservation, management, and restoration of remaining habitats and population management have reduced the threats of habitat loss and small population size, these threats remain significant.

Methodology Used to Complete This Review:

This review was prepared by Alison Anderson at the Carlsbad Fish and Wildlife Office, following the Region 8 guidance issued in March 2008. We used status and survey information from experts and published peer-reviewed research, in particular The Urban Wildlands Group

and the Palos Verdes Peninsula Land Conservancy. We received no information relative to Palos Verdes blue butterfly from the public in response to our **Federal Notice** initiating this 5-year review. This 5-year review contains updated information on the subspecies' biology and threats, and an assessment of information compared to that described in the 2008 status review. We focus on current threats to the subspecies pursuant to the Act's five listing factors. This review synthesizes this information to evaluate the listing status of the subspecies and provide an indication of progress towards recovery. Finally, based on this synthesis and the threats identified in performing the five-factor analysis, we herein 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** on May 25, 2011 (USFWS 2011, p. 30378). No information relevant to the Palos Verdes blue butterfly was received.

Listing History:

Federal Listing

FR Notice: 45 FR 44939 (USFWS 1980)

Date of Final Rule: July 2, 1980

Entity Listed: Palos Verdes blue butterfly

(*Glaucopsyche lygdamus palosverdesensis*), an insect subspecies

Classification: Endangered

State Listing

The Palos Verdes blue butterfly is not listed by the State of California as endangered or threatened because insects are not covered under the California Endangered Species Act.

Associated Rulemakings:

Critical habitat was designated for the Palos Verdes blue butterfly on July 2, 1980, at the time of listing (USFWS 1980). Critical habitat consisted of three units on the western slope of the peninsula; Agua Amarga Canyon (40 acres (ac) (16 hectares (ha)), Frank Hesse Park (36 ac (15 ha)), and Palos Verdes Drive (15 ac (6 ha)).

Review History:

The Service initiated 5-year reviews for the Palos Verdes blue butterfly in 1985 and 1991 (USFWS 1985; USFWS 1991); both status reviews were completed with no recommended change in status. The most recent 5-year review was initiated in 2007 and signed March 31, 2008 (USFWS 2008); we recommended no change in status.

Subspecies' Recovery Priority Number at Start of 5-Year Review:

The recovery priority number for the Palos Verdes blue butterfly is 6 according to the Service's 2013 Recovery Data Call, based on a 1–18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (USFWS 1983a, pp. 43098–43105; USFWS 1983b, p. 51985). This number indicates that the taxon is a subspecies that faces a high degree of threat and a low potential for recovery.

Recovery Plan or Outline:

Name of Plan or Outline: Palos Verdes Blue Butterfly Recovery Plan (Recovery Plan)
Date Issued: January 19, 1984
Dates of Previous Revisions: N/A

II. REVIEW ANALYSIS

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

The Act defines “species” as including any subspecies of fish, or wildlife, or plants, and any distinct population segment (DPS) of any species of vertebrate. This definition of species under the Act limits listing as DPSs to species of vertebrate fish or wildlife. The 1996 Policy Regarding the Recognition of Distinct Vertebrate Population Segments under the Act (USFWS 1996, pp. 4722–4725) clarifies the interpretation of the phrase “distinct population segment” for the purposes of listing, delisting, and reclassifying species under the Act. The Palos Verdes blue butterfly is an invertebrate and is therefore not listed as a DPS.

Information on the Species and its Status:

Subspecies Description

As described in the Recovery Plan (USFWS 1984, p. 2) Palos Verdes blue butterflies are morphologically distinguished from other subspecies *Glaucopsyche lygdamus* (Doubleday) by their size, wing color, and maculation (spotting) pattern. The Palos Verdes blue butterfly is a member of the family Lycaenidae. Males have a silvery-blue dorsal wing surface with a narrow black border, the female's dorsal wing surfaces is a brownish-gray color. Males and females have a gray ventral wing surface with dark spots surrounded by white. The Palos Verdes blue butterfly wingspan is approximately 1 inch (25 millimeters (mm)) (Arnold, 1987, p. 203).

Subspecies Biology and Habitat

Palos Verdes blue butterflies require suitable larval hostplants for oviposition and larval development. *Astragalus trichopodus lonchus* (coast locoweed) was once thought to be the exclusive larval hostplant; however, Palos Verdes blue butterfly larvae are now known to feed on *Acmispon glaber* (deerweed) (Mattoni 1994, p. 186). Both of these hostplants are naturally distributed within disturbed patches in coastal sage scrub (CSS) communities throughout the Palos Verdes Peninsula. Both host plant species invade cleared areas following disturbance. Mattoni *et al.*'s (2002, p. 13) model demonstrated the best predictors of Palos Verdes blue butterfly abundance are *Acmispon glaber*, *Astragalus trichopodus*, slope, and azimuth. Most adult butterflies were found at intermediate slopes facing north through east with higher numbers of host plants. Adults seem to respond to specific topoclimatic variables, and given the subspecies' yearly spatial variation, different sites likely provide optimal conditions in different years (Mattoni *et al.* 2002, p. 13). Silvery blue butterflies (*Glauchopsyche lygdamus*) are known to use a variety of flowers as nectar sources, primarily Asteraceae (composites, sunflowers; BAMONA 2013).

The adult flight period is tied to hostplant flowering and generally occurs between late January and early May (Lipman *et al.* 1999, p. 4). Palos Verdes blue butterfly adults are thought to be relatively poor dispersers (Mattoni 1994, p. 185), and initial studies suggest that males are more likely to disperse among habitat patches than females (Lipman *et al.* 1999, p. 5). Oviposition (egg-depositing) occurs throughout the flight season, and eggs are deposited on the flowers or leaves of *Astragalus trichopodus lonchus* or *Acmispon glaber*.

Spatial Distribution and Abundance

Historically, Palos Verdes blue butterflies were known to occur throughout the coastal slope of the topographically diverse Palos Verdes peninsula in Los Angeles County, California. The subspecies was subsequently considered extinct, and then rediscovered at a site outside its former known range on the inland, more eastern, slope of the peninsula (Figure 1). When the Palos Verdes blue butterfly was recognized as a distinct subspecies in the 1970s, its range and distribution were already reduced by grazing, agriculture, and residential and urban development (USFWS 1984, p. 4; Mattoni 1994, pp. 183 and 185). The type locality (where the subspecies was first collected and identified) on the Alta Vista Terrace was extirpated in 1978 after the area was developed for residential use (USFWS 1984, p. 4; Arnold 1987, p. 207; Mattoni 1994, p. 183).

At listing there were three known occupied localities, which were designated as critical habitat: Agua Amarga Canyon, Frank Hesse [Memorial] Park, and Palos Verdes Drive [East] (USFWS 1980, p. 44942). Three years after listing, the Recovery Plan (USFWS 1984, p. 4) described seven extant locations: Agua Amarga Canyon, Frank Hesse Memorial Park, Crest Road, Portuguese Canyon, Phantom Drive, Palos Verdes Drive East, and San Pedro Hill (Figure 1, Table 1). There was one additional historical location near Palos Verdes Drive East that was reported in 1987 (from 1982) not mentioned in the Recovery Plan (Service GIS database from Arnold 1987 data) see Table 1 below), bringing the total to eight. No individuals could be found within the historical range between 1983 and 1993, leading to the conclusion that the Palos Verdes blue butterfly was likely extinct (Mattoni 1994, p. 185). However, the Palos Verdes blue

butterfly was subsequently discovered in 1994 on the Defense Fuel Support Point, San Pedro (DFSP San Pedro; Mattoni 1994, p. 185), located east of the former known range (Figure 1, Table 1).

Palos Verdes blue butterfly is currently presumed extant at two known areas: (1) DFSP San Pedro and adjacent former Palos Verdes Navy housing area (DFSP San Pedro/Navy housing site), and (2) Chandler Preserve. The species may be extant at the Malaga Dune site, but the status is currently unknown (Table 1). The only area consistently occupied by Palos Verdes blue butterflies since rediscovery is the DFSP San Pedro/Navy housing site. There are several additional sites within the Palos Verdes blue butterfly's historical range that are recognized habitat for the subspecies, but not currently occupied (Table 1). These include the former Palos Verdes Drive East Colony location that was occupied in the 1980s (USFWS 1984, pp. 4, 6, 9, 13, and 22), the adjacent Trump National Golf Course (Ocean Trails, L.P, pp. 6 and 7) where Palos Verdes blue butterflies were released in 2009, and Deane Dana Friendship Community Regional County Park (Friendship Park; Sapphos Environmental 2007) where Palos Verdes blue butterflies were released in 2009 and 2010. Palos Verdes Drive East Colony is designated critical habitat (USFWS 1980, p. 44942) and was described in the Recovery Plan as one of the largest colonies in 1982 with 100 hostplants (USFWS 1984, pp. 9 and 22). Introduction was initially successful at Trump National Golf Course, but this site is not believed to be extant (T. Longcore 2012, pers. comm.), and introduction does not appear to have been successful at Friendship Park (Osborne 2013, p. 3).

Extant Historical Site: DFSP San Pedro/Navy housing site

The Navy committed to conserving the Palos Verdes blue butterfly within both the DFSP San Pedro (USFWS 1996; Chevron Biological Opinion, BiOp) and on a portion of the former Palos Verdes Navy housing area (USFWS 2001; Navy Housing BiOp). There are currently (approximately 50 ac (20 ha)) of occupied habitat at the DFSP San Pedro/Navy housing site. To implement the Chevron BiOp, the Navy restored approximately 10 ac (4.05 ha) of Palos Verdes blue butterfly habitat, and a 10.4 ac (4.2 ha) conservation area was established with implementation of the Navy Housing BiOp. Through the 2001 Integrated Natural Resource Management Plan (INRMP), the Navy proposed additional measures to protect existing Palos Verdes blue butterfly habitat within the DFSP San Pedro (Tierra Data Systems 2001). The guidelines described in the Chevron BiOp have been superseded by the DFSP San Pedro Operations and Maintenance (O&M) BiOp (USFWS 2010), which covers all routine operations and maintenance activities within the base. The DFSP San Pedro O&M BiOp provides measures to monitor and captive breed Palos Verdes blue butterflies and actively restore habitat for this species. There are areas within the former Navy housing area that are now privately owned and outside of the Navy conservation area where Palos Verdes blue butterflies were observed in the past; however, no surveys have been conducted outside the conservation area since it was established.

Researchers have conducted annual Palos Verdes blue butterfly surveys on DFSP San Pedro since 1994 (Longcore and Osborne 2012, p. 1); and in the adjacent former Palos Verdes Navy housing area since 1999 (except 2006; Osborne and Longcore 2012, p. 1). In 2011, one Palos Verdes blue butterfly was incidentally observed outside the conservation area within the former Palos Verdes Navy housing area (Osborne and Longcore 2011, p. 8). Palos Verdes blue

butterflies have been observed during formal surveys at the DFSP San Pedro/Navy housing site every year since 1994 (Longcore and Osborne 2012, p. 1).

In 2012, the estimated combined population size along surveyed transects at DFSP San Pedro/Navy housing area site was 145, which is in the second quartile of yearly population estimates (Longcore and Osborne 2012, p. 10), but over twice the size of the 2011 estimates. The estimated population size of Palos Verdes blue butterfly at DFSP San Pedro has varied over 19 years of monitoring from an estimate of 50 to 300 individuals without a statistically significant temporal trend (Longcore and Osborne 2012, p. 12). The adult butterfly population estimate in 2012 was close to average, however spatial data indicate a contraction in the population distribution (Longcore and Osborne 2011, p. 15; Longcore and Osborne 2012, pp. 12 and 15), and Longcore (2013, pers. comm.) expressed concern that 2013 was the “second worst year on record for total [Palos Verdes blue butterfly] numbers.” Researchers hypothesized hostplant loss due to succession to more closed scrub habitat is responsible for the population distribution contraction.

Relative estimates of annual abundance varied substantially among hostplant patches in an 8 year study at the Defense Fuel Support, San Pedro (Mattoni *et al.* 2002, p. 4). The authors did not define “hostplant patch” or “habitat patch” and used the terms interchangeably; however, the term can be interpreted from context as discrete clusters of plants on the approximate scale of 10 to 200 meters (33 to 656 feet). This spatial and temporal variation suggested that no single patch can provide consistently high-quality habitat for the Palos Verdes blue butterfly over the long term. Patches with few or no Palos Verdes blue butterflies in a given year may support high abundances in other years.

Historical Site: Malaga Dune

One potentially occupied location that supported Palos Verdes blue butterflies in the past is Malaga Dune. Occupancy at this location is currently unknown; however, based on the continued presence of hostplants at Malaga Dune the site may still be occupied. Two male and one female Palos Verdes blue butterflies were observed in the city park at Malaga Dune in 2001 in the City of Palos Verdes Estates (R. Mattoni and J. George 2002, pers. comm.). Previous surveys at Malaga Dune did not detect Palos Verdes blue butterfly; therefore, abundance was assumed to be low at this site (Mattoni and George 2002, pers. comm.). We are not aware of any surveys or observations since 2001.

Extant Introduction Site: Chandler Preserve

Introduction of the Palos Verdes blue butterfly within its current range at Linden H. Chandler Preserve (Chandler Preserve) in the City of Rolling Hills Estates (between Malaga Dune and the DFSP San Pedro/Navy housing site) has been a recovery goal for the past 13 years. Pupae from the DFSP San Pedro captive rearing program were introduced to the 28.5 ac (11.5 ha) Chandler Preserve following habitat restoration efforts in 2000; however, occupancy was not subsequently sustained. The Palos Verdes Peninsula Land Conservancy (PVPLC) continued habitat restoration work and initiated a second effort to reestablish the Palos Verdes blue butterfly at Chandler Preserve in 2007 (Dalkey 2011 p. 1; Johnson et al. 2012, p. 1), and obtained a grant to restore and enhance 3 ac (1.2 ha) of habitat at the Chandler Preserve.

In 2009, 512 gravid females and “several thousand (at least 2,000–5,000) eggs through fourth instar larvae” were released in managed habitat at Chandler Preserve (Johnson *et al.* 2010, p. 15). An additional 94 females and 29 males were released at Chandler Preserve in 2010, and two releases totaling 56 females and 30 males were made in 2011 (Dalkey 2011, pp. 1 and 2). In 2011, a total of 41 Palos Verdes blue butterflies were observed at Chandler Preserve; 18 were captive-bred individuals released that year (Dalkey 2011, p. 3); however, the maximum number of unique individuals observed in a single day was 7 (Dalkey 2011, pp. A 4–A 9). In 2012 (Johnson *et al.* 2012, p 16), a total of 135 adult males, 133 females and “500 to 1000” larvae, were released at Chandler Preserve. Some of the females were already fertilized.

The most recent report of Chandler Preserve conservation activities summarized PVPLC activities: From 2009 through 2012, a total of 721 adults and around 2,500 larvae have been released at the site. During the 2013 flight season, approximately 140 butterflies were released on April 7, and 27 larvae in early June. Throughout this time, PVPLC supported the butterfly through supplemental host plant installation and volunteer habitat restoration projects (Dalkey 2013, p. 1). A total of 23 adults were observed during 2013 surveys of Chandler Preserve, of which 4 were judged to be captive reared individuals. The Urban Wildlands Group and PVPLC will not release captive reared Palos Verdes blue butterflies for the next few years (Dalkey 2013, p. 6). By discontinuing releases in 2014, researchers can collect data from surveys conducted absent releases to determine the resident population size at Chandler Preserve, and begin to evaluate population establishment.

Summary

There is one relatively small but stable Palos Verdes blue butterfly population at the DFSP San Pedro/Navy housing site that is consistently occupied (approximately 50 ac (20 ha)). The Chandler Preserve site is also considered extant and population establishment will be monitored for the next few years to determine if the reintroduction efforts were successful. The complete historical and current distribution is illustrated in Figure 1 and described in Table 1 below.

Taxonomic Status and Genetics

A subspecies of the silvery blue (*Glaucopsyche lygdamus*), the Palos Verdes blue butterfly is distinguished by its size, early flight season, white rings that surround larger dark macules on the underwings, relatively fast flight speed, and use of rattlepod (*Astragalus trichopodus*) by the larvae (Lipman *et al.* 1999, p. 3).

Subspecies-specific Research and/or Grant-supported Activities

In 1994, a captive rearing program was established from the population at DFSP San Pedro (Longcore *et al.* 2002, p. 1). In 2007, a secondary rearing facility was established at Moorpark College, Moorpark, California. Palos Verdes blue butterflies have been successfully reared in captivity every year since the program was established (Johnson *et al.* 2012, p. 1). The rearing program run by The Urban Wildlands Group and Moorpark College is permitted under the Chevron BiOp (USFWS 1996) superseded by the DFSP San Pedro O&M BiOp (USFWS 2010). The current rearing program utilizes methods adapted from Johnson, Pratt, and Mattoni, described in Johnson *et al.* (2012, pp. 2–8). Captive rearing is conducted at the laboratory

facilities at DFSP San Pedro and America's Teaching Zoo at Moorpark College; the majority of production occurs at the latter because of the availability of student labor (Johnson *et al* 2001, p. 2).

The propagation program, consistent with the Service's Controlled Propagation Policy (USFWS 2000), is dedicated to producing individuals for augmentation of field populations, and research to improve future rearing techniques. Individuals have been released into the wild at Chandler Preserve (see Spatial Distribution and Abundance above) annually from 2009 through 2013; a total of 861 adults and over 2,500 larvae (Dalkey 2013, p. 1). In 2012 (Johnson *et al.* 2012, p. 16), a total of 135 adult males and 133 females were released at Chandler Preserve; 89 adult females and 44 males were released at DFSP San Pedro. Releases in 2012 also included "500 to 1000" larvae at Chandler Preserve, and 100 pupae placed in the field at DFSP San Pedro as part of an eclosion timing study (Johnson *et al.* 2012, p 16; see also below). Releases at Chandler Preserve will not continue in 2014, in order to assess population establishment (see *Extant Introduction Site: Chandler Preserve* above). There were two releases of adults on DFSP in 2011 (Johnson *et al.* 2011, p. 12) we do not have release numbers for 2012. Eighty one adults were released March 21, 2011, in the 2 year-old mechanically disturbed area (see habitat details below), and 79 were released on March 28 behind the firing range. As of 2013 there are no reported plans to discontinue adult releases at DFSP. Johnson *et al.* (2011, p. 16) reported the results of research associated with the captive rearing, including the effects of diet on pupal weight and larval coloration. They found that larvae fed a diet that includes *Acmispon glaber* flowers had significantly heavier pupation weight compared with all other diets, and increased weight at pupation is associated with increased adult fecundity (Johnson *et al.* 2011, p. 16). Johnson *et al.* (2012, pp. 9–11, and 19) also conducted an experiment to determine likely longevity of pupae in the field (natural diapause duration). Their results indicate pupae in the field are more likely to diapause for a second year than unrefrigerated pupae, and refrigeration slows pupal water loss. They hypothesized the previously reported value of up to 5 years of longevity in the captive pupal stage does not reflect field values, and a closer field estimate would be 2–3 years.

Since the last 5-year status review, there has been some activity to maintain and restore habitat at the DFSP San Pedro/Navy housing site. A pilot experiment that mechanically disturbed 1 ac (0.4 ha) of habitat is underway at DFSP San Pedro, there was preliminary recruitment of *Acmispon glaber* seedlings, and researchers speculated these were likely to be of sufficient size for butterfly reproduction in 2013 (Longcore and Osborne 2011, p. 16). The Navy is conducting nonnative species removal in the former Navy housing area, which benefits the Palos Verdes blue butterfly. In 2013 Dill (p. 1) reported successful hand removal of sea-lavender (*Limonium ramosissimum*) outside of a two-foot buffer around all host plants. This effort represents a substantial first step at this site in the ongoing nonnative plant species invasion control program. The USFWS is currently working with its partners, the Navy and the Urban Wildlands Group to secure a long-term manager for the conservation area, and draft a habitat management plan. The goal for the conservation area is to increase Palos Verdes blue butterfly abundance through habitat enhancement and to sustain a dense, stable population in perpetuity through active habitat management.

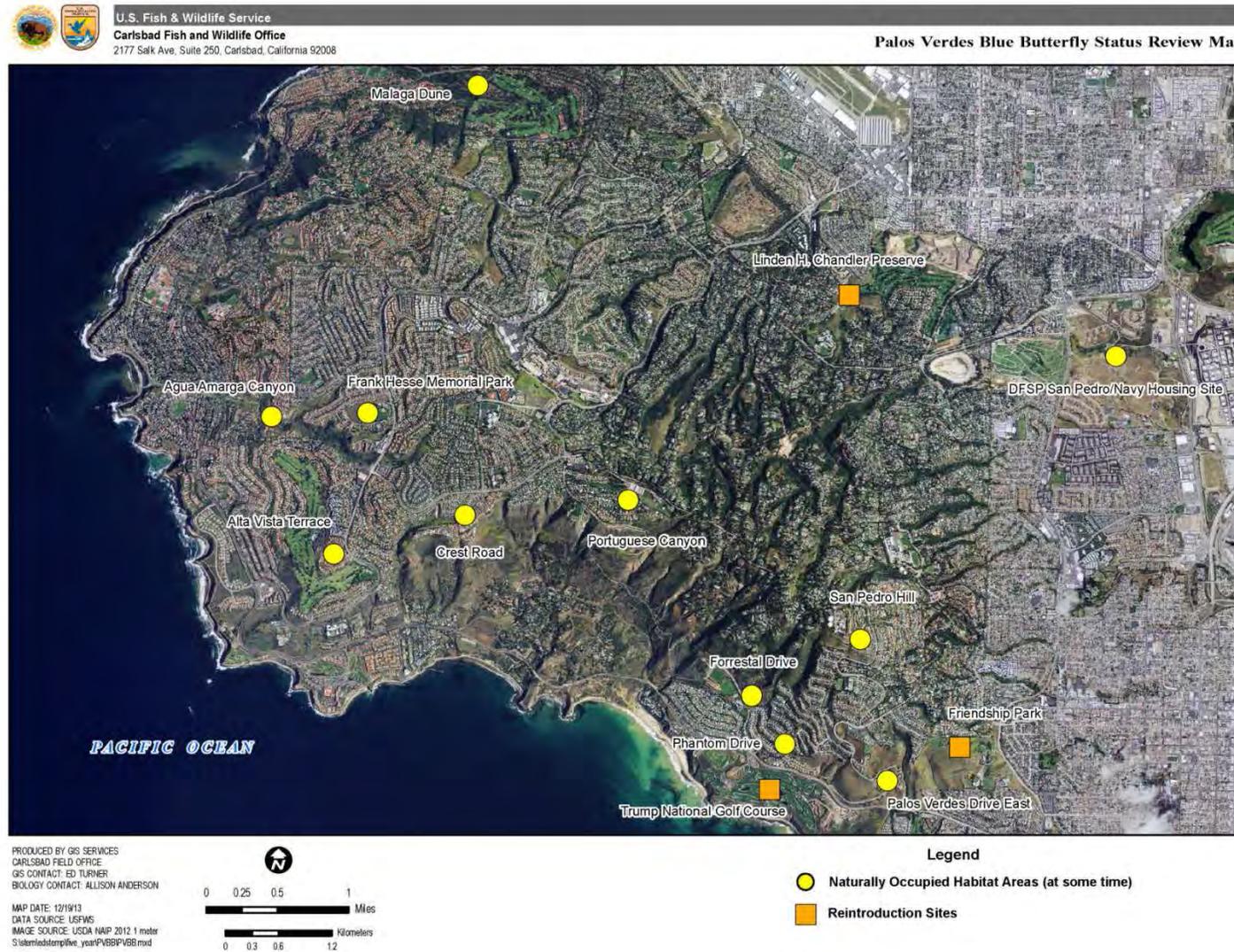


Figure 1. Historical distribution and reintroduction sites of the Palos Verdes blue butterfly (*Glaucopsyche lygdamus palosverdesensis*) in Los Angeles County, California.

Table 1. Palos Verdes blue butterfly occurrence information for undeveloped land.

Habitat area	Status at listing (critical habitat)	Status per Recovery Plan	Status per 2008 5-year review	Current status	Maximum # adults last observed/day (year)	Ownership	Habitat status and current threats notes (if reported)
Palos Verdes Drive East	extant (yes)	extant	extirpated	extirpated	Unknown (1984)	City of Rancho Palos Verdes	Zoned “open-space hazard.” Partially protected by the Ocean Trails (Trump National Golf Course) HCP. Includes historical butterfly observations from outside critical habitat, one within the western boundary of Friendship Park.
Frank Hesse Memorial Park	extant (yes)	extant	extirpated	extirpated	Unknown (1983)	City of Rancho Palos Verdes	Developed
Agua Amarga Canyon	extant (yes)	extant	extirpated	extirpated	1 (1979)	Private property	Per recovery plan, “Extremely small.” Narrow canyon surrounded by development.
Alta Vista Terrace	not known	extirpated	extirpated	extirpated	Unknown (1984)	Private property	Developed
Crest Road	not known	extant	extirpated	extirpated	Unknown	Private property	Per recovery plan, “Less than a square meter in size, no more than 12 hostplants.” Narrow canyon surrounded by development.
Portuguese Canyon	not known	extant	extirpated	extirpated	Unknown	Private property	Developed
Phantom Drive	not known	extant	extirpated	extirpated	Unknown	Private property	Developed
San Pedro Hill	not known	extant	extirpated	extirpated	Unknown	Private property	Developed

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DFSP San Pedro/Navy Housing site	not known	no known	extant	extant	17 (2012), last release 2013.*	Navy	Conserved, protected, and managed. Reported threats are habitat succession and nonnative species invasion.
Forrestal Drive	not known	not known	not known	extirpated	2 (1982)	Unknown, likely private.	From Richard Arnold's 1987 report (USFWS GIS database); reported 4 larvae and 6 eggs. Not developed.
Linden H. Chandler Preserve	not known	not known	not known	extant	23 (2013), last release 2013.*	Palos Verdes Peninsula Land Conservancy	Introduction site that is conserved, protected, and managed. No historical population known from this location. Reported threat is nonnative species invasion.
Malaga Dune	not known	not known	extant	unknown	3 (2001)	City of Palos Verdes Estates	City Park. Reported threat is nonnative species invasion.
Friendship Park	not known	not known	not known	not extant	Unknown, last release 2010*	County of Los Angeles	County Park. No historical population known from this location. Negative surveys in 2013.
Trump National Golf Course	not known	not known	not known	believed extirpated	No surveys, last release 2009*	Private property	Introduction site. No historical population known from this location. Habitat overgrown, management focused on mature sage scrub for other species.

* Includes captive-bred released individuals.

** "Conserved" means habitat is permanently protected through designation as a wildlife preserve, conservation easement, or equivalent.

"Protected" means conserved and managed at some level to maintain habitat quality and prevent butterfly loss.

There are two sites within the Palos Verdes blue butterfly's historical range where introduction has been attempted, Trump National Golf Course (Ocean Trails, L.P, pp. 6 and 7) where Palos Verdes blue butterflies were released in 2009, and Deane Dana Friendship Community Regional County Park (Friendship Park; Sapphos Environmental 2007) where Palos Verdes blue butterflies were released in 2009 and 2010. Friendship Park is owned by the County of Los Angeles, and Palos Verdes blue butterflies were first released there following habitat restoration in 2009 under a Safe Harbor Agreement (Friendship Park SHA; Sapphos Environmental Inc. 2007, p. 13). In 2010, 58 male and 23 female butterflies (unmated) were released at Friendship Park (Johnson *et al.* 2011, p. 15). The Friendship Park SHA (Sapphos Environmental Inc. 2007, p. 15) states "For a period of three (3) years from February 1, 2009, Friendship Park will be monitored by the Permittee or its authorized agents to assess the presence/absence of the PVB during the flight season." According to researchers and 2013 surveys, it appears the population at Friendship Park was not successful (Osborne 2013, p. 3). Palos Verdes blue butterflies were also released at Trump National Golf Course in 2009, which is covered by a Habitat Conservation Plan (HCP) (Ocean Trails, L.P 2000, pp. 6 and 7). It is believed occupancy was established at this site successfully for 2-3 years, but all of the habitat containing hostplants has subsequently been overgrown with mature CSS; therefore, this briefly established population has potentially been extirpated (Longcore 2012, pers. comm.).

In summary, the status of the Palos Verdes blue butterfly population at the Chandler Preserve will be monitored for the next few years to determine if the reintroduction was successful. Persistence of occupancy following releases at Friendship Park and Trump National Golf Course does not appear to have occurred. Habitat management and Palos Verdes blue butterfly augmentation are continuing at the DFSP San Pedro/Navy housing site, and partners are working together actively to achieve recovery goals. The captive rearing program provides some assurance against extinction should catastrophic events extirpate wild populations.

Vulnerability Factors

Species may be vulnerable to threats for a variety of reasons. Primack (2006, p. 159) outlined five categories of species considered most vulnerable to extinction as:

- 1) Species with very narrow geographical ranges,
- 2) Species with only one or a few populations,
- 3) Species with a small population size (identified as one of the best predictors of species extinction rate),
- 4) Species in which population size is declining, and
- 5) Species hunted or harvested by people.

Consideration of these categories in conjunction with life history traits can provide a vulnerability profile for Palos Verdes blue butterfly. Palos Verdes blue butterfly exhibits several attributes that make the subspecies vulnerable to extinction, including categories 1–4 above.

Small population size, ongoing invasion of habitat by nonnative species, and succession (transition from early colonizing plants with an open canopy, to mature shrubs with a more closed canopy) are likely the most significant Palos Verdes blue butterfly vulnerabilities. Other

threats described below in the **Five-Factor Analysis** section likely have the greatest impacts on this vulnerability.

Five-Factor Analysis

At the time of listing (USFWS 1980, pp. 44939–44942), habitat loss through urban development and habitat degradation through weed control practices were considered the major threats to the Palos Verdes blue butterfly. While these threats were described under listing Factor E (other natural or manmade factors), they are discussed in this review under **FACTOR A** below. The 2008 status review (USFWS 2008, pp. 5–9) identified nonnative plant invasion and small population size and isolation as the greatest threats to the subspecies. The following five-factor analysis describes and evaluates the current threats to Palos Verdes blue butterfly relative to the five listing factors outlined in section 4(a)(1) of the Act.

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

At the time of listing, threats to Palos Verdes blue butterfly occupied habitat were development and weed control practices (USFWS 1980, p. 44939). The last 5-year status review (USFWS 2008, p. 5) concluded that while not totally eliminated, the threat of habitat destruction had been greatly reduced, and all occupied habitat requires management to control the spread of nonnative weeds. Development has been reduced to the level of a stressor, but nonnative plants remain a threat.

The primary issue with regard to Factor A is natural succession, which reduces habitat availability. We anticipate that future impacts to Palos Verdes blue butterfly habitat within the DFSP San Pedro and the former Palos Verdes Navy housing area will be minor and mostly temporary. The Navy works closely with the Service to ensure that projects with potential to impact Palos Verdes blue butterfly habitat will adequately address the species to ensure long-term protection of the existing population. Specific management objectives are described in the Navy's INRMP for the DFSP San Pedro occurrence. Longcore and Osborne (2012, p. 15) noted that the distribution of Palos Verdes blue butterfly on DFSP San Pedro had decreased in extent since the mid-1990s due to maturation of coastal sage scrub vegetation, including dominant plant species such as California sagebrush (*Artemisia californica*) and California brittlebush (*Encelia californica*). This succession of coastal sage scrub is the reason mechanical disturbance of habitat is required to maintain occupancy (prescribed fire is not an option in occupied areas). At Chandler Preserve, nonnative plants and also later-successional CSS vegetation continue to compete with hostplants in the restoration areas; however, PVPLC is actively improving habitat through nonnative plant removal and hostplant installations (Dalkey 2011, p. i). At the Malaga Dune site, which may support a small population of Palos Verdes blue butterfly, there is no identified development threat, although the site is not protected by any conservation mechanism from future development proposals (e.g., conservation easement) and habitat disturbances such as dumping and nonnative plant invasion remain uncontrolled (E. Porter and A. Anderson, USFWS, 2013, pers. obs.).

Large tracts of undeveloped land remain within the historical distribution of the Palos Verdes blue butterfly that include areas suitable for reintroduction following habitat restoration.

Because the sites have the potential to support additional Palos Verdes blue butterfly populations, they have high value for recovery efforts. The City of Rancho Palos Verdes has a draft Natural Communities Conservation Plan/Habitat Conservation Plan (NCCP/HCP) that includes approximately 1,400 ac (566.6 ha) of already conserved land, mostly within the historical range of the Palos Verdes blue butterfly. Implementation of the Rancho Palos Verdes NCCP/HCP will nearly eliminate the threat of habitat destruction or modification within recoverable Palos Verdes blue butterfly habitat, including the East Palos Verdes Drive. Thus, while not totally eliminated, the threat of habitat destruction has been greatly reduced at some remaining occupied and restorable sites within Palos Verdes blue butterfly's historical range.

Summary of Factor A

Since the last 5-year review, natural succession has become a greater threat, but no loss of Palos Verdes blue butterfly habitat is known to have occurred. Some small habitat patches have been restored and reintroduction efforts have continued and further expanded to additional sites. Management for succession and nonnative invasive plants is crucial, because the Palos Verdes blue butterfly populations are still limited to two relatively small, disjunct sites (unknown at the time of listing, only one wild established population; Table 1). The potentially occupied Malaga Dune site is not conserved through any permanent conservation easements or other perpetual conservation strategies (see **FACTOR D** analysis below). All occupied habitat requires management to control the spread of nonnative plants, and maintaining enough habitat in an early successional state to support hostplants and butterflies. Therefore habitat modification, including natural succession, poses an ongoing threat to Palos Verdes blue butterfly survival and recovery.

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

At listing, and in the 2008 status review, overuse was not considered a threat to Palos Verdes blue butterfly. We have no information indicating that overuse is a threat to the continued existence of Palos Verdes blue butterfly anywhere in its range.

FACTOR C: Disease and Predation

Neither the final listing rule nor the recovery plan identified disease or predation as a threat to the Palos Verdes blue butterfly. Disease is still not known to substantially impact the subspecies. However, the 2008 status review (USFWS 2008, p. 6) noted there is concern that watering of hostplants during habitat restoration may result in larval and egg predation by earwigs (Dermaptera). Although this is a potential threat that should be considered in future research efforts, it is not currently considered significant.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

In the listing rule, existing regulatory mechanisms were not thought to adequately protect Palos Verdes blue butterfly from the primary threat of habitat destruction (USFWS 1980, p. 44940). The 2008 status review indicated the Act is still the primary regulatory mechanism mandating Palos Verdes blue butterfly conservation. The status of regulatory mechanisms and their

adequacy for protection of the Palos Verdes blue butterfly remains largely unchanged since 2008. Several State and Federal mechanisms may provide conservation benefit to the Palos Verdes blue butterfly, as described in the following paragraphs.

State Protections in California

The State's authority to conserve rare invertebrate wildlife is contained within two major statutes: the California Environmental Quality Act (CEQA), and the Natural Community Conservation Planning (NCCP) Act.

California Environmental Quality Act (CEQA)

As a federally-listed subspecies, Palos Verdes blue butterfly is considered a rare species under CEQA (Section 15380, Public Resources Code), which is the principal statute mandating environmental assessment of projects in California. The purpose of CEQA is to evaluate whether a proposed project may have an adverse effect on the environment and, if so, to determine whether that effect can be reduced or eliminated by pursuing an alternative course of action or through mitigation. CEQA applies to projects proposed to be undertaken or requiring approval by State and local public agencies (http://www.ceres.ca.gov/topic/env_law/ceqa/summary.html). CEQA requires disclosure of potential environmental impacts and a determination of "significant" if a project has the potential to reduce the number or restrict the range of a rare or endangered plant or animal; however, projects may move forward if there is a statement of overriding consideration. If significant effects are identified, the lead agency has the option of requiring mitigation through changes in the project or to decide that overriding considerations make mitigation infeasible (CEQA section 21002). Protection of listed species through CEQA is, therefore, dependent upon the discretion of the lead agency involved.

Natural Community Conservation Planning (NCCP) Act

In 1991, the State of California passed the NCCP Act to address the conservation needs of natural ecosystems throughout the State (CFG 2800–2835). The NCCP program is a cooperative effort involving the State of California and numerous private and public partners to protect regional habitats and species. The primary objective of NCCPs is to conserve natural communities at the ecosystem scale while accommodating compatible land uses (<http://www.dfg.ca.gov/nccp/>). NCCPs help identify, and provide for, the regional- or area-wide protection of plants, animals, and their habitats while allowing compatible and appropriate economic activity. Many NCCPs are developed in conjunction with HCPs prepared pursuant to the Act. Regional NCCPs may provide protection to federally-listed species by conserving native habitats upon which the species depend. There are no final NCCPs in effect that protect Palos Verdes blue butterflies, however there is a draft Rancho Palos Verdes NCCP (see above under **FACTOR A**) that will afford protection for populations within that city (see Table 1).

Federal Protections

National Environmental Policy Act (NEPA)

All Federal agencies are required to adhere to the NEPA of 1970 (42 U.S.C. 4321 *et seq.*) for projects they fund, authorize, or carry out. Prior to implementation of such projects with a Federal nexus, NEPA requires the agency to analyze the project for potential impacts to the human environment, including natural resources. The Council on Environmental Quality's regulations for implementing NEPA state that agencies shall include a discussion on the environmental impacts of the various project alternatives (including the proposed action), any adverse environmental effects that cannot be avoided, and any irreversible or irretrievable commitments of resources involved (40 CFR part 1502). Its public notice provisions provide an opportunity for the Service and others to review proposed actions and provide recommendations to the implementing agency. NEPA does not impose substantive environmental obligations on Federal agencies—it merely prohibits an uninformed agency action. However, if an Environmental Impact Statement is prepared for an agency action, the agency must take a “hard look” at the consequences of this action and must consider all potentially significant environmental impacts. Effects on threatened and endangered species is an important element for determining the significance of an impact of an agency action (40 CFR § 1508.27). Thus, although NEPA does not itself regulate activities that might affect the Palos Verdes blue butterfly, it does require full evaluation and disclosure of information regarding the effects of contemplated Federal actions on sensitive species and their habitats. NEPA (42 U.S.C. 4371 *et seq.*) provides some protection for listed species that may be affected by activities undertaken, authorized, or funded by Federal agencies. Prior to implementation of actions with a Federal nexus, NEPA requires the agency to analyze the action for potential impacts to the human environment, including natural resources. In cases where that analysis reveals significant environmental effects, the Federal agency must propose mitigation alternatives that would offset those effects (40 C.F.R. 1502.16). These mitigations usually provide some protection for listed species. However, NEPA does not require that adverse impacts be fully mitigated, only that impacts be assessed and the analysis disclosed to the public. This disclosure to the public, including other Federal agencies, provides an opportunity to submit comments on the particular project and propose other conservation measures that may directly benefit listed species, such as Palos Verdes blue butterfly.

Endangered Species Act of 1973, as amended (Act)

The Act is the primary Federal law providing protection for Palos Verdes blue butterfly. The Service is responsible for administering the Act, including sections 7, 9, and 10. Section 7(a)(1) of the Act requires all Federal agencies to utilize their authorities in furtherance of the purposes of the Act by carrying out programs for the conservation of endangered and threatened species. Section 7(a)(2) of the Act requires Federal agencies, including the Service, to satisfy two standards in carrying out their program. Federal agencies must ensure that actions they fund, authorize, or carry out are not likely to (1) jeopardize the continued existence of any listed species or (2) result in the destruction or adverse modification of designated critical habitat. Critical habitat has been designated for this species (USFWS 1980, p. 44939). A jeopardy determination is made for a project that is reasonably expected, either directly or indirectly, to appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild

by reducing its reproduction, numbers, or distribution (50 CFR 402.02). A non-jeopardy determination may include reasonable and prudent measures that minimize the amount or extent of incidental take of listed species associated with a project.

Section 9 of the Act prohibits the taking of any federally listed endangered or threatened species. Section 3(18) defines “take” to mean “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.” Service regulations (50 CFR 17.3) define “harm” to include significant habitat modification or degradation which actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harassment is defined by the Service as an intentional or negligent action that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns, which include, but are not limited to, breeding, feeding, or sheltering. The Act provides for civil and criminal penalties for the unlawful taking of listed species. Under the terms of section 7(b)(4) and section 7(o)(2) of the Act, taking that is incidental to and not intended as part of a Federal agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of an incidental take statement.

Section 10 provides for project development and planning under an HCP that permits incidental take under section 9, while assuring a net recovery benefit to the species. Incidental take refers to taking of listed species that results from, but is not the purpose of, carrying out an otherwise lawful activity by a Federal agency or applicant (50 CFR 402.02). To qualify for an incidental take permit, applicants must develop, fund, and implement a Service-approved HCP that details measures to minimize and mitigate the project’s adverse impacts to listed species. Regional HCPs in some areas now provide an additional layer of regulatory protection for covered species, and many of these HCPs are coordinated with California’s related NCCP program. To date the Palos Verdes blue butterfly has benefitted from conservation strategies developed for the Chandler Preserve and Ocean Trails (now Trump National) HCPs, which both include habitat restoration and authorize release of captive-bred butterflies. The draft Rancho Palos Verdes NCCP is also an HCP (see above under **FACTOR A**).

Federal projects (evaluated under section 7 of the Act), other projects (evaluated under section 10(a)(1)(B) of the Act), or recovery actions (evaluated under section 10(a)(1)(A) of the Act) may result in incidental take of the Palos Verdes blue butterfly. Beyond the formal consultations associated with HCPs and Safe Harbor Agreements, we conducted three formal consultation under section 7 of the Act that may result in incidental take of Palos Verdes blue butterfly, two of which are still in effect, the DFSP San Pedro O&M BiOp (USFWS 2010; superseded the Chevron BiOp) and the Navy Housing BiOp (USFWS 2001).

The DFSP San Pedro O&M BiOp addressed project impacts to Palos Verdes blue butterfly as a result of typical military operations within the DFSP San Pedro. To avoid, minimize, and offset potential impacts to Palos Verdes blue butterfly, DFSP San Pedro committed to conservation measures including: (1) submit annual activity reports; (2) maintain and fund the Palos Verdes blue butterfly captive breeding program; (3) allow the operation of a native plant nursery at DFSP; (4) monitor and survey for Palos Verdes blue butterfly; and (5) minimize and avoid impacts to all life stages. To minimize impacts to Palos Verdes blue butterfly habitat, DFSP San Pedro committed to: (1) avoid uprooting native shrubs; (2) salvage topsoil in high quality

habitat where disturbance is necessary and collect seeds or clippings; (3) impact no more than 0.5 ac (0.2 ha) of suitable habitat in any year, and no more than 1 ac (0.4 ha) over any 3 years; and (4) restore impacted areas. Finally, to minimize the risk of habitat degradation from the invasion of nonnative vegetation, DFSP San Pedro committed to: monitor vegetation characteristics annually; eradicate and manage nonnative plant species; maintain a list of nonnative plants that are known to quickly invade and degrade native habitat in the vicinity of DFSP San Pedro; and maintain open canopy habitat for the butterfly. Incidental take was issued in the DFSP San Pedro O&M BiOp for an undefined number of butterflies within no more than 0.5 ac (0.2 ha) of land annually (habitat measure 4 above).

The Navy Housing BiOp addresses transfer of the former Navy Housing area to private landowners and the City of Los Angeles (City). It describes creation of a 10.44 ac (4.2 ha) butterfly reserve incorporating the majority of occupied habitat in the former Navy housing area, and the commitment of property recipients and the City to implement measures that minimize project impact on the Palos Verdes blue butterfly. Measures included: (1) design of drainage facilities and future modifications to maintain natural hydrology; (2) new utility lines installed only outside of the reserve; (3) existing utilities inside the reserve abandoned and relocated; (4) required maintenance coordinated to avoid and minimize impacts to Palos Verdes blue butterfly; and (5) Covenants, Codes, and Restrictions to address issues such as control of domestic pets, dust abatement, and the potential for fires. The Navy committed to: (1) manage the reserve in accordance with the Defense Logistics Agency DFSP INRMP (Tierra data 2001;DFSP INRMP) (see below description under Sikes Act Improvement Act); (2) install a security fence around the perimeter of the reserve; and (3) conduct a one-time pupae salvage operation in occupied areas outside the reserve. Incidental take was issued in the Navy housing BiOp for an unquantifiable number of butterflies in all life stages within approximately 7 ac (3 ha) outside the reserve, and in areas impacted by the phased fencing plan and maintenance and repair activities within the reserve.

Sikes Act Improvement Act (Sikes Act):

The Sikes Act (16 U.S.C. 670) authorizes the Secretary of Defense to develop cooperative plans for conservation and rehabilitation programs on military reservations and to establish outdoor recreation facilities. The Sikes Act also provides for the Secretaries of Agriculture and the Interior to develop cooperative plans for conservation and rehabilitation programs on public lands under their jurisdiction. While the Sikes Act of 1960 was in effect at the time of the Palos Verdes blue butterfly's listing, it was not until the amendment of 1997 (Sikes Act Improvement Act) that Department of Defense (DOD) installations were required to prepare INRMPs. Consistent with the use of military installations to ensure the readiness of the Armed Forces, INRMPs provide for the conservation and rehabilitation of natural resources on military lands. They incorporate, to the maximum extent practicable, ecosystem management principles and provide the landscape necessary to sustain military land uses. While INRMPs are not technically a regulatory mechanism because their implementation is subject to funding availability, they address the conservation of natural resources on military lands and can be an added conservation tool in promoting the recovery of endangered and threatened species.

In 2001, pursuant to the Sikes Act, the Navy adopted the DFSP INRMP (Tierra Data 2001). Like other INRMPs, it is largely ecosystem-based except where biological opinions direct

species-specific actions. The DFSP San Pedro's INRMP incorporated the Service's Chevron BiOp (USFWS 1996), superseded by the DFSP San Pedro O&M BiOp (USFWS 2010). The DFSP San Pedro's INRMP provides specific direction regarding Palos Verdes blue butterfly management, habitat restoration, and captive breeding. The Conceptual strategy in the INRMP included measures to: (1) identify high habitat value lands; (2) document baseline conditions; (3) prevent habitat loss; (4) control nonnative species; (5) foster habitat diversity; and (6) Maximize recovery and stability of Palos Verdes blue butterfly habitat. The DFSP INRMP specifically emphasized reestablishment of structural habitat elements required by the butterfly and research, planning, and project implementation coordinated with the Service and other stakeholders. The DFSP INRMP also included specific criteria for habitat restoration, selection of sites for restoration, nonnative plant control, native plant propagation, and butterfly captive rearing.

Summary of Factor D

While both CEQA and NEPA and the State's NCCP Act may provide some discretionary conservation benefit to the Palos Verdes blue butterfly, the Act is the primary regulatory mechanism mandating conservation and ensuring that the subspecies is addressed during planning efforts that may impact the species or its habitat. Because the one established population at DFSP San Pedro is under the Navy's jurisdiction, section 7 of the Act is the primary Federal process for addressing Palos Verdes blue butterfly conservation needs at this site. Section 10 of the Act is the primary Federal process for addressing both the economic development needs of the Palos Verdes Peninsula and the conservation needs of the species on private lands. Thus, it is through the Act that we continue to work with our Federal and State partners, local jurisdictions, and private landowners to implement actions to reduce ongoing threats and recover this subspecies.

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

At the time of listing, habitat destruction through recreational development (e.g., City Parks) and habitat modification through nonnative invasive plant control were considered under this listing factor; however, we have addressed these impacts under **FACTOR A** (destruction, modification, or curtailment of habitat) for this review. In the 2008 status review, based on the limited distribution of Palos Verdes blue butterfly in the wild, we identified small population size and isolation as significant, ongoing threats to the subspecies; at this time we do not believe these threats have changed. An assessment of the Factor E threats currently impacting Palos Verdes blue butterfly is provided below.

Extinction Vulnerability Due to Small Population Sizes and Isolation

Palos Verdes blue butterfly is threatened by small population size and isolation of the two known occupied areas (DFSP San Pedro/Navy housing site and Chandler Preserve); none of the three sites known to be occupied at listing are currently occupied (two were developed). It is commonly accepted in conservation biology that small populations have higher probabilities of extinction than larger populations because their low numbers make them susceptible to inbreeding, loss of genetic variation, high variability in age and sex ratios, demographic stochasticity, and random naturally occurring events such as wildfires, floods, droughts, or

disease epidemics (Shaffer 1981, p. 134; Goodman 1987, pp. 11–23; Soulé 1987, pp. 11–68; Meffe and Carroll 1997, pp. 162–227).

Another factor commonly understood to make populations vulnerable to stochastic events is isolation. Isolation often acts in concert with small population size to increase the probability of extinction. Isolated populations are more susceptible to long-term/permanent extirpation by accidental or natural catastrophes because the likelihood of recolonization following such events is negatively correlated with the extent of isolation (i.e., colonization is less likely as isolation increases) (Wilcox and Murphy 1985, pp. 881–883; Meffe and Carroll 1997, pp. 204–227). Urbanization and land conversion have fragmented the historical range of Palos Verdes blue butterfly such that remaining blocks of occupied habitat likely now function more independently of each other (i.e., are more isolated) where they were formerly connected. Population viability analyses have been conducted annually since 2003 (Longcore and Osborne 20012, p. 17). Probability of extinction has been highly variable, ranging from as low as 24 percent in 2004, to 100 percent as recently as 2011. The estimate of extinction probability was down in 2012 to 70 percent (Longcore and Osborne 2012, p. 17). Large reserve areas associated with the draft Rancho Palos Verdes NCCP/HCP have the potential to support connected patches of occupied habitat following habitat restoration and reintroduction of Palos Verdes blue butterfly. However, the threats of small population size and isolation will continue to threaten the subspecies' survival until this plan and an effective reintroduction effort are implemented and habitat management is ensured.

Climate Change

Our analyses under the 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). The term “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 2007a, 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 2007a, p. 78).

Various changes in climate may 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 interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007a, pp. 8–14, 18–19). Identifying likely effects often involves aspects of climate change vulnerability analysis. Vulnerability refers to the degree to which a species (or system) is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the type, magnitude, and rate of climate change and variation to which a species is exposed, its sensitivity, and its adaptive capacity (IPCC 2007a, p. 89; see also Glick *et al.* 2011, pp. 19–22). There is no single method for conducting such analyses that applies to all situations (Glick *et al.* 2011, p. 3). We use our expert judgment and appropriate analytical approaches to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

Although many species already listed as endangered or threatened may be particularly vulnerable to negative effects related to changes in climate, we also recognize that, for some listed species, the likely effects may be positive or neutral. In any case, the identification of effective recovery strategies and actions for recovery plans, as well as assessment of their results in 5-year reviews, should include consideration of climate-related changes and interactions of climate and other variables. These analyses also may contribute to evaluating whether an endangered species can be reclassified as threatened, or whether a threatened species can be delisted.

Potential threats exist to flora and fauna of the United States from ongoing, accelerated climate change (IPCC 2007b, pp. 1–52; PRBO 2011, pp. 1–68). A recent study examined the effects of climate change scenarios as they pertain specifically to the different ecoregions of California (PRBO 2011, pp. 1–68). An ecoregional approach was examined because climate change effects will vary in different areas of California due to the State’s size and diverse topography (PRBO 2011, p. 1). Climate projections, as they relate to temperature, precipitation, and sea-level rise, for these ecoregions were established by analyzing numerous IPCC emission scenarios (2007b, pp. 44–54), the core of most climate projections, for atmospheric and oceanic global circulation models (PRBO 2011, p. 1). Longcore and Osborne (2011, pp. 13 and 14) found that larval year rainfall (September through May of the previous season) was positively correlated with adult population size, but the relationship was stronger when rainfall was log-transformed. This means that a moderately wet year typically increases population size, but an extremely wet year does not have any additional positive effect on population size (Longcore and Osborne 2011, pp. 13 and 14; Longcore and Osborne 2012, pp. 17 and 18). These results should be interpreted with caution because the sample size was relatively small. The PRBO (2011, p. 40) study found Southwestern California ecoregion climate models project a decrease in mean annual rainfall within the range of 51 to 184 mm by 2070, but summarized their findings by stating there is relatively little consensus about the projected effects of climate change on precipitation patterns in southwestern California. The Climate Wizard (<http://www.climatewizard.org/>; accessed December 21, 2012) downscaled precipitation model ensemble average (High A2 IPCC emissions scenario) predicts an approximate 10 percent decrease by the mid-century during September through November and March through April, with no change December through February. Climate predictions and population correlations indicate negative future effects of climate, but uncertainty is high due to low butterfly sample size and climate model consensus. Therefore, while we recognize that climate change is an important issue with potential adverse effects to listed species and their habitats, information is not available to make accurate predictions regarding its effects to the Palos Verdes blue butterfly at this time.

Summary of Factor E

Due to the small size of the Palos Verdes blue butterfly population at the DFSP San Pedro/Navy housing site, and the uncertain status of establishment or persistence at other sites, Factor E threats are ongoing and affect the entire range of the subspecies. The subspecies’ survival remains insecure because of the combined threats of isolation and vulnerability of small populations from stochastic processes. However, work is being done to develop the Rancho Palos Verdes NCCP/HCP and effective reintroduction efforts and successful habitat management practices are being investigated to ensure Palos Verdes blue butterfly persistence in the future.

Cumulative Effects of Threats Under all Factors

Current threats to survival of the Palos Verdes blue butterfly include habitat conversion through nonnative plant invasion and ecological succession, and small population size. Small population size makes this subspecies susceptible to impacts by stochastic events, including events such as potential novel disease epidemics, severe weather, genetic bottlenecks, and wildfire. Nonnative plant invasion and ecological succession result in loss of hostplants. The primary measures in place to reduce these threats are vegetative management and captive propagation. Climate change may increase the severity of current threats. While the threats of habitat loss and small population size are cumulative (together they pose a greater threat than either alone), the best available information concerning the butterfly's status does not allow us to assess the magnitude or immediacy of potential combined impacts at this time.

III. RECOVERY CRITERIA

While the Palos Verdes Blue butterfly has a final, approved recovery plan (USFWS 1984), it does not contain objective, measurable criteria for downlisting and delisting, and was written prior to discovery of current extant populations.

IV. SYNTHESIS

At the time of listing in 1980, habitat loss through urban development and habitat degradation through invasive plant control practices were considered the major threats to the Palos Verdes blue butterfly. All three Palos Verdes blue butterfly populations known at the time of listing, as well as the type locality and the seven extant populations described in the Recovery Plan, were thought to be extirpated by 1983. Currently, there is only one remaining wild Palos Verdes blue butterfly population known to occupy limited habitat at the DFSP San Pedro/Navy housing site (not known at listing). The Chandler Preserve supports an introduced population that is also considered extant and will be monitored to determine if the reintroduction efforts were successful. There may be a very small population at Malaga Dune (status unknown) and efforts are underway to continue reintroduction efforts to other sites where suitable habitat is available (e.g., Friendship Park and Trump National Golf Course) to establish additional sustainable populations.

Since the last status review in 2008, there has been no significant change in trend of Palos Verdes blue butterfly abundance, but the reported numbers of individuals has decreased. Efforts are being implemented to reintroduce Palos Verdes blue butterfly at multiple sites and to manage habitat, but the number of established populations has not increased. Therefore, since the last 5-year review, small population size and isolation continue to put the Palos Verdes blue butterfly at risk of extinction and collectively with other lesser threats contribute to a high degree of threat. While the DFSP San Pedro/Navy housing site population has been relatively stable, management efforts need to change focus to maintain early succession vegetation if this status is to be maintained in the future. Furthermore, additional populations must still be established or augmented to guard against the risk of extinction from a stochastic event and ensure long-term

survival of the species. In recognition of the magnitude of the ongoing threats, we recommend no change in the endangered status of the Palos Verdes blue butterfly at this time.

V. RESULTS

Recommended Listing Action:

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

New Recovery Priority Number and Brief Rationale:

No change to the recovery priority number is recommended at this time. Palos Verdes blue butterfly continues to face a high degree of threat with a low recovery potential. A Recovery Priority Number of 6 remains appropriate for the subspecies.

VI. RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS

The actions listed below are recommendations to be completed over the next 5 years. These will help guide continuing recovery of the Palos Verdes blue butterfly by providing information to better manage the population. We will continue to work with partners (i.e. Federal, State, and local agencies). We will work with Service programs, such as Service's Partners for Fish and Wildlife Program to identify opportunities for conservation or preservation of potential Palos Verdes blue butterfly habitat on private land. Conservation of this taxa is dependent on continued cooperation with our partners (i.e., U.S. Navy and Palos Verdes Peninsula Land Conservancy) to minimize impacts from current threats and stressors and aid future restoration.

- 1) Update the primary objective of the Recovery Plan to maintain and restore existing Palos Verdes blue butterfly populations by determining what criteria are necessary to downlist or delist the species. Identify the physical and biological features essential to the conservation of Palos Verdes blue butterfly. Identify whether there are specific areas within the geographical range that contain those features.
- 2) Disturbance is needed as a management tool at the DFSP San Pedro/Navy housing site, Chandler Preserve and any area that will be relied upon to maintain a persistent Palos Verdes blue butterfly population to keep the early successional hostplants abundant. A pilot experiment that mechanically disturbed 1 ac (0.4 ha) of habitat is underway at DFSP San Pedro (Longcore and Osborne, 2011 p. 16), but additional efforts to create early successional habitats are needed.

- 3) Work with the City of Rancho Palos Verdes and other partners to arrange for and initiate restoration of the formerly occupied “East Palos Verdes Drive colony” site described in the Recovery Plan.
- 4) Explore a partnership with the City of Palos Verdes Estates to support recovery actions at Malaga Dune.
- 5) Determine the status of occupancy at Malaga Dune to inform recovery actions.

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U.S. FISH AND WILDLIFE SERVICE

5-YEAR REVIEW

Palos Verdes Blue Butterfly
(Glaucopsyche lygdamus palosverdesensis)

Current Classification: Endangered

Recommendation Resulting from the 5-year Review:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No Change

Review Conducted By: Carlsbad Fish and Wildlife Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, U.S. Fish and Wildlife Service

ACTING

Approve _____

Scott A. Sobiech

Date _____

JAN 09 2014