U.S. Fish & Wildlife Service

Recovery Plan for the Behren's Silverspot Butterfly (*Speyeria zerene behrensii*)

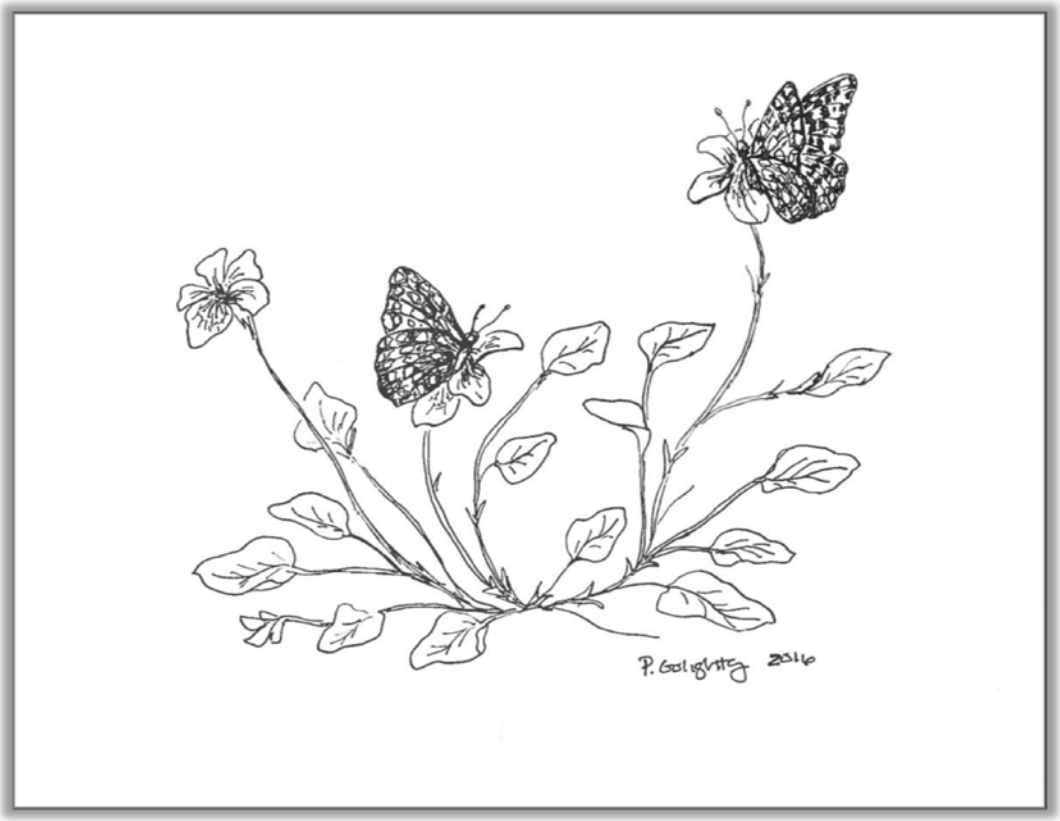

Illustration by Paula Golightly, U.S. Fish and Wildlife Service

Recovery Plan

for the

Behren's Silverspot Butterfly

(*Speyeria zerene behrensii*)

2015

Region 8

U.S. Fish and Wildlife Service

Sacramento, California

Approved: _____

Regional Director, Pacific Southwest Region, U.S. Fish and Wildlife Service

Date: March 10, 2016

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Executive Summary

Current Status

The Behren's silverspot butterfly (*Speyeria zerene behrensii*) was listed as endangered in 1997, and has a disjunct distribution in coastal Sonoma and Mendocino Counties, California. The largest known population is located near Point Arena, Mendocino County, California. Not much is known about the distribution and status of the subspecies, although presence surveys conducted during the flight periods from 2004 to 2006 indicate that the Behren's subspecies persists at several of its previously known sites. Historical and baseline numbers quantifying the butterfly's range-wide population and site-specific metapopulations began to be collected in 2006. Surveys from 2010 through 2012 at new sites, primarily on private lands, have identified very low numbers of Behren's silverspot butterflies. Surveys to collect site-specific data will continue at locations that are believed to be of most importance to the range-wide population. The number of individual Behren's silverspot butterflies likely continues to decline due primarily to the degradation and loss of habitat as a result of development and agricultural practices, although habitat succession (trees encroaching on coastal prairie) and vehicle strikes may also impact habitat and butterfly survival. We are unclear how climate change may affect the range-wide distribution or status of site-specific metapopulations. We believe that threats have not been substantially reduced since the butterfly's listing in 1997 and may have increased as rural and urban development has progressed over time.

Habitat Requirements and Limiting Factors

The Behren's silverspot butterfly occupies early successional coastal terrace prairie habitat that contains its caterpillar's host plant, western early blue violet (*Viola adunca*), adult nectar sources, and suitable adult courtship areas. Additionally, Behren's silverspot butterflies may also inhabit coastal sand dune systems that contain the characteristics listed above. Habitat characteristics and availability are not well understood for the subspecies; however, inferences have been made by comparing site-specific characteristics to similar habitats used by the closely related threatened Oregon silverspot butterfly (*Speyeria zerene hippolyta*)(Service 1980) and endangered Myrtle's silverspot butterfly (*S. z. myrtleae*)(Service 1992). Soil and climatic conditions, salt-spray or mist, and disturbance regimes (such as fire) are believed to have historically contributed to maintaining low, open prairies within the subspecies' range by suppressing encroaching trees and shrubs.

Habitat-related threats identified at the time of listing and that are still a threat include invasion by exotic vegetation, natural succession, fire suppression, and development (all of which have resulted in habitat loss and modification) as well as collection. Land use practices have altered disturbance regimes needed to maintain existing habitats and create new habitats for expansion of the subspecies. Pesticide use may be influencing localized butterfly populations. Presence surveys of historic and potential Behren's silverspot butterfly habitat were completed during the 2004 through 2006 flight periods. The surveys included locations where butterflies were known to be extant at the time we developed the draft Recovery Plan (Service 2003) and historical sites where recent data was lacking. Those surveys indicate that several of the historical sites remain extant; although we still do not have adequate information to determine the number of individual butterflies at each site. Transect surveys to determine the status of the metapopulation at Point Arena began in 2010 and have indicated that the Behren's silverspot butterfly is present, but in very low numbers. Management is needed to maintain sufficient habitat at the extant sites to sustain the subspecies, curtail vegetative succession, and reduce other threats to the subspecies and its habitat. Historical unoccupied Behren's silverspot butterfly habitat needs to be re-established and managed to benefit butterflies.

Recovery Strategy

Protecting suitable habitat throughout the historic range of the Behren's silverspot butterfly is essential to maintaining and increasing the subspecies. The major centers for historical populations have been identified as "metapopulations," within which the U.S. Fish and Wildlife Service will work with partners to protect, maintain, and improve habitat for the butterfly.

Recovery Priority

The Recovery Priority Number for the Behren's silverspot butterfly is 3C, per criteria published in the Federal Register (Service 1983a, 1983b). The priority number is based on the butterfly being a subspecies (rather than a full species) with a high degree of threat, a high potential for recovery, and existing conflict between the species' conservation and development (residential and agricultural development). The 5-Year Status Reviews in 2006 and 2012 reaffirmed the Recovery Priority Number.

Recovery Goal

The Recovery Goal is to recover the Behren's silverspot butterfly to the point where it can be downlisted and ultimately delisted. Meeting specified Recovery Criteria will provide for a self-sustaining population in the wild and will result in downlisting the butterfly to threatened, and then to its ultimate recovery and delisting.

Recovery Objectives

To achieve the recovery goal, the following objectives have been identified:

1. Secure self-sustaining wild metapopulations throughout the historic range of the subspecies.
2. Determine metapopulation and range-wide population numbers and monitor them to determine long-term trends.
3. Reduce and eliminate threats, to the extent possible.
4. Protect, conserve, and restore healthy butterfly ecosystems and their function.

Recovery Criteria

Downlisting of Behren's silverspot butterfly to a threatened status can be considered when:

1. Three metapopulations in Mendocino County, and one metapopulation in Sonoma County, have been established (discovered or reintroduced) at protected sites.
2. All four metapopulations are protected and managed in perpetuity.
3. Adequate funding for management of all sites is assured and adaptive management plans have been developed and are being implemented.
4. Annual monitoring has shown that the range-wide population cumulatively supports a minimum of 4,000 adults for at least 10 consecutive years, with no individual protected metapopulation having fewer than 1,000 adults in any year. Each metapopulation needs to reflect a stable or increasing population trend over the 10-year period.

Delisting can be considered when all of the following conditions have been met after downlisting:

1. Metapopulations have been established at six protected locations; two in Sonoma County and four in Mendocino County.
2. The six protected metapopulations are managed in perpetuity and threats are sufficiently controlled or ameliorated through the active implementation of management plans.
3. Each of the six protected metapopulations supports a minimum viable population of 1,000 adult butterflies for at least 10 years, with a range-wide total population of at least 6,000 adult butterflies during the same period. Each metapopulation needs to reflect a stable or increasing population trend over the 10-year period.

Action Needed:

1. Protect habitat
2. Determine ecological requirements, population constraints, and management needs
3. Monitor population status and habitat
4. Undertake public information and outreach programs

Estimated Cost of Recovery:

Species recovery for the Behren's silverspot butterfly is estimated to cost approximately $10.5 million, plus additional costs that cannot be estimated at this time. The estimated cost of recovery includes a three percent increase since the Draft Recovery Plan in 2003 to account for inflation.

Major costs include acquisition of habitat and subsequent operation expenses, including costs associated with monitoring and implementation of recovery actions. Funding is also necessary for exploration of historical and potential sites, and coordinated management. The costs of maintaining habitat on private lands is unknown.

Date of Recovery:

If surveys, reintroduction, and management efforts are successful and allow recovery criteria to be met, the 10-year monitoring period for downlisting might be initiated by 2015, downlisting might be considered by 2025, and delisting might be considered by 2035.

Changes from the Draft Recovery Plan

The numbers of individual butterflies needed for each metapopulation, and therefore, the range-wide population, were increased from the draft Recovery Plan based on peer review comment regarding relevant research on invertebrate populations. In addition, we adjusted our estimate of recovery costs due to the lapse in time from the draft to final Recovery Plans to reflect costs associated with inflation. These costs are an estimate, and actual costs of recovery may differ from predicted costs. Implementation of recovery actions is discretionary.

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I. Introduction

A. OVERVIEW

The Behren's silverspot butterfly (*Speyeria zerene behrensii*) is a coastal subspecies of the Zerene silverspot (S*peyeria zerene*), a member of the brush-foot family (Nymphalidae). The Zerene silverspot has 15 currently recognized subspecies, 6 of which are distributed in northern California, Oregon, and Washington, although there is some evidence that recognition of additional subspecies may be warranted (Figure 1).

The Behren's silverspot butterfly is similar in appearance to several other subspecies of *Speyeria zerene* (Howe 1975; Hammond 1980; McCorkle and Hammond 1988). The Oregon silverspot butterfly (*S. z. hippolyta*) has a coastal distribution to the north of *S. z. behrensii* from Lake Earl in coastal northern California to Long Beach in Washington (Service 2001). The Myrtle's silverspot butterfly (*S. z. myrtleae*) is located to the south of the Behren's silverspot butterfly's distribution, generally meeting in the area of the Russian River, Sonoma County, California. Emmel and Emmel (1998) have proposed a split from the Myrtle's silverspot butterfly (*S. z. myrtleae*), describing a new subspecies, the Point Reyes silverspot butterfly (*S. z. puntareyes*), which they believe is distinct from *S. z. myrtleae*. The Point Reyes silverspot butterfly is believed by Emmel and Emmel (1998) to occupy coastal terraces from Point Reyes in Marin County, north to Fort Ross in Sonoma County, California. Consequently, if this new taxon is widely accepted, the Point Reyes silverspot butterfly may replace Myrtle's as the subspecies that borders the Behren's silverspot butterfly near the Russian River.

The current distribution of the Behren's silverspot butterfly is not well known. Observations from 2004, and species specific presence surveys in 2005, indicate that the largest numbers of individuals are likely near Point Arena, Mendocino County, California (Pratt 2004; Arnold 2006). Additional surveys are needed; some of which have been initiated. Adult butterflies that are intermediate in appearance between Behren's silverspots and Myrtle's silverspots have been observed near Jenner and south of Stewart's Point in Sonoma County, California. All of the silverspot subspecies occupy restricted habitat types near the coast and have been seriously affected by human activities (Hammond and McCorkle 1984; Schaeffer and Kiser 1994). The Oregon silverspot butterfly was federally listed as threatened by the U.S. Fish and Wildlife Service (Service) in 1980 (45 FR 44935),

and the Myrtle's silverspot butterfly was listed as endangered in 1992 (57 FR 27848).

The Service listed the Behren's silverspot butterfly as an endangered species on December 5, 1997 (Service 1997; 62 FR 64306). Out of concern for impacts from the collection of rare and endangered butterflies and the subspecies' limited distribution, we did not designate critical habitat for the Behren's silverspot butterfly at the time of listing or since the time of listing.

The Draft Recovery Plan for the Behren's silverspot butterfly was completed and made available to the public in November 2003 (Service 2003). No agency or public comments were received during the comment period on the Draft Recovery Plan (Appendix A), but we did receive peer review comments. Actions listed in this recovery plan (and in Appendix B) are designed to help initiate the recovery process which will continue until the butterfly no longer needs the special protection afforded by the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.).

B. CHANGES FROM THE DRAFT RECOVERY PLAN

The number of individual butterflies needed for recovery of each metapopulation, and therefore, the overall range-wide population, were increased from the draft Recovery Plan to this final Recovery Plan based on peer review regarding relevant research with invertebrate populations (refer to section E below, Population Status). We also updated information on parasitism and predation, as suggested by peer review. In addition, we adjusted our estimate of recovery costs to reflect the costs associated with inflation. These costs are an estimate, and actual costs of recovery may differ from predicted costs (refer to section III below, Implementation Schedule).

C. TAXONOMY AND DESCRIPTION

Thirteen species of true silverspot butterflies are known to occur, which are comprised of multiple genera. Silverspot butterflies are restricted to North America. The genus *Speyeria* is a member of a complex group having a polytypic (*i.e*., having many forms) population structure with many geographic subspecies (Scott 1986). Simonsen *et al*. (2006) proposed merging *Speyeria* into the genus *Argynnis*; however, the Service continues to treat the Behren's silverspot butterfly as a member of the genus *Speyeria* until the change to *Argynnis* is widely accepted.

The Behren's silverspot butterfly has been identified as one of 15 subspecies of *Speyeria zerene* (Boisduval 1852) (Figure 1). Grey and Moeck (1962); McCorkle, Hammond, and Pennington (1980); and McCorkle and Hammond (1988) have reviewed the taxonomy and relationships within this group of butterflies. Subspecies of *S. zerene* are clustered into five major groups that are genetically distinct but not genetically isolated; some interbreeding likely occurs. These groupings are: (1) the *bremnerii* group in the Pacific Northwest west of the Cascade Range and on the California Coast, of which Behren's silverspot is a member; (2) the typical *zerene* group in the Sierra Nevada, southern Cascade, Siskiyou, and Salmon Mountains and in the northern California Coast Range; (3) the *carolae* group along the eastern slope of the Sierra Nevada and in southern California; (4) the *garretti* group east of the Cascade Range in the Pacific Northwest and through the Rocky Mountains; and (5) the *gunderi* group in the Great Basin.

William H. Edwards described the Behren's silverspot butterfly in 1869 based on an adult male collected by an unknown lepidopterist in Mendocino, California (Edwards 1869; dos Passos and Grey 1945). The Behren's silverspot butterfly is a medium-sized butterfly with a wingspan of approximately 2.2 inches (5.5 centimeters). The upper surfaces are golden brown with numerous black spots and lines. Wing undersides are brown, orange-brown, and tan with black lines and distinctive silver and black spots. Basal areas of the wings and body are densely pubescent (covered with short, soft hairs) (Edwards 1869; dos Passos and Grey 1945).

The Behren's silverspot butterfly (*Speyeria zerene behrensii*) (Figure 2) differs from the Oregon silverspot butterfly (*S. z. hippolyta*) primarily by its darker suffusion of color on the upper sides of the wings near the base and its relatively larger size. The Myrtle's silverspot butterfly (*S. z.* myrtleae) is larger and lighter in color than the Behren's silverspot butterfly (McCorkle and Hammond 1988; Service 1980; Service 1992).

Silverspot butterfly populations near Jenner in central coastal Sonoma County appear to have intermediates between the Myrtle's (or potentially the Point Reyes) silverspot butterfly and the Behren's silverspot butterfly (Emmel and Emmel 1998). The subspecies to the south of Behren's silverspot butterfly is currently classified as Myrtle's, but Emmel and Emmel (1998) propose that a new subspecies, the Point Reyes silverspot butterfly (*Speyeria zerene puntareyes*), exists from Marin and southern Sonoma Counties, California. The populations described as *S. z. puntareyes* are proposed to be split from *S. z. myrtleae* based on

geographic proximity and phenotypic differences. The validity of the *S. z. puntareyes* taxon are being considered, and if widely accepted and accepted by the Service, *S. z. puntareyes* may replace *S. z. myrtleae* as the subspecies that interfaces with *S. z. behrensii* near the Russian River in Sonoma County. However, at this time we will continue to consider those silverspot butterflies in coastal Sonoma County south of the Russian River (*i.e.*, Jenner) to be Myrtle's silverspot butterflies (*S. z. myrtleae*). Until widely accepted, we continue to consider the subspecies breakdown of the *bremnerii* group (coastal Pacific Northwest) to be composed of six subspecies.

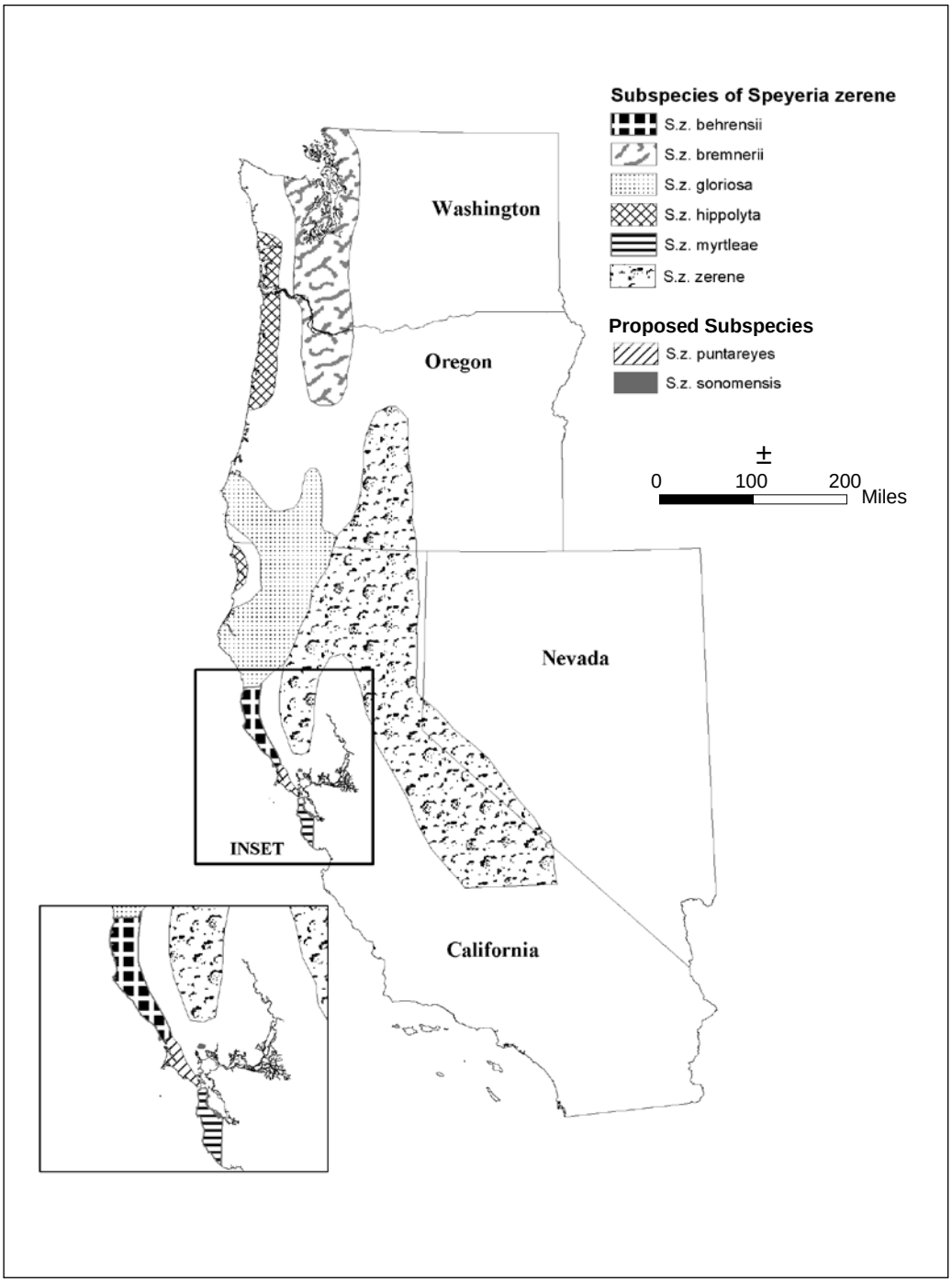

Figure 1. Distribution of six subspecies of the *Speyeria zerene* complex of silverspot butterflies (*S. z. bremnerii* group) in the northwestern United States. The *S. z. sonomensis* and *S. z. puntareyes* subspecies (also depicted here) have been recently described and are being evaluated by taxonomists.

Figure 2. Behren's silverspot butterfly (*Speyeria zerene behrensii*). Photo: G. Pratt

Another closely related subspecies, *Speyeria zerene sonomensis*, is found geographically close to the Behren's silverspot butterfly (Emmel *et al*. 1998). *Speyeria zerene sonomensis* is described from the southern end of the Sonoma Mountains, located north of San Francisco Bay. Like *S. z. puntareyes*, the *S. z. sonomensis* subspecies is being evaluated by taxonomists. Variation, hybridization, subspecies, and taxonomy in California butterflies are briefly discussed in Garth and Tilden (1986).

D. GEOGRAPHIC DISTRIBUTION

Behren's silverspot butterflies inhabit coastal terrace prairie habitat, as is the case with the Oregon silverspot butterfly. Because the Myrtle's silverspot butterfly is known from the coastal sand dunes near Point Reyes National Seashore, we suspect that Behren's silverspot butterflies may also use similar habitats. Consequently, our search for new populations has included sand dune habitat types, as well as coastal terrace prairie habitats. The distribution of each of these subspecies is restricted to a limited range. Within its range, the Behren's silverspot butterfly is currently or historically known from specific locations, each of which is referred to in this recovery plan as a metapopulation. A metapopulation can be a single population, or a group of subpopulations in an area that could individually be more vulnerable to random extinction than the range-wide population as a whole. The metapopulation concept is discussed in Harrison *et al*. (1988) and Wells and Richmond (1995).

The Behren's silverspot butterfly was historically known from six locations which extended from the vicinity of the City of Mendocino, Mendocino County, south to the area of Salt Point State Park, Sonoma County. The six locations, from north to south, are: (1) Mendocino headlands, (2) Point Arena, (3) south Anchor Bay headlands (type location [*i.e.*, where first specimens were collected for the subspecies]), (4) Sea Ranch, (5) Stewarts Point, and (6) north of Salt Point. The record is unclear regarding specimens collected to the south near Jenner, at the mouth of the Russian River. Due to access restrictions, researchers do not have adequate information to state if the Behren's silverspot butterfly is extant at each

of these sites (Figure 3). Additional surveys are needed to determine the butterfly's status.

Generally, the Service considers the Behren's silverspot butterfly's range to be north of the Russian River, Sonoma County, to the vicinity of Laguna Point within MacKerricher State Park, Mendocino County. The Myrtle's silverspot butterfly occupies that area to the south of Jenner, Sonoma County (Figure 1). The 1997 listing for the Behren's silverspot butterfly indicates that the butterfly's distribution extends only as far north as Point Arena (62 FR 64306). However, because the type location (*i.e*., where first specimens were collected for the subspecies) is believed to be near the vicinity of Anchor Bay, and suitable habitat extends north to Laguna Point, we believe the range of the *S. z. berhensii* subspecies may extend further north than documented at listing. Surveys are needed to determine if the coastal terrace north of Point Arena contains suitable habitat, and if Behren's silverspot butterflies are found north of Point Arena. Additionally, some older records from the 1930s, 1940s, and into the 1970s, indicate that *S. z. behrensii* may have extended as far north as Orick, Humboldt County, California (California Natural Diversity Data Base 2011). However, the Humboldt County records are most likely *S. z. gloriosa*, which exhibits a range of phenotypic variation overlapping with *S. z. behrensii* (R. Arnold, personal communication 2002).

Launer *et al*. (1992) considered the subspecies near Jenner as most closely related to the Myrtle's silverspot (*S. z. myrtleae*). Butterflies that are intermediate in appearance between the Myrtle's (*S. z. myrtleae*) and Behren's silverspot butterflies have been observed near Jenner and south of Stewart's Point, including the Fort Ross area. Observations during the 2005 flight period found silverspots at Salt Point that exhibited phenotypes that were intermediate between *berensii* and *myrtlaea* (Arnold 2006). Even though the Jenner metapopulation may likely be more closely aligned with the Myrtle's silverspot butterfly, it has been considered similar to the Behren's silverspot butterfly by some researchers (Launer *et al.* 1992). Some taxonomists believe the region from Stewarts Point to Jenner is an intermediate zone where both the *S. z. myrtleae* and *S. z. behrensii* subspecies overlap (R. Arnold, personal communication 2002).

The California Natural Diversity Data Base (2011) also includes a record from Comptche, Mendocino County. The Comptche record is a single 1973 specimen from an area within the outer coast range about 10 miles (16 kilometers) inland from the coast and about 200-300 feet (61-91 meters) in elevation. This site is well inland from confirmed records of Behren's. The taxonomic status of the

Comptche specimen has not been confirmed; it may represent an inland range extension of Behren's, a range extension of a different subspecies (*S. z. zerene*), which occurs further inland in the coast range, or possibly a misidentification. To our knowledge, the distribution of *Speyeria zerene* has not been described to include the outer coast range in Mendocino County. However, *Speyeria zerene* individuals, thought to be of the *S. z. zerene* subspecies, were found at Cahto Peak, Mendocino County, in 1993 (K. Hansen, pers. comm. 2012); this peak is located about 30 miles (48 kilometers) north of Comptche and 10 miles (16 kilometers) inland from the coast, at an elevation of about 4,000 feet (1,219 meters). Therefore, we do not currently consider the Comptche record to be *S. z. behrensii* or include this area as part of the Behren's silverspot distribution, although this specimen and area merit further evaluation.

E. POPULATION STATUS

Little is known regarding the current or historic status (i.e., range-wide population size or trend) of the Behren's silverspot butterfly. Presence surveys conducted in 2005 located adult Behren's silverspot butterflies at Salt Point, Stewart's Point, Point Arena, and Manchester (Arnold 2006). These limited surveys were conducted primarily to determine the presence of the butterfly at previously known sites. There is no substantial documentation in the records that quantifies the number of individuals at a specific site (*i.e.*, metapopulation) or on a range-wide basis. Repeated surveys that follow an established protocol (Appendix C) continue to be needed to determine baseline data and detect population trends.

This effort of collecting baseline data and establishing a monitoring program has been initiated on the Bureau of Land Management (BLM) managed lands near Point Arena. California Department of Parks and Recreation (State Parks) is also conducting regular surveys during the butterfly's flight period at Manchester State Park. Until those programs and similar monitoring programs at other extant sites are well established, no reliable data are available regarding population trends for the butterfly. We believe it likely that the overall population is declining from historical numbers, based on increased development and agricultural pressure occurring within the subspecies' range. However, at this time, this is based solely on observed habitat loss and conversion over time. A monitoring program to determine trends at site locations throughout the butterfly's range continues to be needed before the population's status can be adequately determined.

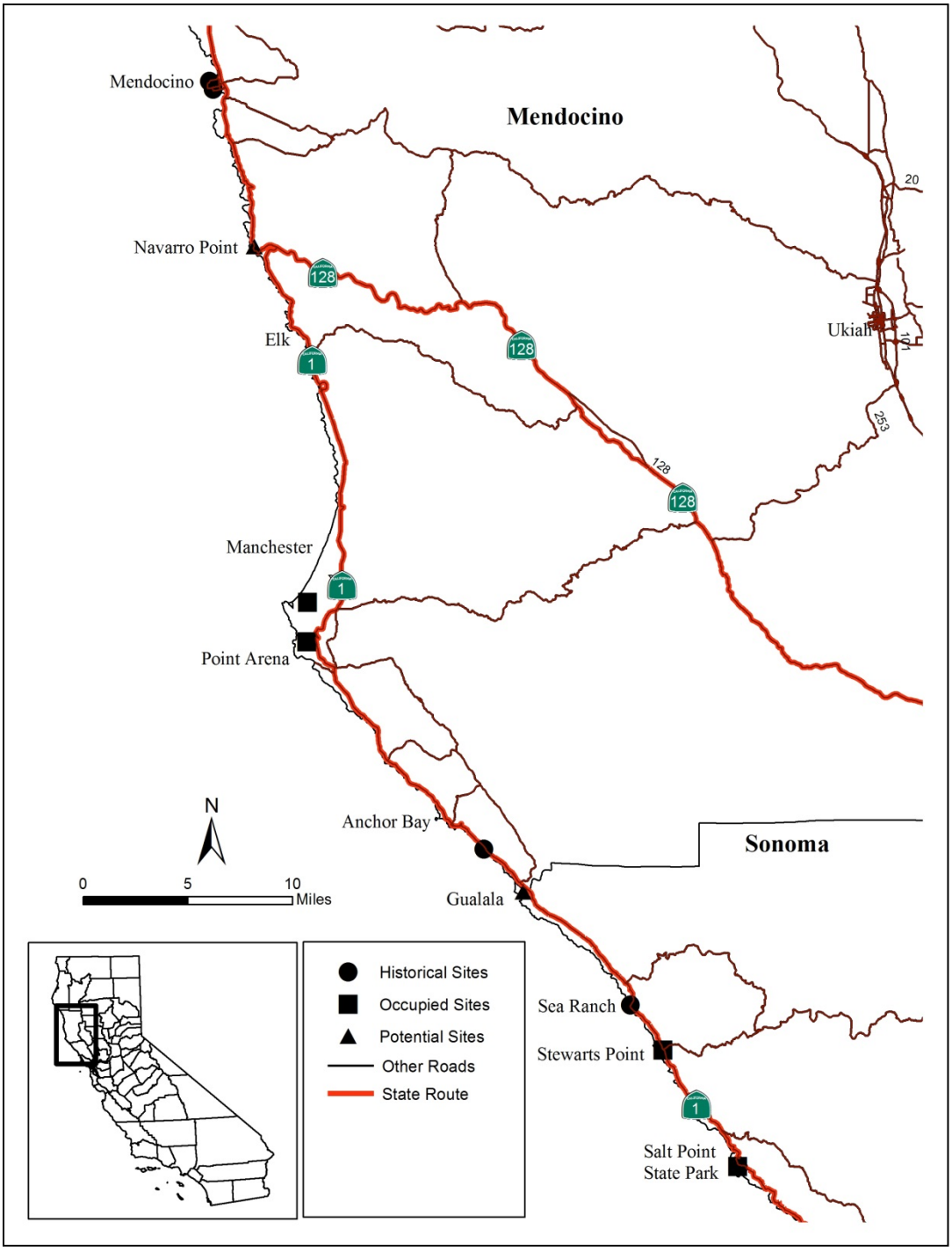

Figure 3. Distribution of historical, occupied, and potential Behren's silverspot butterfly (*Speyeria zerene behrensii*) habitat in Mendocino and Sonoma Counties, California.

Historically, the Behren's silverspot butterfly likely occurred as a number of metapopulations at geographically separated localities, each of which was composed of one to several subpopulations interlinked by occasional movement of individuals (Arnold, pers. comm. 2006). Interbreeding between populations within a metapopulation likely helped maintain the genetic diversity necessary for a viable metapopulation (Wells and Richmond 1995; Franklin 1980). Data from closely related species and subspecies that also function as metapopulations provide some insight into the range of population sizes that might be expected for Behren's silverspot, though often show dramatic fluctuation from year to year. The Service's 5-year review of Myrtle's silverspot butterfly (*S. z. myrtleae*) notes that surveys have estimated a total population of approximately 10,000, with up to 5,000 individuals in a single metapopulation (Service 2009a). The Service's 5-year review of the Oregon silverspot butterfly (*S. z. hippolyta*) reports estimated population sizes ranging from 140 to 1334 individuals (Service 2011). Surveys of the Callippe silverspot butterfly (*S. callippe callippe*) indicated metapopulation sizes of 11,000 and 8,000 in 1980 and 1981 respectively, while surveys between 1982 and 2001 using less exhaustive methods yielded results ranging from 216 to 1749 (Service 2009b).

Determining insect population size is difficult because many individuals may be overlooked due to their cryptic coloration, small size, sometimes sparse distribution, and often complicated life cycle. Current survey methodologies provide population indices and trends, rather than absolute counts. Additionally, butterfly and other insect populations are known to fluctuate greatly in size from year to year. Population size has been determined in the Oregon silverspot butterfly as a result knowing the number of individuals introduced at a site though augmentation or reintroduction, and correlation with observed adults on transects (Walker, pers. comm. 2015). A coefficient is developed to compare survey results (an index) with known numbers of individuals, to determine site population size.

Relatively recent observations and surveys indicate that the Behren's silverspot butterfly is extant (*i.e*. known to occur) at Point Arena (J. Ebner, personal observation 1998; Pratt 2004; Arnold 2005). Subsequent to our publication of the draft Recovery Plan in November 2003, a portion of the area inhabited by the Point Arena metapopulation (believed to be largest known metapopulation) was publically acquired, with the BLM being the lead habitat manager. The California Coastal Conservancy, Service, and others, contributed to the acquisition of the Stornetta Ranch (871 acres; 352 hectares). In 2012 and 2013, portions of the Cypress Abbey Ranch (or Atwood Ranch) were purchased for public ownership

and conservation, adding approximately 126 acres (51 hectares) to the Stornetta ranchlands to be managed by the BLM. Although the ranch is publicly owned, other habitat on adjoining private lands are difficult to survey. Private ownership, however, can limit access by collectors affording some protection to a metapopulation. Approval from the landowner is required to access sites on private lands to conduct butterfly or habitat surveys.

Behren's silverspot butterflies were also observed at Manchester State Park in both 2004 and 2005 (Pratt 2004; Arnold 2005). Arnold (2005) speculates that the silverspots observed at Manchester and Point Arena may belong to the same metapopulation due to the availability and proximity of habitat. Other California State Park lands at Salt Point (Sonoma County) were found to have extant populations of silverspots as well. Some of the adults observed at Salt Point State Park appeared to be phenotypically intermediate between *behrensii* and *myrtleae* (Arnold 2005). Similarly, Behren's silverspot butterflies were observed at Stewart's Point during the same period. Although adult butterflies were observed during the 2004 and 2005 flight periods, no transects were established to quantify metapopulation size. The observations, or surveys, were primarily site visits designed to determine presence or absence (Pratt 2004; Arnold 2005).

The status of the Mendocino headlands and south Anchor Bay headlands metapopulations remains uncertain. The Sea Ranch metapopulation is believed to have been extirpated as a result of residential development and fire suppression measures. Surveys are needed to determine the metapopulation's status and confirm observations. The Mendocino headlands and north Salt Point locations appear to contain suitable habitat, on lands managed by State Parks. No Behren's silverspot butterflies were observed at the Mendocino Headlands during surveys in 2004 and 2005 (Pratt 2004; Arnold 2005). Additional surveys at the Headlands should be conducted in cooperation with State Parks to determine if the Behren's silverspot butterfly occupies that location. The south Anchor Bay and Stewarts Point locations are on private property; therefore, landowner approval (preferably in writing) is necessary prior to survey initiation. The observations of adult butterflies at Stewart's Point, during surveys in 2004 and 2005, were made from Highway 1.

Suitable habitat exists at other locations including Gualala and Navarro Point (Figure 3). The Mendocino Land Trust owns and manages lands at Navarro Point, just north of the mouth of the Navarro River, Mendocino County. This site may be too small on its own to support a viable butterfly population of Behren's silverspot; however, it could potentially play a role in conjunction with private

lands to the east of Highway 1 (Arnold, pers. comm. 2006). Another potential site includes habitat at Gualala Point Regional Park, Sonoma County. Although this site appears to contain suitable habitat, cursory surveys in 2005 and 2006 indicate that the site lacks a sufficient population of violets to support larval Behren's silverspots (Arnold, pers. comm. 2006). Augmentation of the violet population, along with other management, may make this site suitable habitat for the Behren's silverspot butterfly in the future (Watkins, personal observation 2002).

Although individual butterflies have been observed at Salt Point, Stewarts Point, and in the Point Arena-Manchester area in the past 5-10 years, the size and viability of populations are unknown (Arnold 2006). Regular monitoring, such as along established transects, is required to determine population and range-wide trends. Transects designed to help determine the size and viability of the populations and population trends were established in the Point Arena area on Stornetta Public Lands and Manchester State Park in 2006, and at Salt Point in 2010, as a result of cooperative efforts from staff at State Parks, BLM, and the Arcata Fish and Wildlife Office (i.e., Service). In total, there have been 1.8 miles (2.95 kilometers) of 33-yard (30-meter) -wide fixed width transects established near Point Arena on Stornetta Public Lands and Manchester State Park, and 1.2 miles (1.95 kilometers) of similar transects established in Salt Point State Park. These have been surveyed annually since being established in 2006 and 2010, using a survey protocol adapted from a standardized method (Pollard and Yates 1993) that has been used for monitoring Oregon silverspot butterfly populations since 1990 (Pickering et al. 1992). The protocol (Appendix C) calls for weekly surveys of all transects throughout the Behren's flight season, conducted under weather conditions favorable to butterfly flight and related observation. Low numbers of butterflies were observed during surveys, bringing into question the long-term viability of these locations. The following tables provide number of individuals observed from Point Arena and Salt Point transects.

Table 1. Number of Behren's silverspot butterflies observed on Point Arena transects, Mendocino County, California.

Survey Year	Butterflies Observed
2007	1
2008	0
2009	0
2010	0
2011	2
2012	0
2013	Not Surveyed
2014	0

Table 2. Number of Behren's silverspot butterflies observed at Salt Point transects, Sonoma County, California.

Survey Year	Butterflies Observed
2010	2
2011	3
2012	0

Protocol surveys (Appendix C) provide an index that is used to determine population trend at a specific site (*i.e.*, metapopulation trend). The surveys, or transects, are a sample, and do not represent an absolute number of individuals present or provide an indication of reproductive success. Together, the combined metapopulation trends can be used to give a rough estimate of the range-wide population trend for the species. In order to determine a trend, several years of data need to be in place for comparison. To date, there are not enough data to provide metapopulation or range-wide population trends. However, based on the low number of butterflies observed during the limited surveys conducted, we are confident stating that the overall abundance of the Behren's silverspot butterfly is low (refer to Appendix D below and the 2012 Status Review).

Figure 4. Early blue Violet (*Viola adunca*). Photo: Service

From 2010 to 2011, presence surveys for the species (different from protocol surveys) were conducted on previously unsurveyed sites on private lands between extreme northern Sonoma County (Sea Ranch) and the Point Arena area (Mendocino County), in areas where aerial imagery indicated the potential presence of suitable habitat. Twelve properties were visited from one to four times; a single Behren's silverspot was observed during these surveys, on a private parcel about 1 mile (1.6 kilometers) south of the City of Point Arena (Liebenberg 2011).

F. LIFE CYCLE, HABITAT REQUIREMENTS, AND LIMITING FACTORS

1. Life Cycle and Population Dynamics

No specific information is available regarding ovipositing (egg laying) in Behren's silverspot butterflies; however, studies conducted on the Oregon silverspot butterfly (McCorkle 1980; McCorkle and Hammond 1988) found that females lay their eggs in the debris and dried stems of the larval food plant, the early blue violet (*Viola adunca*) (Figure 4). Other violets (*Viola* spp.) are likely used as well (McCorkle 1980; McCorkle and Hammond 1988).

The Behren's, like the Oregon and Myrtle's silverspot butterflies, have a total of six larval instar stages (*i.e.*, stages of caterpillar development). Upon hatching, the first-instar caterpillars eat the lining of the eggshell, prior to their pre-diapause (*i.e.*, physical dormancy) movement. The caterpillars wander a short distance and spin a silk pad upon which they pass the fall and winter (*i.e.*, diapause) (McIver *et al*. 1991).

The caterpillars (*i.e.* larvae) are dark-colored with many branching, sharp spines on their backs. The caterpillars immediately seek out the food plant upon termination of their diapause in the spring. The caterpillars then pass through five additional instars before forming a pupa within a chamber of leaves that they draw together with silk. The adults emerge in about 3 weeks and live for approximately 3 weeks. Depending upon environmental conditions, the flight period of this single-brooded butterfly ranges from early-July possibly to October. Adult males patrol open areas in search of newly emerged females (Launer *et al*. 1992).

Because of the close taxonomic relationship and similarities in habitat requirements, the Behren's silverspot butterfly's life cycle is likely the same as or very similar to that of the Oregon silverspot butterfly. Noted exceptions are that the peak of the flight period for the Behren's silverspot butterfly is generally earlier in the year (mid to late summer) than it is for the Oregon silverspot butterfly (late summer to early fall); and, although slow, caterpillar development appears to be faster in the Behren's silverspot butterfly. Both the earlier flight period and increased caterpillar development rate in the Behren's silverspot butterfly may be a response to generally warmer temperatures at southerly latitudes (R. Arnold, pers. comm.). As the climate generally gets warmer, the Behren's life cycle may adjust, with egg and caterpillar development being shorter, and the adult flight period being earlier. Depending on the type of climate change and its degree, there is a potential for the effects of climate change to hasten population decreases (McLaughlin *et al*. 2002).

Behren's silverspot butterfly flight behavior is moderately erratic and swift in windy places, 0.6 to 1.8 meters (2 to 6 feet) above ground surface. During calm periods, flight is sometimes gentle and relaxed, especially when fog is present (Ebner, personal observation 1998). Males appear to stay within several hundred feet of places where females occur. Flights usually occur by late morning when temperatures are above 16 degrees Celsius (60 degrees Fahrenheit), with males becoming skittish at 21 to 27 degrees Celsius (70 to 80 degrees Fahrenheit). Newly emerged males pause much less frequently than older males and females, and seem to remain on the wing for longer periods of time (Ebner, personal observation 1998). Newly emerged males can be difficult to approach. Adults may feed on nectar for as long as 5 minutes, returning to the same plant repeatedly. Behren's silverspot butterflies may rest on bare ground, in grasses, or on ferns (bracken) and other foliage. They almost always extend their wings during periods of rest, but may close them tightly after feeding and when basking (Ebner, personal observation 1998).

2. Habitat Requirements

The Behren's silverspot butterfly inhabits coastal terrace prairie habitat west of the Coast Range in southern Mendocino and northern Sonoma Counties, California. Because the closely related and distributed Myrtle's silverspot butterfly uses coastal sand dune habitats, it is likely that the Behren's silverspot butterfly uses these habitats as well, provided that the key habitat components are present. These habitats are strongly influenced by proximity to the ocean, with mild temperatures, moderate to high rainfall, and persistent fog. An occupied or potential site must have two key resources: (1) larval host plants, and (2) adult nectar sources. Distribution of the Behren's silverspot butterfly is highly dependent on these resources. Vegetation that provides sheltering habitat can also be important, particularly if the sheltering habitat is proximate to violets and nectar sources. Depending on the pattern of a site's vegetation mosaic, a location may have a single butterfly population or several subpopulations that comprise a metapopulation.

Holland (1986) described coastal terrace prairie as a dense, tall grassland (to 1 meter [3.3 feet] tall), dominated by both sod and tussock-forming perennial grasses. Most stands are quite patchy and variable in composition, reflecting local differences in available soil moisture capacity. Soils are sandy loams on marine terraces near the coast below 215 to 305 meters (700 to 1,000 feet) elevation, within the zone of coastal fog incursion. Sawyer and Keeler-Wolf (1995) listed plant species associated with coastal terrace prairie as follows: alta fescue (*Festuca arundinacea*), blackberry (*Rubus vitifolius*), bracken fern (*Pteridium aquilinum*), coast mugwort (*Artemisia suksdorfii*), coyote brush (*Baccharis pilularis*), red alder (*Alnus rubra*), salal (*Gaultheria shallon*), tufted hairgrass (*Deschampsia cespitosa*), and yellow bush lupine (*Lupinus arboreus*). Within the coastal terrace prairie, suitable habitat for the Behren's silverspot butterfly needs to contain violets (*Viola* spp.), as they are the butterfly's larval host plant. In addition, nectar sources, such as yellow bush lupine, need to be available to foraging adults during the July to September flight period. Thistles (*Cirsium* sp.) may be an important nectar source for Behren's silverspot butterflies as they were observed being used by Behren's silverspots at the extant Point Arena location (Ebner, personal observation 1998). Violets, the larval host plant, were observed in isolated patches at the Stornetta Public Lands location (Sander 2004), possibly a result of soil moisture and cattle grazing (Watkins, personal observation 2002). Therefore, the Point Arena metapopulation appears to have the necessary habitat features to support a viable population of Behren's silverspot butterflies.

Coastal sand dune systems in California have been greatly modified by anthropogenic development including buildings, roads, and other infrastructure; reduction in beach deposited sediments; and the introduction of invasive non-native vegetation. The dune system at the southern end of Manchester State Park, Mendocino County, is one of the dune systems most likely to support Behren's silverspot butterflies as the dunes have become somewhat stabilized. The dynamic nature of the Manchester system has been modified by European beachgrass (*Ammophila arenaria*) to the point where the stabilized dunes now support coyote brush (*Baccharis pilularis*) and a blue-flowering form of *Lupinus arboreus*. Remnant dune mat communities that likely support the Behren's larval host plant, early blue violet, still exist within the system at a couple of locations (Pickart and Sawyer 1998; Sander 2004). These features provide habitat preferred by Behren's silverspot butterflies.

Critical habitat has not been designated for the Behren's silverspot butterfly out of concern that collectors of rare butterflies would look to designated areas to illegally collect specimens. Unregulated collection could adversely impact a site's butterfly population.

3. Threats and Limiting Factors

The 1997 listing of the Behren's silverspot butterfly states that it is imperiled by overcollection, urban development, alien plant invasion and competition, and excessive livestock grazing (Service 1997, 62 FR 64306).

The following analysis describes and evaluates the threats to the Behren's silverspot butterfly attributable to one or more of the five listing factors outlined in section 4(a)(1) of the Endangered Species Act of 1973, as amended. The five factors include: (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; and (E) other natural or manmade factors affecting the its continued existence.

Factor A: The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range

Succession

Three factors likely affect rates of succession of coastal terrace prairie habitat: soil conditions, salt spray and mist from breaking waves and onshore winds, and

disturbance regimes. Without these limiting factors, succession is rapid under favorable growing conditions at coastal terrace prairie habitats.

Disturbance regimes have changed dramatically over the last century. To some degree landslides; burrowing by small mammals; and herbivory by invertebrates, small mammals, and large native ungulates likely played a role in creating or maintaining open conditions. Fire, likely set by indigenous peoples, was an important factor that maintained coastal terrace prairie habitat. The timing and frequency of the historical fire regime is not well understood for the Mendocino and Sonoma coasts of California. Most fires probably occurred in late summer and early fall, although some may have occurred in January or February during dry periods. Fire can dictate plant species composition and influence their distribution. In addition, fire can make host violets accessible to butterflies by removing the buildup of thatch, comprised of dead vegetation. Ash, a result of fires, is an important nutrient and soil component. Fire also has the potential to kill butterfly eggs and caterpillars (*i.e*. larvae), potentially affecting population numbers.

Exotic Vegetation

Loss of major disturbance patterns has accelerated succession at historical and potential Behren's silverspot butterfly sites (Figure 5). A number of plants increase under lower disturbance levels, including shrubs such as coyote brush and yellow bush lupine, trees like red alder and shore pine (*Pinus contorta*), and ferns, such as bracken and sword fern (*Polystichum munitum*). Lack of historical disturbance regimes has probably accelerated expansion of several non-native plant species that are a threat to Behren's silverspot butterfly populations, in addition to facilitating encroachment of native shrubs and trees.

Figure 5. Shore Pine (*Pinus contorta*) invading Behren's silverspot butterfly habitat.

The BLM and California Department of Parks and Recreation have both used agency funds and contributed monies provided by the Service from 2007 to 2010 to remove non-native trees at the Stornetta Public Lands and Manchester State Beach, respectively. Both of these agencies manage habitat for the Behren's silverspot butterfly's Point Arena metapopulation.

The spread of non-native plants has likely reduced, degraded, or eliminated habitat for the Behren's silverspot butterfly at several sites by making larval host plants and nectar sources difficult to access. Tall shrubs and grasses impede an individual butterfly's ability to find and utilize low-laying violets for egg-laying. Similarly, nectar sources can be difficult to reach as well. Scotch, or Scots, broom (*Cytisus scoparius*) is one of the most visible non-native shrubs due to its showy yellow flowers. Another dominant non-native invader of coastal terrace prairies that has reduced, degraded, or eliminated habitat for the Behren's silverspot butterfly, is the Himalayan blackberry (*Rubus discolor*). The Himalayan blackberry forms dense thickets that dominate coastal prairie habitat by choking out other native plants used by silverspot butterflies. Introduced grasses represent one of the most imminent threats to habitat maintenance. Non-native grasses include heath grass (*Danthonia decumbens* [*Sieglingia decumbens*]), bent grass (*Agrostis alba*), velvet grass (*Holcus lanatus*), orchard grass (*Dactylis glomerata*), tall fescue (*Festuca arundinacea*), reed canary grass (*Phalaris arundinacea*), and European beach grass (*Ammophila arenaria*). These grasses produce particularly tall or dense stands which eliminate native plants (Hammond 1994), including violets. Effects of vegetation management techniques on non-native grasses and other competitive species should be monitored carefully to detect negative impacts to early blue violets and native nectar sources. Management should be adjusted accordingly.

Researchers have found that abundance of early blue violets and levels of Oregon silverspot butterfly oviposition (*i.e.*, egg deposition) activity are inversely correlated with vegetation height and thatch depth (Singleton 1989; McIver *et al*. 1991; Pickering *et al*. 1992). The relationship between butterfly oviposition and vegetation height and thatch depth is likely similar for the Behren's silverspot butterfly, although that remains to be confirmed. Tall grasses and deep thatch depth prevent the Behren's silverspot butterfly from accessing violets, which are a necessary component to larval (caterpillar) development. Failure to access early blue violets prevents female butterflies from successfully ovipositing their eggs.

Early blue violets can persist in a suppressed vegetative form or in the seed bank under other vegetation for many years. Removal of shrubs and trees has released

Figure 6. Cattle grazing in Behren's silverspot butterfly habitat.

dormant early blue violets that subsequently have initiated vigorous growth (Hammond 1986). It is important to note, however, that in the years subsequent to removal of woody overstory, some sites were invaded by perennial, non-native grasses that have suppressed violets. Effective techniques for long-term grass removal are currently unknown. In addition, persistence of violets in the seed bank or in a vegetative form in a perennial, non-native grass-dominated system has never been demonstrated; therefore, it is unknown if violets would respond vigorously to removal of grass (Pickering, personal communication 2001).

Livestock Grazing

Grazing by domestic animals, primarily cattle and sheep, replaced fire as the major disturbance agent at many of the historic and potential butterfly sites (Figure 6). Grazing reduces grass density and thatch depth through consumption of vegetation and trampling, whereas fire performed a similar function in the past prior to suppression being the primary fire management strategy. Fire reduced vegetation and debris buildup by periodic burning, preventing succession, and the encroachment of woody vegetation. Fire and grazing have different effects on vegetation composition and function, although both reduce thatch depth and maintain the open character of the prairie. While poor grazing management can denude vegetation and reduce habitat quality, light to moderate grazing can result in reduction of invasive woody plants and maintain early successional grassland habitats conducive to Behren's silverspot butterfly use. In addition, it is conceivable that the use of livestock in an area where Behren's silverspot butterfly larvae are densely populated could result in the trampling of larvae and host plants.

Grazing of host plants and trampling could be a significant source of butterfly mortality for Behren's silverspot butterfly. Potentially, grazing could result in eggs and larvae being incidentally consumed by livestock along with violets. However, if grazing is moderate to light and conducted with managed timing and

frequency, the reduction of thatch and aeration of soils could have a beneficial effect on Behren's silverspot butterfly habitat by reducing or reversing the effects of succession. Aeration of soils avoids compaction, thus improving conditions for violets. A 5-year study of the effects of grazing on key habitat resources was initiated in 2008 on the Stornetta Public Lands. Results of the study were inconclusive; some inferences could be made, although the statistical power of the data is not significant (RT Navratil 2014).

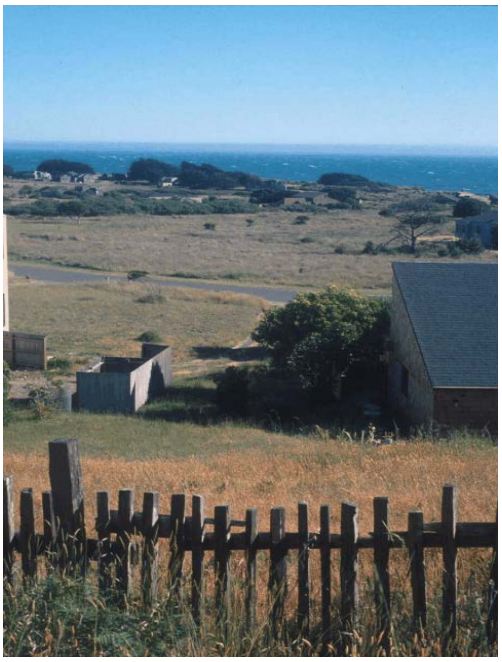

Figure 7. Residential development in Behren's silverspot butterfly habitat.

Development

Agricultural, residential, and commercial development (Figure 7) have removed or degraded habitat for the Behren's silverspot butterfly. For example, coastal terrace prairie has been converted to agricultural uses, especially row crops. The Sea Ranch residential community in Sonoma County likely resulted in the degradation and loss of Behren's silverspot butterfly habitat, and the construction of U.S. Highway 1 along the coast has affected ecosystem processes on coastal terrace prairies by traversing watercourses, stabilizing soils at some locations, creating cuts at others, and providing public access. In addition, fire suppression associated with settlement of the region has greatly increased the rate of succession. As a result, native coastal terrace prairie habitats have been altered, changing vegetation communities from those preferred by the Behren's silverspot butterfly to plant assemblages that are less suitable.

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

Butterfly Collecting

For a number of butterfly species that exist in small colonies, collection or repeated handling and marking (particularly of females and in years of low abundance), can seriously affect populations through loss of individuals and loss

of genetic variability (Gall 1984; Murphy 1988; Singer and Wedlake 1981). Collection of females dispersing from a colony also can reduce the probability that new populations will be established. Butterfly collectors pose a threat because they may be unable to recognize when they are depleting populations below thresholds of survival or recovery, especially when they lack appropriate biological training or the area is visited for a short period of time (Collins and Morris 1985).

Although collectors generally do not adversely affect healthy, well-dispersed populations of many butterfly species, a number of rare species, such as those that are highly valued by collectors, are vulnerable to extirpation or extinction from collecting. Species with small populations at only a few sites may be adversely affected by the cumulative effort of removal of only one or very few individuals from a site by a few collectors. We believe this is the case for the Behren's silverspot butterfly. Collectors who take every specimen they can find on successive days could easily eliminate populations of some species in just a few years. Several butterfly species have been listed due to imperilment by collectors. Due to a concern that collectors could impact the Behren's silverspot butterfly's population, the decision was made not to designate critical habitat in fear that the designation would lead collectors to the butterflies.

Factor C: Disease or Predation

Disease and Parasitoids (parasites on butterflies)

Disease could be a threat that has not yet been identified for the Behren's silverspot butterfly. *Wolbachia*, an intercellular bacteria, has been detected in other butterfly species which can potentially affect the health of small populations of butterflies (Telschow, *et al*. 2005; Kodandaramaiah, 2011). Although not detected in the genus *Speyeria*, *Wolbachia* bacteria have been identified in other species of butterflies in the family Nymphalidae.

Similarly, parasitoids or parasites are a possible threat that could depress or deplete metapopulation numbers by killing caterpillars. For example, some wasp and fly larvae feed on butterfly caterpillars and can affect local butterfly populations. However, no parasitoids or parasites are known to affect the Behren's silverspot butterfly, although no studies have been conducted to determine if this is the case.

Predation has been observed on the Oregon silverspot butterfly (Walker, pers. comm. 2014). A white-crowned sparrow (*Zonotrichia albicollis*) consumed most

of the adult butterflies when it entered an enclosure containing Oregon silverspot butterflies being released at a restored habitat site near Agate Meadow. Although predation by sparrows may occur in nature, it has not been reported. Spiders have been observed capturing Oregon silverspot butterflies at Mt. Hebo, Oregon (Walker, pers. comm. 2014); however, their predation is not believed to be a significant threat to butterfly populations.

Factor D: Inadequacy of Existing Regulatory Mechanisms

Existing Regulations

There has been no change in the imminence of this threat factor since the time of listing. The original listing rule (62 FR 64306) did not address regulatory mechanisms. The California Environmental Quality Act (CEQA) (chapter 2, section 21050 *et seq.* of the California Public Resources Code) affords limited protection for the species under State law, due to its status as a federally endangered species. The California Coastal Act of 1976 (Division 20, section 30000 *et seq*.) applies when habitat is located in the coastal zone. Projects within the coastal zone are reviewed by either the California Coastal Commission or local government by virtue of their Local Coastal Plan, when a project occurs within their jurisdiction. Commission review or compliance with approved Coastal Plans ensures that protective provisions of the Coastal Zone Management Act are considered when impacts to coastal resources, such as the butterfly, may be affected by project implementation. However, the Coastal Zone Management and the California Coastal Acts do not address the injury or death of butterflies and only reduce loss or degradation of habitat. These Acts do not necessarily prevent a net loss of habitat or loss of individual butterflies.

The BLM now manages the Stornetta Ranch (a large portion of the site known as the Point Arena metapopulation) under an interim plan that allows for resource conservation, limited recreational access (primarily hiking and equestrian), and cattle grazing. Continued cattle grazing was conditioned as part of the ranch's acquisition (BLM 2006). BLM's management is subject to section 7 review under the Endangered Species Act, and public review under the National Environmental Policy Act. Butterflies and habitat on non-Federal lands are subject to provisions in section 10 of the Endangered Species Act, and the California Environmental Quality Act (State law).

Factor E: Other Natural or Manmade Factors Affecting its Continued Existence

Vehicle Strikes

The original listing rule (Service 1997, 62 FR 64306) did not address other natural or manmade factors. Collision with vehicles (road-kill) is identified as a threat for the closely related Oregon silverspot butterfly (Service 2001). The magnitude of road-kill as a threat to the Behrens' silverspot is not documented, but road-kill is a potential threat due to the proximity of occupied habitat to Highway 1 and other well-traveled public roads. We believe that any such threat has likely increased since the time of listing, due to increased development and traffic within the historical range. However, we do not have direct evidence either supporting or disproving this supposition.

Climate Change

The potential effects of climate change are not well known. Changes in climate may cause the migration of multiple subspecies of *Speyeria* butterflies to alter their distribution as they seek to adjust to changes in temperature, moisture, storm frequency, and habitat changes that result from climate change, thereby increasing their likelihood to overlap. The resulting overlap may result in interbreeding that dilutes the genetic uniqueness of each of the subspecies. Under this scenario, the varying subspecies of silverspot butterflies could become a single species with little genetic variation. As the climate generally gets warmer, the Behren's life cycle may adjust, with egg and caterpillar development being shorter, and the adult flight period being earlier. Depending on the type of climate change and its degree, there is a potential for the effects of climate change to hasten population decreases (McLaughlin *et al*. 2002).

Climate change may also result in changes to the preferred habitat of the Behren's silverspot butterfly (Johnstone and Dawson 2010). Soil depth and texture limits vegetation growth, phenology, and succession. Sandy or thin rocky soils that do not hold moisture may preclude the establishment of violets and nectar sources, or may result in violet senescence (*i.e*., aging and death) in drier years. Conversely, clay soils may cause puddling in wet years, resulting in flooding of violets and associated larvae. The effects of short-term inundation on violets and caterpillars have not been studied. Storm intensity and frequency, erosion, flooding, and drought may all impact soils and the plants they support.

Under some models, sea-level rise is expected to increase up to 4 feet over the next century (IPCC 2007). An increase in sea level, storm frequency, and intensity, can result in erosion of coastal terrace and sand dune habitats, reducing the amount of habitat available to the butterfly. In addition, vegetation composition could change depending on rainfall and temperature trends. Changes in vegetation may favor invasive species that tend to have a better ability to adapt to changing conditions than endemic, or site-specific species. Furthermore, we anticipate that an increase in wind, particularly during the flight period, may affect the ability for Behren's silverspot butterflies to oviposit. In summary, climate change has the potential to affect butterfly habitat, food sources, distribution, genetics, and survivorship. However, it should be noted that supporting data are lacking, and this is our best estimate based on climate change models.

G. CONSERVATION AND MANAGEMENT

The Service has responsibilities under the Endangered Species Act for listing, recovery, grants to the States, and consultation with Federal agencies. Section 7(a)(1) of the Endangered Species Act requires that all Federal agencies use their authorities to further the purpose of the Endangered Species Act by carrying out programs for the conservation of listed species. Section 7(a)(2) of the Endangered Species Act requires Federal agencies to consult with us if their actions may affect listed species or critical habitat.

The Service has worked cooperatively with Federal and State resource agencies, local governments, and private landowners to conserve Behren's silverspot butterflies. Lands have been acquired with the assistance of Service funds for public use and species conservation within the Point Arena metapopulation, likely the Behren's silverspot butterfly's most significant location. In addition, the Service has worked to establish transects at Point Arena to determine metapopulation trends. The BLM is the principle land manager of the acquired lands, known as the Stornetta Public Lands. Nearby lands at Manchester State Park are also protected for conservation and public recreational use.

The Service and California Department of Parks and Recreation have been working cooperatively to monitor butterflies on State Park lands at Point Arena and Salt Point. Similarly, the BLM has conducted surveys on the Stornetta Public Lands with assistance from the California Department of Parks and Recreation and the Service.

The BLM has consulted under Section 7(a)(1) with the Service on management actions within the Stornetta Ranch Public Lands. Areas have been set aside for management of sensitive species, including the Behren's silverspot butterfly, and research is being conducted on the effects of grazing on the butterfly's host plant. In addition, BLM and Service funding has provided BLM with the ability to reduce adverse effects of shore pine encroachment into butterfly habitat. Approximately 210 acres of pines have been removed and thinned between 2007 and 2010, in a manner that both agencies believe will benefit the Behren's silverspot butterfly. Some disagreement exists regarding the extent of pine removal needed. Some suggest that pines can provide shelter from wind, thereby benefiting butterflies during the flight stage. Others believe pines will overtake open coastal prairie habitat, leading to succession, habitat degradation, and ultimately habitat loss. Some pine removal and thinning is seen as a compromise, complimenting both strategies. Monitoring of vegetation and butterflies will assist in future decisions regarding shore pine management.

The Service can enter into cooperative agreements with State resource agencies that have jurisdiction for invertebrates, or their habitat, within the range of the Behren's silverspot butterfly. The Service entered into a cooperative agreement with the California Department of Fish and Wildlife on March 16, 2015. Cooperative agreements allow State resource agencies to develop conservation programs for species and apply for Federal funds through section 6 of the Endangered Species Act. Research projects, surveys, and recovery actions for the species can be cooperatively funded as part of the section 6 program of grants to the States. The Service has provided funds to the State through the Section 6 grants program for the purchase of additional lands in the Point Arena area, butterfly monitoring, and for cooperative management with private landowners. The Act's Section 6 program is a competitive process, and grant funding for the butterfly has been sporadic.

In addition, the Service enforces the prohibitions against take under section 9 of the Endangered Species Act. "Take" of any endangered or threatened animal is prohibited without such a permit. The term "take" is defined in section 3 of the Endangered Species Act, and includes to harass, harm, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. "Harm" in the definition of "take" in the Endangered Species Act means an act that actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns including breeding, feeding, or sheltering (50 CFR 17.3). Pursuant to section 10 of the Endangered Species Act, we also issue

permits for take otherwise prohibited by section 9 for scientific purposes, to enhance propagation, and for taking that is incidental to, and not the purpose of, carrying out an otherwise lawful activity.

Habitat Conservation Plans have been developed as an option to administer the Endangered Species Act in a more proactive and effective fashion for private landowners. If a project proposed by a private landowner is likely to result in take of Behren's silverspot butterflies, a permit authorizing the incidental take of the species is needed before the project can proceed. An incidental take permit under section 10(a)(1)(B) of the Endangered Species Act provides long-term assurances to landowners that their activities will be in compliance with the requirements of the Endangered Species Act. To qualify for the permit, a Habitat Conservation Plan must be prepared that shows how the impacts of take on the listed species will be minimized, what alternatives to take were considered, how the impacts on the species will be mitigated, and how implementation of the program will be funded and enforced. Congress intended the habitat conservation planning process, at its best, to integrate non-Federal development and land use activities with conservation goals, resolve conflicts between endangered species protection and economic activities on non-Federal lands, and create a climate of partnership and cooperation. While no Habitat Conservation Plans have been developed for the Behren's silverspot butterfly, the partnership with California State Parks has been beneficial toward management of State Park lands and collecting habitat and butterfly data on other non-Federal lands.

Another option for private landowners is the Safe Harbor program. We issued our final policy on Safe Harbor Agreements on June 17, 1999 (64 FR 32705). Safe Harbor Agreements provide incentives and reduce disincentives to private landowners to foster the recovery of listed species. The Safe Harbor program provides assurances to landowners that the use of their property will not be subject to additional restrictions under the Endangered Species Act. There are currently no Safe Harbor Agreements in place for the Behren's silverspot butterfly.

II. Recovery

A. RECOVERY STRATEGY

The primary reason for listing the Behren's silverspot butterfly was the loss and degradation of habitat from human activities, including overgrazing and residential, commercial, and agricultural development (62 FR 64306). To address these threats, it is necessary to protect currently occupied and suitable habitat from development and to manage the protected land appropriately to maintain habitat quality. Because the population is currently small and geographically restricted, it is vulnerable to loss of genetic diversity, catastrophic environmental events, and random fluctuations in demographic parameters. Expansion of the existing metapopulation and reestablishment of populations on unoccupied habitat will be necessary to protect against these threats; to this end, captive propagation and reintroduction should be assessed.

Protection of Habitat

The highest priority will be to protect habitat to maintain the existing metapopulations at Point Arena/Manchester, Salt Point, and Steward's Point. Additionally, locating other occupied sites and identifying suitable habitat for the Behren's silverspot butterfly, should reintroduction prove to be warranted, are essential measures to ensure the long-term viability of the subspecies.

Habitat Management

Management of protected habitats is necessary to address continuing and persistent threats. Management should be planned on a site-specific basis with consideration given to enhancing specific habitat attributes and removing the specific threats to those habitats.

Augmentation

Augmentation is an attempt to increase the size of a metapopulation by collecting female butterflies from a site, allowing them to oviposit in captivity, rearing the larvae in captivity, and returning larvae or pupae back into the wild at the site from which the females were taken. The objective of augmentation is to keep a metapopulation from becoming nonviable or becoming extirpated. Augmentation should be implemented to bolster small existing populations before they become so low that they are at risk of extirpation.

Reintroduction

Reintroduction is similar to augmentation, but is an attempt to establish a metapopulation at a site that is *not* currently occupied. Female butterflies would be collected from an existing population, preferably at a site in close proximity to the proposed reintroduction site, and allowed to oviposit in captivity. The larvae would be reared in captivity, and larvae or pupae would be returned back into the wild at the new, protected site.

Note that for both augmentation and reintroduction, the presence of *Wolbachia* sp. bacteria should be determined in advance, as *Wolbachia* sp. may influence butterfly survivorship. Consequently, for a small population or metapopulation, *Wolbachia* sp. may cause a significant decline where the population may not be able to bounce back (Hamm, et al. 2014).

B. RECOVERY GOAL AND OBJECTIVES

This recovery plan is intended to guide willing managers to minimize the threats to the Behren's silverspot butterfly and the habitats upon which it depends. The goal is to recover the subspecies to the point where it can be downlisted and ultimately delisted. In part, this can be accomplished by ensuring the number of individuals in a metapopulation is sustainable, and that the butterfly's distribution represents its former range.

Recovery Goal: Recover the Behren's silverspot butterfly to the point where it can be downlisted and ultimately delisted. Meeting specified Recovery Criteria will provide for a self-sustaining population in the wild and will result in downlisting the butterfly to threatened and its ultimate recovery and delisting.

Recovery Objectives: To meet the recovery goal, the objectives in this recovery plan are to recover the Behren's silverspot butterfly sufficiently to allow delisting in 20 to 30 years by managing non-native plants, protecting and enhancing habitat, and establishing additional occurrences.

To meet the recovery goal, the following recovery objectives have been identified:

1. Secure self-sustaining wild metapopulations throughout the historic range of the subspecies.
2. Determine metapopulation and range-wide population numbers, and monitor them to determine long-term trends.

3. Reduce and eliminate threats, to the extent possible.
4. Protect, conserve, and restore healthy butterfly ecosystems and their function.

C. RECOVERY CRITERIA

Although knowledge of the current range-wide distribution and status of the butterfly's historic metapopulations is limited with respect to their short- and long-term survival, criteria for downlisting and delisting are established based on the best available information. These criteria will be revised and quantified as additional information is obtained from monitoring. The recovery criteria presented in this plan are comparable to criteria developed previously for the closely related Myrtle's and Oregon silverspot butterflies. Recovery criteria should include criteria that are threat-based. The recovery criteria for Behren's silverspot butterfly are outlined by threat factor in Appendix B.

1. Downlisting Criteria for Behren's Silverspot Butterfly

The Behren's silverspot butterfly can be reclassified to threatened status when:

(a) Three metapopulations in Mendocino County and one metapopulation in Sonoma County occupy (currently known, discovered, or reintroduced) sites that reflect historical distribution (four metapopulations represents the historical distribution).
(b) All four metapopulations are protected and managed in perpetuity.
(c) Adequate funding for management of all four sites is assured and Service-approved adaptive management plans that control threats to the habitat such as succession, exotic vegetation and livestock grazing, have been developed and are being implemented.
(d) Annual monitoring has shown that the range-wide population cumulatively supports a minimum of 4,000 adults for at least 10 consecutive years, with no individual protected metapopulation having fewer than 1,000 adults in any year (see Appendix A). This figure is consistent with metapopulation sizes in closely related taxa, but may be revised as more species-specific information becomes available. Each metapopulation needs to reflect an increasing population trend over the 10-year period.

2. Delisting Criteria for the Behren's Silverspot Butterfly

Delisting the Behren's silverspot butterfly can be considered when all of the following conditions have been met after downlisting:

(a) Metapopulations occupy six protected locations: two in Sonoma County and four in Mendocino County.
(b) The six protected metapopulations are protected and managed in perpetuity for the Behren's silverspot butterfly and threats are sufficiently controlled or ameliorated through the active implementation of management plans.
(c) Each of the six protected metapopulations supports a minimum viable population of 1,000 butterflies for at least 10 years (*i.e.* 6,000 butterflies across the range)(see Appendix A). This figure is consistent with metapopulation sizes in closely related taxa, but may be revised as more species-specific information becomes available. Each metapopulation needs to reflect an increasing population trend over the 10-year period.

D. RECOVERY ACTION NARRATIVE

Recovery actions for the Behren's silverspot butterfly are outlined below in step-down format. Recovery actions are linked with threats and recovery criteria in Appendix B.

1. Protect Habitat for the Behren's Silverspot Butterfly

Habitat for the Behren's silverspot butterfly should be secured and managed to benefit the species throughout its historical range.

1.1. Protect the Point Arena Metapopulation

The Stornetta Ranch and adjacent Cypress Abbey Ranch, both part of the Point Arena metapopulation, have been purchased by conservation organizations with help from State and Federal agencies. Both properties are being managed by the BLM. Additional habitat in the Point Arena area remains on adjacent private lands. Purchase of suitable habitat from willing sellers, and development of conservation easements and management agreements are tools that can be used to secure habitat for the butterfly. As noted above, more of Point Arena is likely to be acquired in the near future for conservation of butterflies and other rare and sensitive species. Management actions are expected to be compatible with species conservation.

1.1.1. Develop a Habitat Conservation Strategy for the Point Arena and Salt Point Metapopulations.

Suitable habitat in the Point Arena and Manchester areas likely exists on more than one ownership. Consequently, a habitat conservation area needs to be designed to protect occupied habitat through acquisition from willing sellers, the development of conservation easements, and management agreements. Lands important to the Point Arena metapopulation should be identified based on occupied and potential Behren's silverspot butterfly habitat, and habitat needs should be identified through research and site-specific observations. The metapopulation includes the Stornetta Public Lands and lands within Manchester State Park. Other lands are likely part of the metapopulation as well.

1.1.2. Determine Willingness of Landowners in Point Arena and Salt Point Metapopulations to Participate in Recovery of the Behren's Silverspot Butterfly.

Opportunities for recovery on private land should be investigated on a willing landowner basis. Landowners should be informed of the opportunities that exist under Safe Harbor Agreements and Habitat Conservation Plans. Funding should be sought to assist with recovery implementation on private lands. Funding sources include, but are not limited to: Endangered Species Landowner Incentive Program, Partners for Fish and Wildlife, Safe Harbor Agreement funding, section 6 of the Act, the Natural Resource Conservation Service's Wildlife Habitat Improvement Project funds, and weed management programs. The California Department of Parks and Recreation should be a lead State agency working with California Department of Fish and Wildlife to seek funding from section 6 of the Act, and other sources.

1.1.3. Map Habitat Areas for the Point Arena and Salt Point Metapopulations.

Occupied and potential habitat in the Point Arena area needs to be mapped on U.S. Geological Survey topographic maps and in a geographic information system database. These map sources should be updated as new information is acquired, and reviewed every 3-5 years until the habitat is stabilized through an implemented

management commitment. Permission is required to access private lands for the purposes of surveying habitat and the metapopulation. The BLM has initiated habitat mapping on lands managed by their agency.

1.1.4. Protect Habitat for the Point Arena and Salt Point Metapopulations.

Lands identified in Tasks 1.1.1 - 1.1.3 above should be protected through acquisition from willing sellers, the development of conservation easements, and management agreements. The California Coastal Conservancy has been a key partner agency. Service funds are available through the Coastal Wetland Grant funds and section 6 of the Act.

Management agreements should state each entity's commitment and role in the recovery of the Behren's silverspot butterfly. Signatories to agreements should include all interested land owners, land managing agencies or organizations, and the Service.

The BLM has initiated their planning process for the Stornetta Public Lands in cooperation with State and Federal agencies and will consult on their plan prior to its implementation as required under section 7 of the Act. Additionally, BLM will comply with the National Environmental Policy Act to incorporate public input to their plan.

1.2. Protect Potential Habitat within Historical Range of the Behren's Silverspot Butterfly.

Some potentially suitable sites already exist in public ownership on either State Park lands or those managed by Sonoma County. For example, Manchester and Salt Point State Parks are in public ownership, and Gualala Point Regional Park is managed by Sonoma County. Additionally, the Mendocino Land Trust and Sonoma Land Trust currently hold title to lands that may, upon further inspection, be suitable habitat for the butterfly or become suitable with appropriate restoration and management. Additional lands may be acquired for conservation purposes. Conservation management of potential habitat may allow the Behren's silverspot butterfly to expand to its historical range.

1.2.1. Develop a Strategy for Conservation of Potential Habitat.

Private landowners and land management agencies with potential habitat should be identified, and existing information about habitat quality and former population status should be compiled to help assess which of these sites should have highest priority for further conservation measures.

1.2.2. Determine Willingness of Landowners with Potential Habitat to Participate in Recovery of the Behren's Silverspot Butterfly.

Opportunities for recovery on private land should be investigated on a willing landowner basis. Landowners should be informed of the opportunities that exist under Safe Harbor Agreements and Habitat Conservation Plans. Funding should be sought to assist with recovery implementation on private lands. Funding sources include, but are not limited to: Endangered Species Landowner Incentive Program, Partners for Fish and Wildlife, Safe Harbor Agreement funding, section 6 of the Act, the Natural Resource Conservation Service's Wildlife Habitat Improvement Project funds, and weed management programs. The California Department of Parks and Recreation should be a lead State agency working with the California Department of Fish and Wildlife to seek funding from section 6 of the Act, and other sources.

1.2.3. Survey and Map Habitat Areas with Potential Habitat.

Little is known regarding the amount and distribution of the butterfly's remaining habitat. Suitable habitat consists of breeding, nectaring, and sheltering habitats, and potential dispersal corridors adjoining suitable habitat. Potential habitat should be mapped on aerial photographs and 7.5 minute U.S. Geological Survey topographic maps, including landowner information. Potential habitat areas should be visited to ensure that they contain the necessary habitat components.

1.2.4. Protect Habitats in Areas with Potential Habitat.

Potential habitat (identified in Task 1.2.1) exists on State lands managed by the California Department of Parks and Recreation and at sites managed by Sonoma County Parks. Although habitat may exist on park lands that are protected from development, these lands are not currently being managed for the butterfly. Consequently, efforts must be made to ensure that habitat and its necessary components remain available for the butterfly. Likewise, potential habitat held by land trusts should be treated similarly.

Habitat protection mechanisms may include acquisition of fee title from willing sellers, conservation easements, and/or management agreements over key properties by Federal or State governments or appropriate nonprofit conservation organizations. The appropriate protection mechanism will depend on interests of the landowners and availability of funding. In general and where feasible, breeding habitat should be protected through acquisition and easements. Nectaring habitat and flight corridors may be protected through easements and management agreements.

Management agreements should state each entity's commitment and role in the recovery of the Behren's silverspot butterfly. Signatories to agreements should include all interested land owners, land managing agencies or organizations, and the Service.

1.3. Develop and Implement Management Plans for Habitats Protected at Point Arena and Salt Point, and Areas with Potential Habitat Identified in Tasks 1.1 and 1.2.

1.3.1. Develop Management Plans.

Develop site-specific management plans to address habitat management needs and threats to the habitat or metapopulation. The plan should include identification of threats, management goals for removing threats and addressing population levels, strategies for achieving those goals, funding sources, and a time line. An associated monitoring plan should be developed to

accompany the management plan. Adaptive management should be incorporated to detect significant changes in threats, management, research, or status of the species. Management plans should be reviewed, updated, and revised every 5 to 10 years.

1.3.2. Implement Management Plans.

As new habitats are acquired or otherwise protected through easements and management agreements, and management plans are developed, we should ensure that implementation of individual, site-specific management plans meet range-wide goals that will lead to the butterfly's recovery. We should assist agency and private land owners competing for grant funding through effective cost share programs, and assist whenever possible, with acquiring permits required to implement beneficial actions for the butterfly.

2. Determine Ecological Requirements, Population Constraints, and Management Needs of the Behren's Silverspot Butterfly.

Little is known about the ecological requirements, population constraints, and management needs of the Behren's silverspot butterfly, although much can be learned through cautious comparison with the closely related and better studied Oregon silverspot butterfly (*Speyeria zerene hippolyta*) where it occurs on coastal terrace habitats. Nonetheless, research is needed on the Behren's silverspot butterfly to determine its requirements relative to its environment and distribution. Once the population status of the butterfly is better understood, management measures to reduce threats and improve conditions can be refined or developed, as appropriate.

2.1. Develop an Understanding of the Behren's Silverspot Butterfly Habitat Requirements for the Conservation Planning Process.

2.1.1. Clarify the Extent and Condition of Habitat Areas Necessary to Provide for Breeding, Nectaring, and Shelter by the Behren's Silverspot Butterfly.

Research needs to be initiated to investigate both habitat conditions and butterfly response to habitats. Future needs include identification of habitat areas that support high, medium, and low

densities of adult butterflies and determination of environmental correlates of butterfly distribution and abundance, taking into consideration slope, aspect, soil types, distance from the coast, vegetation composition and structure, and historical management. With this information a managed vegetation community can be proposed to meet ovipositing, nectaring, and sheltering habitat needs of a viable population. Alternative configurations may be feasible.

2.1.2. Ascertain the Distribution and Habitat Requirements of the Early Blue Violet and Nectar Source Plants.

The environmental correlates of habitat suitability for early blue violet need to be determined, including slope, aspect, soil types, soil moisture, distance from coast, vegetational community, successional stage, and historical management. The actual distribution and density of early blue violet needs to be mapped within suitable habitat. Nectar source plants also need to be mapped. Determine the potential effects of climate change on violet distribution, and therefore, the potential distribution of associated Behren's silverspot butterfly.

2.1.3. Identify Dispersal Patterns (distances, directions, habitat requirements) of the Behren's Silverspot Butterfly Needed to Facilitate Migration between Patches.

The length, width, and structural characteristics of potential routes likely to be used by the majority of dispersing individuals need to be determined. This task needs to be completed for both the subpopulation and metapopulation levels. Once the population status of the butterfly is better understood, mark-recapture studies to identify dispersal routes between habitat types, populations, and metapopulations may be used when it is determined the number of individuals is sufficient to support use of that methodology. In the interim, or when the number of individuals is determined to be low, direct observation should be used. The role of prevailing winds in butterfly dispersal should be determined.

Isolation and fragmentation of existing butterfly metapopulations may reduce the ability to further determine natural dispersal patterns of this subspecies. Threats to dispersal should be identified.

2.2. Determine an Understanding of the Factors that Affect Range-wide Population, Metapopulation and Subpopulation Dynamics, and Persistence of the Behren's Silverspot Butterfly for the Purposes of Reserve Management.

The Behren's silverspot butterfly is believed to require low-growing early successional coastal meadow habitat with adequate juxtaposition and abundance of early blue violet, blooming nectar sources during the flight period, and wind protection. Management methods to enhance habitat should be identified and evaluated. Information should be obtained to address the needs of several sensitive plant species that may occur within suitable habitat for the butterfly.

2.2.1. Determine Management Methods for:

2.2.1.1. Controlling Exotic Grasses.

Non-native grasses such as bent grass, European beach grass, heath grass, orchard grass, velvet grass, reed canary grass, and tall fescue commonly invade meadows and crowd out low-growing early blue violet and nectar plants needed by Behren's silverspot butterfly. Managers wishing to control invasive non-native grasses should communicate with those managers that have been attempting to treat similar habitats to benefit the Oregon silverspot butterfly. Additional information can be obtained from the weed management programs in Mendocino and Sonoma Counties.

Effective control techniques for non-native grasses need to be developed and implemented. Effects of control methods on early blue violets and native nectar sources should be determined. More intensive methods should be developed for areas with advanced encroachment of grasses or where violet and nectar sources have been completely suppressed.

2.2.1.2. Increasing or Maintaining Early Blue Violet Density.

Experimental mowing and burning have been used successfully to some degree for almost 10 years at some Oregon silverspot butterfly sites to improve conditions for early blue violets, and this also may be appropriate for

Behren's. Additionally, early blue violet seeds have been broadcast to expand violet populations for the Oregon silverspot butterfly, and this also is an option for Behren's.

Cattle grazing currently occurs at the only remaining extant site for the Behren's silverspot butterfly. Grazing (both cattle and sheep) should be explored as a possible method of increasing or maintaining early blue violet densities.

More information should be gathered on these and other techniques to help reestablish early blue violet populations on large remnant areas capable of supporting populations or on sites within the dispersal distance of Behren's occupied habitats. Research should be conducted on violet dispersal within the butterfly's habitat.

2.2.1.3. Establishing or Maintaining Nectar Plant Abundance and Density.

The availability of nectar plants within suitable habitat during the Behren's silverspot butterfly's flight period is not well understood, and may be a factor limiting the butterfly's distribution and population numbers. Management techniques such as mowing and grazing, which encourage early blue violets, can potentially have negative impacts on nectar species. Other nectar species may be stimulated by mowing or grazing (e.g., thistles).

Information on butterfly use of nectar species has been developed as part of work being implemented to recover the Oregon silverspot butterfly. Those sources of information, and others, can provide insight regarding the effects of management practices on those species, and they may help inform Behren's. Techniques to enhance nectar species on coastal terraces should be completed.

2.2.1.4. Controlling Trees.

At some of the historical locations for the Behren's silverspot butterfly, tree species such as shore pine, Monterey pine, Monterey cypress, and red alder are invading coastal terrace

meadow habitat. Existing stands of trees can be removed by cutting, mowing, grazing, or burning, but these procedures can be expensive. These techniques should be refined as additional information becomes available. Consideration should be given to native trees that provide wind shelter for adult butterflies, especially in areas where violets and nectar sources exist. However, the maintenance of open, coastal terrace meadow should be given priority over maintaining windrow trees, as shrubby native vegetation also provides shelter from the wind.

BLM has worked with partners to reduce the encroachment of pines on the Stornetta Public Lands from 2007 to 2010. Partial funding was provided by the Service. Additional funding may be available in the future depending on allocations and success at competing for grants.

2.2.1.5. Controlling Brush.

Brush species can invade coastal terrace meadows and crowd out the low-growing early blue violet and nectar plants needed by the butterfly. Brush has successfully been removed within the range of the Oregon silverspot butterfly using hand slash-and-burn and mowing. Nevertheless, these and other techniques need to be studied further and refined to ultimately allow control of resilient species that seem to benefit from occasional control treatments. Consideration should be given to native brush species that provide wind shelter for adult Behren's butterflies, especially in areas where violets and nectar sources exist.

2.2.1.6. Monitor and Control Exotic Forbs.

Intense mowing to control unwanted forbs appears to increase the numbers of false dandelion (*Hypochaeris radicata*), which could compete with the early blue violet. Exotic forbs should be monitored to determine their response to management treatments. Effective control techniques should be developed and implemented.

2.2.1.7. Monitor the Effectiveness of Management Actions.

Implementation of management plans containing specific actions should, if properly completed, achieve a desired result that would change existing conditions. Managers need to be prepared to quantify those changes and correlate them to the status of the butterfly and its environment. Monitoring should determine if management methods are achieving desired results. If the desired results are not being achieved, management should be changed to accomplish targeted goals.

2.2.2. Determine effects of selected management methods on nontarget species.

Coastal terraces used by the Behren's silverspot butterfly are sensitive and relatively rare environments, and they include the habitat of other rare species such as Mendocino Coast Indian paintbrush (*Castilleja mendocinesis*), round-headed Chinese houses (*Collinsia corymbosa*), and supple daisy (*Erigeron supplex*). As a consequence, species-specific management actions should be evaluated to ensure that they do not have a negative effect on the overall ecosystem in which the Behren's silverspot butterfly occurs.

2.3. Determine the Optimum Methods of Re-introducing the Butterfly into Restored or Unoccupied Habitat, or Augmenting Existing Populations.

Although the distribution of the Behren's silverspot butterfly has always been limited, we assume the butterfly currently occupies only a small fraction of its historical distribution. While not confirmed, we believe the Point Arena metapopulation likely is the largest remaining metapopulation containing individuals that maintain the pure characteristics of the *S. z. behrensii* subspecies. As a result, artificial reintroduction techniques may be necessary to restore historical metapopulations throughout the Behren's silverspot butterfly's range. The Point Arena metapopulation is a potential source population, but further study is needed.

Additionally, augmentation may be needed at some metapopulation locations where populations may be declining or at very low numbers.

Several methods may be needed to maintain genetic diversity (or distinctness in areas where closely related subspecies overlap in distribution) and maintain viable populations. These methods include the following: captive breeding, return of individuals reared in captivity (*i.e.*, captive rearing) to their respective metapopulation or to a different metapopulation, or collection of adults to translocate them into a different metapopulation (*i.e.*, reintroduce to historical habitat, or introduce to suitable habitat not previously known to be occupied by the Behren's silverspot butterfly). Disease transmission between sites should be considered in any reintroduction or augmentation plan. Also, if disease is a limiting factor at the depleted site, research should be conducted to determine if augmentation or reintroduction is warranted. Similarly, the presence and potential effects of parasitoids should be considered prior to using reintroduction or augmentation as methods to increase metapopulation size. All introductions will be conducted in adherence to applicable Federal, State, and local laws, regulations, and policies, including our Controlled Propagation Policy (Service and NOAA 2000; 65 FR 56916).

2.3.1. Determine Methods for the Captive Culture and Rearing of the Behren's Silverspot Butterfly.

Successful techniques for the culture and rearing of the Oregon silverspot butterfly are likely directly applicable to the Behren's silverspot butterfly. These techniques are described in detail by Hammond and McCorkle (1991) and were modified and implemented by Anderson *et al.* (2001). Refinements of the captive culture and rearing techniques for the Oregon silverspot butterfly are ongoing.

2.3.2. Determine Methods for the Release of Reared Behren's Silverspot Butterfly Pupae into Restored or Unoccupied Habitat.

Oregon silverspot butterfly pupae have been successfully released at Cascade Head, Oregon (Pickering 2001), using methods modified from Hammond and McCorkle (1991). Releasing pupae allow them to be protected under field cages. Research needs to be completed to determine if the techniques used for Oregon silverspot butterfly

caterpillar releases are suitable and appropriate for the Behren's silverspot butterfly.

2.4. Determine Possible Sources of Mortality at Occupied and Historical Behren's Silverspot Butterfly Sites.

The Behren's silverspot butterfly is susceptible to a number of possible sources of mortality, including habitat removal or degradation, pesticide use, collision with vehicles, collection, untimely fire events, and excessive predation. Understanding the sources of mortality can lead to management practices designed to reduce the risk of mortality.

2.4.1. Determine the Potential Sources of Mortality at the Point Arena and Salt Point Metapopulations.

Because the Point Arena metapopulation may be the largest remaining location for the Behren's silverspot butterfly, sources of mortality must be determined. Salt Point should also be considered, as Behren's silverspot butterflies are extant at this location as well. This task is essential to the survival and recovery of the subspecies. Research is needed to determine if there are sources of adult or larval mortality that can be addressed through appropriate management. As a conjectural example, the use of insecticides at or near a subpopulation site could limit its capacity for survival, threatening the recovery of the metapopulation and possibly the subspecies. Identifying sources of potential mortality can direct management to remove the threat and assess risk to the metapopulation.

2.4.2. Determine Likely Sources of Mortality at Historical and Potential Behren's Silverspot Butterfly Sites.

Each of the potentially suitable sites for the Behren's silverspot butterfly should be studied to determine if site limitations (*i.e.*, potential sources of mortality) exist that may render the site unusable and to identify ways to eliminate these threats. This information will enable managers to assess the relative importance of a site for recovery in comparison to other occupied or identified sites.

3. Monitor the Behren's Silverspot Butterfly's Status and Habitat.

The purpose of monitoring is to track the butterfly's status and progress toward its recovery goal. Because the Behren's silverspot butterfly inhabits early successional grasslands that can rapidly be invaded by shrubs and trees, monitoring the distribution and abundance of subpopulations and metapopulations and tracking of habitat management actions is necessary. We must select parameters to monitor, determine methods and techniques, and develop and implement a monitoring plan.

3.1. Determine Appropriate Parameters to Determine Population Trends.

The following criteria should be used to select parameters for monitoring a subpopulation or metapopulation: (1) the parameter should reflect real changes in the number and distribution of individuals and suitable habitat, (2) data collection should have minimal effects on butterfly numbers and habitat, and (3) monitoring methodology should be cost effective.

3.2. Determine Appropriate Parameters to Determine Habitat Trends.

Habitat parameters should be selected that meet the following criteria: (1) the parameter should reflect real changes in the habitat that affect Behren's silverspot butterfly numbers, (2) data collection should have minimal effects on butterfly numbers, and (3) the monitoring methodology should be cost effective without adversely modifying habitat.

3.3. Develop Monitoring Guidelines and Techniques for Tracking Population Status.

Population monitoring guidelines and techniques should be selected that meet the following criteria: (1) they have an acceptable level of accuracy, (2) they are repeatable over time and among observers, and (3) they have a low impact on the butterfly and its habitat. Ongoing monitoring that follows the program developed for the Oregon silverspot butterfly should be expanded to all extant metapopulations, in addition to Point Arena and Salt Point.

Researchers and managers should consider techniques and methodologies developed to monitor populations of the related Oregon silverspot

butterfly when developing guidelines for populations of the Behren's silverspot butterfly. Furthermore, the Pollard method suggested in peer review should be considered (see discussion in 3.5 below). Monitoring guidelines should specify the methods to be used, frequency and timing of monitoring activity, equipment needs, and skills and experience needed by researchers collecting data.

3.4. Develop Monitoring Guidelines and Techniques for Tracking Habitat Status and Habitat Management Activities.

Habitat monitoring guidelines should specify the methods to be used, frequency and timing of monitoring activity, equipment needs, and skills and experience needed by researchers collecting data. Consideration should be given to the techniques and methodologies developed to monitor habitat for the closely related Oregon silverspot butterfly.

To evaluate habitat status and accurately implement monitoring activities, data should be maintained on location, extent, and timing of management actions. Each management action should be fully described (*e.g.*, weather conditions during a prescribed burn and type of burn, equipment used in mowing, and mowing height; Refer to task 3.3). Guidelines need to include habitat monitoring that provides for the evaluation of management action effectiveness.

3.5. Develop a Monitoring Plan for the Point Arena and Salt Point Metapopulations, and Populations Subsequently Identified.

The site-specific monitoring plan(s) should be based on guidelines and techniques developed in tasks 3.3 and 3.4. Each plan should describe specific monitoring methods for the site, how and when each method will be implemented, where data will be stored, and what personnel will be involved. Monitoring plans should be reviewed and updated every 5 years, or as new information and/or modifications are made to the plan. Monitoring should be coordinated between sites to maximize its usefulness. The Pollard program (Pollard 1991) has been recommended by a peer reviewer as a useful monitoring program, which should be considered during plan development. The Pollard program has been used in monitoring the Oregon silverspot subspecies.

The Service and California Department of Parks and Recreation have been working cooperatively to monitor butterflies on State Park lands at

Point Arena and Salt Point. Similarly, the BLM has conducted surveys on the Stornetta Public Lands with assistance from the California Department of Parks and Recreation and the Service.

3.6. Implement a Monitoring Plan for the Point Arena and Salt Point Metapopulations and other Documented Sites.

Monitoring data will make it possible to evaluate the effectiveness of management activities and to track recovery and population trends of the Behren's silverspot butterfly. Copies of monitoring reports should be provided to us and to appropriate State and County agencies with jurisdiction over, or interest in, the management of invertebrates.

Data should be gathered according to methods outlined in the monitoring plan. Any deviations from the plan should be noted. Data should be reviewed annually and a summary provided to Federal, State, and County resource agencies so they can further review and assess the status of butterfly numbers and habitat. Monitoring results should be reviewed to identify any new threats to the species.

The Service, State Parks, and BLM have initiated a monitoring program in 2006 for a portion of the Point Arena metapopulation. Conclusions from the surveys will not likely be available for 5 to 10 years (Van Strien *et al*. 1997). In addition, private lands within the metapopulation's range are not being surveyed. Appendix D summarizes the most recent data collected as presented in the 2012 5-year status review.

3.7. Implement Augmentation/reintroduction, if Appropriate, Based upon Population Trends, Habitat Availability, and Life History Factors.

Augmentation may be necessary to prevent extirpation of metapopulations while concurrent attempts to understand and reverse declining trends are being undertaken. Reintroduction of butterflies to sites of extirpated metapopulations should be considered if habitat conditions are suitable and threats have been removed. Strategies for augmentation or reintroduction of metapopulations should adaptively incorporate the results of studies to identify reasons for the population declines.

4. Reduce Take.

The Behren's silverspot butterfly is prized by butterfly collectors. Incidental take of the Behren's silverspot butterfly may also occur as a result of development, changes in land use, and road mortality.

Collection of, and commerce in, this subspecies should be monitored. Land-use changes or land development activities that may take Behren's silverspot butterflies may be monitored through local planning processes and indirectly through the subtasks of action 3. State Park and BLM Ranger patrols in the vicinity of Point Arena and Salt Point should consider potential sources of butterfly take as outlined by the Act and its implementing regulations. Enforcement of regulations can be an effective deterrent to potential butterfly collectors.

Research should be conducted to determine the best period of the Behren's life cycle when habitat restoration could occur with the least amount of impact on eggs, larvae, or adult butterflies. Consideration should be given to avoid trampling, mowing, or burning any life stage, thereby reducing the potential for incidental take to occur through injury or mortality.

Law enforcement agencies, including the Law Enforcement branch of the Service, are responsible for investigating suspected violations of the take prohibition. Because this task is part of their regular responsibilities and funding should be provided accordingly, costs of enforcement activities are not specifically quantified in this recovery plan.

5. Undertake Public Information and Outreach Programs.

An effort is needed to increase public awareness regarding the needs and threats to the Behren's silverspot butterfly and other sensitive butterfly species.

5.1. Develop and Implement Public Information and Outreach Programs.

Public information and outreach efforts play a key role in obtaining compliance with protective measures. Programs should target land managers and potential managers, government agencies, children, and the general public. An outreach plan should be developed for each managed site to inform land users and adjacent land owners regarding threats to the Behren's silverspot butterfly and actions being taken to remove the

threats. Additionally, the public should be made aware of the effects of management

The Service has been working with the Redwood Coast Land Conservancy to contact private land owners to assess habitat and status of Behren's silverspot butterfly on their lands.

III. Implementation Schedule

The table that follows is a summary of scheduled actions and estimated costs for recovery of the Behren's silverspot butterfly. It is a guide to meet the objectives detailed in Part II C, Recovery Action Narrative. This table indicates the priority in scheduling actions, estimated costs for performing these actions, identified agencies responsible for performing each action, and a time table to accomplish objectives. Initiation and implementation of these actions is subject to availability of funds. Estimated implementation costs in this Recovery Plan have been adjusted by approximately 3 percent over those presented in the 2003 Draft Recovery Plan for Behren's Silverspot Butterfly (Service 2003). The increase represents an estimated increase in costs due to inflation since the publication of the 2003 draft recovery plan and is only reflected in the total estimated costs.

Priorities in the first column of the following implementation schedule are assigned as follows:

Priority 1: An action that must be taken to prevent extinction or to prevent the subspecies from declining irreversibly.

Priority 2: An action that must be taken to prevent a significant decline in the subspecies population/habitat quality, or some other significant negative impact short of extinction.

Priority 3: All other actions necessary to provide for full recovery of the subspecies.

Codes used in the implementation schedule:

Continual: Action will be implemented on an annual periodic basis once it is begun

Ongoing: Action is currently being implemented and will continue until actions are no longer necessary for recovery

***** Lead agency/partner

Total Cost: Projected cost from start to completion of action (adjusted for a 3 percent increase for inflation since the 2003 Draft Recovery Plan)

Abbreviations used in the Implementation Schedule:

BLM	Bureau of Land Management
CACC	California Coastal Conservancy
CCC	California Coastal Commission
CDFW	California Department of Fish and Wildlife
CDPR	California Department of Parks and Recreation (State Parks)
FWS	U.S. Fish and Wildlife Service
SCP	Sonoma County Parks
TBD	To be determined

Table 3. Implementation Schedule for Behren's Silverspot Butterfly Recovery Plan

Action Priority	Action No.	Action Description	Action Duration (Years)	Responsible Parties	Cost Estimate (in $1,000 units)					Comments/Notes
					Total Costs	FY15	FY16	FY17	FY18	
1	1.1.1	Develop a habitat conservation strategy for the Point Arena and Salt Point metapopulations.	2	BLM CDPR FWS* CDFW	5	0	4	1	0	
1	1.1.2	Determine willingness of landowners identified in Point Arena and Salt Point metapopulations to participate in recovery of the Behren's silverspot butterfly.	2	FWS* CCC	3	3	0	0	0	
1	1.1.3	Map habitat areas for the Point Arena and Salt Point metapopulations.	3	FWS CDPR CDFW BLM*	14	7	1	5	1	

Table 3. Implementation Schedule for Behren's Silverspot Butterfly Recovery Plan

Action Priority	Action No.	Action Description	Action Duration (Years)	Responsible Parties	Cost Estimate (in $1,000 units)					Comments/Notes
					Total Costs	FY15	FY16	FY17	FY18	
1	1.1.4	Protect habitat for the Point Arena and Salt Point metapopulations.	1	FWS CCC*	10,000	10,000	0	0	0	
1	1.2.1	Develop a strategy for conservation of potential habitat.	2	FWS* CDPR SCP	4	0	3	0	0	
1	1.2.2	Determine willingness of landowners with potential habitat to participate in recovery of the Behren's silverspot butterfly.	1	CCC FWS*	2	0	2	0	0	
1	1.2.3	Survey and map habitat areas with potential habitat.	1	FWS*	40	40	0	0	0	

Table 3. Implementation Schedule for Behren's Silverspot Butterfly Recovery Plan

Action Priority	Action No.	Action Description	Action Duration (Years)	Responsible Parties	Cost Estimate (in $1,000 units)					Comments/Notes
					Total Costs	FY15	FY16	FY17	FY18	
1	1.2.4	Protect habitats in areas with potential habitat.	TBD	FWS* CDPR SCP BLM	TBD	0	0	0	0	Cost depends on specific habitats identified. BLM acquired and currently manages the Stornetta Ranch, Point Arena.
1	1.3.1	Develop management plans.	4	FWS*	40	35	2	2	1	
1	1.3.2	Implement management plans.	4+	TBD	8	0	2	2	2	

Table 3. Implementation Schedule for Behren's Silverspot Butterfly Recovery Plan

Action Priority	Action No.	Action Description	Action Duration (Years)	Responsible Parties	Cost Estimate (in $1,000 units)					Comments/Notes
					Total Costs	FY15	FY16	FY17	FY18	
1	2.1.1	Clarify the extent and condition of habitat areas necessary to provide for breeding, nectaring, and shelter by the Behren's silverspot butterfly.	2	BLM* CDPR FWS	6	1	5	0	0	
1	2.4.1	Determine the potential sources of mortality at the Point Arena and Salt Point metapopulations.	3	FWS*	3	0	1	1	1	
1	3.1	Determine appropriate parameters to determine population trends.	1	FWS*	2	0	2	0	0	

Table 3. Implementation Schedule for Behren's Silverspot Butterfly Recovery Plan

Action Priority	Action No.	Action Description	Action Duration (Years)	Responsible Parties	Cost Estimate (in $1,000 units)					Comments/Notes
					Total Costs	FY15	FY16	FY17	FY18	
1	3.2	Determine appropriate parameters to determine habitat trends.	1	FWS*	2	0	2	0	0	
1	3.3	Develop monitoring guidelines and techniques for tracking population status.	1	FWS*	2	0	2	0	0	
1	3.4	Develop monitoring guidelines and techniques for tracking habitat status and habitat management activities.	1	FWS*	2	0	2	0	0	

Table 3. Implementation Schedule for Behren's Silverspot Butterfly Recovery Plan

Action Priority	Action No.	Action Description	Action Duration (Years)	Responsible Parties	Cost Estimate (in $1,000 units)					Comments/Notes
					Total Costs	FY15	FY16	FY17	FY18	
1	3.5	Develop a monitoring plan for the Point Arena and Salt Point metapopulations, and populations subsequently identified.	1	FWS* BLM CDPR	TBD	0	0	0	0	Costs depend on extent and number of populations.
1	3.6	Implement a monitoring plan for the Point Arena and Salt Point metapopulations, and other documented sites.	5	FWS BLM CDPR	TBD	0	0	0	0	Costs depend on extent and number of populations.
Priority 1 actions subtotal					10,132+					
2	2.1.2	Ascertain the distribution and habitat requirements of the early blue violet and	4	FWS*	4	0	1	1	1	

Table 3. Implementation Schedule for Behren's Silverspot Butterfly Recovery Plan

Action Priority	Action No.	Action Description	Action Duration (Years)	Responsible Parties	Cost Estimate (in $1,000 units)					Comments/Notes
					Total Costs	FY15	FY16	FY17	FY18	
		nectar source plants.								
2	2.1.3	Identify dispersal patterns (distances, directions, habitat requirements) of the Behren's silverspot butterfly needed to facilitate migration between patches.	4	FWS*	TBD	0	0	0	0	Begin FY 2015 Costs depend on extent and number of populations.
2	2.2.1.1	Controlling exotic grass.	5+	BLM* CDPR SCP	15	0	3	3	3	Needed for Point Arena metapopulation.
2	2.2.1.2	Increasing or maintaining early blue violet density.	5+	BLM* CDPR	15	0	3	3	3	

Table 3. Implementation Schedule for Behren's Silverspot Butterfly Recovery Plan

Action Priority	Action No.	Action Description	Action Duration (Years)	Responsible Parties	Cost Estimate (in $1,000 units)					Comments/Notes
					Total Costs	FY15	FY16	FY17	FY18	
				SCP FWS						
2	2.2.1.3	Establishing or maintaining nectar plant abundance and density.	5+	BLM* CDPR SCP	15	0	3	3	3	
2	2.2.1.4	Controlling trees.	5+	BLM* CDPR SCP	TBD	0	0	0	0	Costs depend on extent and number of populations.
2	2.2.1.5	Controlling brush.	5+	BLM* CDPR SCP	TBD	0	0	0	0	Costs depend on extent and number of populations.
2	2.2.1.6	Monitor and control exotic forbs.	5+	BLM* CDPR SCP	TBD	0	0	0	0	Costs depend on extent and number of populations.

Table 3. Implementation Schedule for Behren's Silverspot Butterfly Recovery Plan

Action Priority	Action No.	Action Description	Action Duration (Years)	Responsible Parties	Cost Estimate (in $1,000 units)					Comments/Notes
					Total Costs	FY15	FY16	FY17	FY18	
2	2.2.1.7	Monitor the effectiveness of management actions.	5+	BLM* CDPR SCP	TBD	0	0	0	0	Costs depend on extent and number of populations.
2	2.2.2	Determine effects of selected management methods on nontarget species.	5	FWS*	TBD	0	0	0	0	Costs depend on extent and number of populations.
2	2.3.1	Determine methods for the captive culture and rearing of the Behren's silverspot butterfly.	5	FWS*	TBD	0	0	0	0	Need for captive propagation to be assessed; partners not yet identified

Table 3. Implementation Schedule for Behren's Silverspot Butterfly Recovery Plan

Action Priority	Action No.	Action Description	Action Duration (Years)	Responsible Parties	Cost Estimate (in $1,000 units)					Comments/Notes
					Total Costs	FY15	FY16	FY17	FY18	
2	2.3.2	Determine methods for the release of reared Behren's silverspot butterfly pupae into restored or unoccupied habitat	5	FWS*	TBD	0	0	0	0	Need for captive propagation to be assessed; partners not yet identified.
2	2.4.2	Determine likely sources of mortality at historical and potential Behren's silverspot butterfly sites.	5	FWS*	TBD	0	0	0	0	Sites and specific threats to be determined.
2	3.7	Implement augmentation/ reintroduction, if appropriate, based upon population trends, habitat availability, and life history factors.	TBD	FWS*	TBD	0	0	0	0	Need for captive propagation to be assessed; partners not yet identified.

Table 3. Implementation Schedule for Behren's Silverspot Butterfly Recovery Plan

Action Priority	Action No.	Action Description	Action Duration (Years)	Responsible Parties	Cost Estimate (in $1,000 units)					Comments/Notes
					Total Costs	FY15	FY16	FY17	FY18	
Priority 2 actions subtotal					49					
3	4	Reduce take.	cont	FWS*	0	0	0	0	0	Costs included in law enforcement budgets.
3	5.1	Develop and implement public information and outreach programs.	cont	FWS*	10	3	3	3	1	
Priority 3 actions subtotal					10	3	3	3	1	

Total Estimated Cost of Recovery: $10,496,730 including additional costs that cannot be estimated at this time (this total estimated cost of recovery has been adjusted to reflect a 3 percent increase for inflation since the 2003 Draft Recovery Plan). Identified costs are not agency/partner specific.

IV. References

LITERATURE CITED

Anderson, M.J., B. Csuti, N. Grol, D. Shepherdson, and J. Steele. 2001. Oregon silverspot butterfly (*Speyeria zerene hippolyta*): Cascade Head population supplementation project. Oregon Zoo report, Portland, Oregon. 24 pp.

Arnold, R.A. 2006. Final Report: Surveys for the Endangered Behren's Silverspot Butterfly and its Habitat During 2005 and 2006 in Coastal Sonoma and Mendocino Counties, CA. Entomological Consulting Services, Ltd., Pleasant Hill, California.

Boisduval. 1852. Ann. Soc. Ent. France (2) 10:303

[BLM] Bureau of Land Management. 2006. Record of Decision: Ukiah Resource Management Plan. Ukiah Field Office, Bureau of Land Management. September 25, 2006.

California Natural Diversity Data Base. 2011. California Department of Fish and Game. Element Occurrence Reports for *Speyeria zerene behrensii*. Unpublished cumulative data current to January 2011.

Collins, N.M., and M.G. Morris. 1985. Threatened swallowtail butterflies of the world. ICUN Red Data Book. Gland, Switzerland. 401 pp.

dos Passos, C.F., and L.P. Grey. 1945. An new species and some new subspecies of *Speyeria* (Lepidoptera, Nymphalidae). Amer. Mus. No. 1297.

Edwards, W.H. 1869. Descriptions of new species of diurnal Lepidoptera found within the United States. Trans. Amer. Ent. Soc. 2:369-376.

Emmel, J.F., and T.C. Emmel. 1998. A Previously Unrecognized Subspecies of *Speyeria zerene* (Lepidoptera: Nymphalidae) from Coastal Northern California. *In* T. C. Emmel (ed.), Systematics of Western North American Butterflies. Department of Zoology, University of Florida. pp. 451-454.

Emmel, J.F., T.C. Emmel, and S.O. Mattoon. 1998. A New Subspecies of *Speyeria zerene* (Lepidoptera: Nymphalidae) from the San Francisco Bay Area of California. *In* T. C. Emmel (ed.), Systematics of Western North American Butterflies. Department of Zoology, University of Florida. pp. 455-460.

Falxa, G., and D. Imper. 2012. Summary, Oregon silverspot butterfly surveys, Del Norte County Population. Unpublished report. U.S. Fish and Wildlife Service, Arcata, California. 6 pp.

Franklin, I.A. 1980. Evolutionary change in small populations. Pages 135-150 in M.E. Soulé and B.A. Wilcox, editors. Conservation biology: an evolutionary ecological perspective. Sinauer Associates, Sunderland, Massachusetts.

Gall, L.F. 1984. The effects of capturing and marking on subsequent activity in *Boloria acrocnema* (Lepidoptera: Nymphalidae), with a comparison of different numerical models that estimate population size. Biological Conservation 28:139-154

Garth, J.S., and J.W. Tilden. 1986. California Butterflies. University of California Press. Berkeley, California. 246 pp.

Grey, L.P. and A.H. Moeck. 1962. Notes on overlapping subspecies. I. An example in *Speyeria zerene*. J. Lepid. Soc. 16:81-97

Hammond, P.C. 1980. Appendix I. Taxonomy of *Speyeria zerene hippolyta*. Pp. 84-91. *In* D.V. McCorkle, ed. Ecological investigation report: Oregon silverspot butterfly (*Speyeria zerene hippolyta*). U.S. Forest Service, Siuslaw National Forest, Corvallis, Oregon.

Hammond, P.C. 1986. Ecological investigation of *Viola adunca* 1986 supplement. U.S. Department of Agriculture, Forest Service, Siuslaw National Forest. 25 pp.

Hammond, P.C. 1994. 1994 report of silverspot butterfly use of native meadow habitat on the Siuslaw National Forest. U.S. Department of Agriculture, Forest Service, Siuslaw National Forest. 15 pp.

Hammond, P.C., and D.V. McCorkle. 1984. The decline and extinction of *Speyeri*a populations resulting from human environmental disturbance. J. Res. Lepid. 22:217-224.

Hammond, P.C., and D.V. McCorkle. 1991. Introduction of the Oregon silverspot butterfly (*Speyeria zerene hippolyta*) on Fairview Mountain. U.S. Department of Agriculture, Forest Service, Siuslaw National Forest. 14 pp.

Harrison, S., D.D. Murphy, and P.R. Ehrlich. 1988. Distribution of the Bay checkerspot butterfly, *Euphydryas editha bayensis*: evidence for a metapopulation model. American Naturalist, 132:360-382

Holland, R.F. 1986. Preliminary Descriptions of the Terrestrial Natural Communities of California. State of California, The Resources Agency, Department of Fish and Game, Sacramento, California. Oct. 1986.

Howe, W.H. 1975. Butterflies of North America. Pages 226-227, Plate 22, Garden City, New York, Doubleday and Company, Inc.

[IPCC] Intergovernmental Panel on Climate Change. 2007. Climate change 2007: the physical science basis. Summary for policymakers. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, IPCC Secretariat, World Meteorological Organization and United Nations Environment Programme, Geneva, Switzerland.

Johnstone, J.A., and T.E. Dawson. 2010. Climatic context and ecological implications of summer fog decline in the coast redwood region. PNAS 107: 4533-4538. www.pnas.org/cgi/doi/10.1073/pnas.0915062107

Kodandaramaiah, Ullasa. 2011. Effects of *Wolbachia* on Butterfly Life History and Ecology. In: Advances in Medicine & Biology, Vol 16, Nova Publishers. 7pp.

Launer, A.E., D.D. Murphy, J.M. Hoekstra, and H.R. Sparrow. 1992. The endangered Myrtle's silverspot butterfly: present status and initial conservation planning. J. Res. Lepid. 31(1-2):132-146.

Liebenberg, A.M. 2011. Annual progress report – 2011: Behren's silverspot and Point Arena mountain beaver project. Unpublished report submitted to U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata, California. Prepared by California Department of Parks and Recreation.

McCorkle, D.V. 1980. Ecological investigation report: Oregon silverspot butterfly (*Speyeria zerene hippolyta*). Unpublished report to the U.S. Department of Agriculture, Forest Service, Siuslaw National Forest, , Corvallis, Oregon. 117 pp.

McCorkle, D.V., and P.C. Hammond. 1988. Observations on the biology of *Speyeria zerene hippolyta* (Nymphalidae) in a marine modified environment. J. Lepid. Soc. 42:184-195.

McCorkle, D.V., P.C. Hammond, and G. Pennington. 1980. Ecological investigation report: Oregon silverspot butterfly (*Speyeria zerene hippolyta*). U.S. Department of Agriculture, Forest Service, Siuslaw National Forest. 117 pp.

McIver, J., S. Muttillinja, D. Pickering, and R. VanBuskirk. 1991. Population dynamics and habitat selection of the Oregon silverspot butterfly (*Speyeria zerene hippolyta*): a comparative study at four primary sites in Oregon. Report to the U.S. Department of Agriculture, Forest Service, Siuslaw National Forest, Corvallis, Oregon. 61 pp.

McLaughlin, J.F., J.J. Hellmann, C.L. Boggs, and P.R. Ehrlich. 2002. Climate change hastens population extinctions. PNAS, vol. 99 pp. 6074-6074.

Murphy, D.D. 1988. Are we studying our endangered butterflies to death? J. Res. Lepid. 26(1-4):236-239.

Pickart, A.J. and J.O. Sawyer. 1998. Ecology and Restoration of Northern California Coastal Dunes. California Native Plant Society. 152 pp.

Pickering, D. 2001. Fifth annual report to U.S. Fish and Wildlife Service- Permit # PRT-804885. Enhancement of survival permit for threatened wildlife-Oregon silverspot butterfly (*Speyeria zerene hippolyta*). The Nature Conservancy, Portland, Oregon. 10 pp.

Pickering, D., D. Salzer, and C.A. Macdonald. 1992. Population dynamics and habitat characteristics of the Oregon silverspot butterfly (*Speyeria zerene hippolyta*). Report to the U.S. Department of Agriculture, Forest Service, Siuslaw National Forest. The Nature Conservancy, Portland, Oregon. 100 pp.

Pollard, E. 1991. Monitoring butterfly numbers. Pages 87-111 *in* Monitoring for Conservation and Ecology. Goldsmith, F.B. ed. Chapman and Hall, London.

Pollard, E. and T.J. Yates. 1993. *Monitoring Butterflies for Ecology and Conservation*. Chapman and Hall, London. 274 pp.

Pratt, G.F. 2004. 2004 Survey for the Lotis Blue. Report to U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office. (#101812M579). Submitted September 2004.

RT Navratil 2014. Study of the ecological impacts of cattle grazing on Behren's silverspot butterfly (*Speyeria zerene behrensii*) and its habitat in coastal Mendocino County. Final Report: Summary of Relevant Activities and Results. RT Navratil Consulting, San Francisco, CA. Unpublished report to U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office. 24 pp.

Sander, C. 2004. Spring 2004 field survey for *Viola adunca* and general botanical inventory for the Stornetta Ranch, Point Arena, CA. Unpublished report prepared for the Bureau of Land Management, Ukiah Field Office. 18 pp. plus GIS map.

Sawyer, J.O., and T. Keeler-Wolf. 1995. A Manual of California Vegetation. California Native Plant Society. Sacramento, California

Schaeffer, K.J., and S.L. Kiser. 1994. Hypotheses concerning population decline and rarity in insects. *In* W.W. Covington and L.F. DeBano (eds), Sustainable Ecological Systems: Implementing an Ecological Approach to Land Management. U.S. Department of Agriculture, Forest Service, General Technical Report RM-247. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. pp. 78-84.

Scott, J.A. 1986. The butterflies of North America, a natural history and field guide. Stanford University Press, Stanford, California.

[Service] U.S. Fish and Wildlife Service. 1980. Listing the Oregon silverspot butterfly as a threatened species with critical habitat. Federal Register 45(129):44935-44939. July 2, 1980.

[Service] U.S. Fish and Wildlife Service. 1983a. Endangered and threatened species: Listing and recovery priority guidelines. Federal Register 48:43098-43105. September 21, 1983.

[Service] U.S. Fish and Wildlife Service. 1983b. Endangered and threatened species: Listing and recovery priority guidelines correction. Federal Register 48:51982. November 15, 1983.

[Service] U.S. Fish and Wildlife Service. 1992. Endangered and threatened wildlife and plants: six plants and Myrtle's silverspot butterfly from coastal dunes in northern and central California determined to be endangered. Federal Register 57(120):27848-27859.

[Service] U.S. Fish and Wildlife Service. 1997. Endangered and Threatened Wildlife and Plants: Determination of Endangered Status for the Callippe Silverspot Butterfly and the Behren's Silverspot Butterfly and Threatened Status for the Alameda Whipsnake: Final Rule. Federal Register 62(234):64306-64320.

[Service] U.S. Fish and Wildlife Service. 1998. Seven Coastal Plants and the Myrtle's Silverspot Butterfly Recovery Plan. Portland, Oregon. 141 pp.

[Service] U.S. Fish and Wildlife Service. 2001. Oregon silverspot butterfly (*Speyeria zerene hippolyta*) revised recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon. 113 pp.

[Service] U.S. Fish and Wildlife Service. 2003. Draft Recovery Plan for Behren's Silverspot Butterfly (*Speyeria zerene behrensii*). U.S. Fish and Wildlife Service, Portland, Oregon. vii + 55 pp.

[Service] U.S. Fish and Wildlife Service. 2004. Draft Recovery Plan for the Behren's Silverspot Butterfly; Notice of Document Availability for Review and Comment. 69 Federal Register 2725. January 2004. 2pp,

[Service] U.S. Fish and Wildlife Service, and National Marine Fisheries Service. 2000. Policy Regarding Controlled Propagation of Species Listed Under the Endangered Species Act. Federal Register 65(183):56916-56922. September 20, 2000.

[Service] U.S. Fish and Wildlife Service. 2009. Myrtle's Silverspot Butterfly (*Speyeria zerene myrtleae*) 5-year Review: Summary and Evaluation. U.S. Fish and Wildlife Office, Sacramento, California. August 2009. 28 pp.

[Service] U.S. Fish and Wildlife Service. 2009. Callippe Silverspot Butterfly (*Speyeria callippe callippe*) 5-year Review: Summary and Evaluation. U.S. Fish and Wildlife Office, Sacramento, California. August 2009. 30 pp.

[Service] U.S. Fish and Wildlife Service. 2011. Oregon Silverspot Butterfly (*Speyeria zerene hippolyta*) 5-year Review: Summary and Evaluation. U.S. Fish and Wildlife Office, Newport, Oregon. August 2011. 30 pp.

[Service] U.S. Fish and Wildlife Service. 2012. Behren's Silverspot Butterfly 5-Year Review: Status and Summary. U.S. Fish and Wildlife Service, Arcata, California. July 2012. 26 pp.

Simonsen, T. J., N. Wahlberg, A.V.Z. Brower, and R. de Jong. 2006. Morphology, molecules and fritillaries: approaching a stable phylogeny for Argynnini (Lepidoptera: Nymphalidae). Insect Systematics and Evolution 37:405-418.

Singer, M.C., and P. Wedlake. 1981. Capture does affect probability of recapture in a butterfly species. Ecological Entomology 6:215-216.

Singleton, T.A. 1989. Population dynamics and habitat selection of the Oregon silverspot butterfly (*Speyeria zerene hippolyta*) at Cascade Head Preserve. The Nature Conservancy, Portland, Oregon. 9 pp.

Telschow, A., N. Yamamura, J.H. Werren. 2005. Bidirectional Cytoplasmic Incompatibility and the Stable Coexistence of two *Wolbachia* Strains in Parapatric Host Populations. Journal of Theoretical Biology 235 (2005) 265-274.

Van Strien, A.J., Van De Pavert, R., Moss, D., Yates, T.J., Van Swaay, C.A.M., and Vos, P. 1997. The statistical power of two butterfly monitoring schemes to detect trends, Journal of Applied Ecology. 34(3) pp:817-828.

Wells, J.V., and M.E. Richmond. 1995. Populations, metapopulations, and species populations: what are they and who should care? Wild. Soc. Bul. 1995, 23(3):458-462. NY Cooperative Fish and Wildlife Research Unit, Cornell University, Ithaca, NY.

PERSONNAL COMMUNICATIONS

Arnold, R. 2006. Personal communication. Consultant. Entomological Consulting Services, Ltd., Pleasant Hill, California.

Hansen, Ken. 2012. Personal communication. Amateur lepidopterist. McKinleyville, California. Telephone conversation with Gary Falxa, Service, on February 29, 2012.

Pickering, D. 2001. Personal communication. *In* Revised Recovery Plan for the Oregon Silverspot Butterfly (*Speyeria zerene hippolyta*). U.S. Fish and Wildlife Service, Portland, Oregon. 113 pp.

Pickering, D. 2008. Personal communication. Oregon Coast Stewardship Ecologist, The Nature Conservancy of Oregon.

Walker, A. 2014. Personal communication. Fish and Wildlife Biologist. Oregon Coast Field Office, U.S. Fish and Wildlife Service, Newport, Oregon.

PERSONAL OBSERVATIONS

Ebner, J. 1998. Personal observation. Consultant. Oconomowoc, Wisconsin.

Watkins, J.H. 2002. Personal observation. Fish and Wildlife Biologist. Arcata Fish and Wildlife Office, U.S. Fish and Wildlife Service, Arcata, California.

Appendix A

SUMMARY OF COMMENTS ON THE DRAFT RECOVERY PLAN

We released the draft Recovery Plan for the Behren's Silverspot Butterfly (*Speyeria zerene behrensii*) in November 2003. The availability of the draft Recovery Plan and notice of the public comment period on the draft plan was issued January 20, 2004 (Service 2004). The comment period extended from January 20, 2004, to March 22, 2004 (Service 2004).

Agency and Public Comments

No agency or public comments were received during the comment period on the draft Recovery Plan.

Peer review Comments

Comments received from peer reviewers, who were specifically requested by the Service to review and provide independent comment on the draft Recovery Plan because of their expertise, were addressed above in the text and figures. Significant changes between the draft and final Recovery Plans resulting from peer review comments are below, and are also noted in Section B on page 2 in the Recovery Plan.

Peer reviewers of the draft Behren's Silverspot Butterfly Recovery Plan (draft Recovery Plan) noted that a lower limit of 500 individuals at any one site may limit a metapopulation's evolutionary potential. Analysis of butterfly populations indicates that fairly large population swings can occur between years without reducing viability (Van Strien *et al*. 1997; Pollard and Yates 1993). As a result of these peer review comments and the literature, we have adjusted our recovery criteria from what we proposed in the draft Recovery Plan (see section II.B) to reflect a metapopulation size of 1,000 adult butterflies for both the downlisting and delisting criteria. Our focus will be to work with partners to develop a long-term monitoring program that can detect changes in trend over a minimum of a 10-year period. We believe that a metapopulation size of 1,000 adult butterflies, that also shows an increasing population trend over a 10-year period, will provide adequate numbers of individuals for downlisting or delisting, as appropriate (see all of the recovery criteria). A size of 1,000 individuals is consistent with population sizes observed in closely related species, as mentioned in Section I.E, but may be refined as appropriate if new, relevant information specific to Behren's silverspot populations becomes available. As stated previously in the

draft Recovery Plan, the recovery criteria for the Behren's silverspot butterfly employs the following rationale: (1) downlisting and delisting criteria must be sufficient to ensure that metapopulation and range-wide numbers, when extrapolated from survey results, provide for a robust, sustainable population; and (2) criteria are sufficient to ensure sustainability in light of available survey methodologies and short- and long-term variation in population trends.

Peer reviewers also noted that the draft Recovery Plan did not address parasites and parasitoids. As a result, we provided the following text under Factor C in the above Threats and Limiting Factors section:

Disease and Parasitoids (parasites on butterflies)

Disease could be a threat that has not yet been identified for the Behren's silverspot butterfly. *Wolbachia*, an intercellular bacteria, has been detected in other butterfly species which can potentially affect the health of small populations of butterflies (Telschow, *et al*. 2005; Kodandaramaiah, 2011). Although not detected in the genus *Speyeria*, *Wolbachia* bacteria have been identified in other species of butterflies in the family Nymphalidae.

Similarly, parasitoids or parasites are a possible threat that could depress or deplete metapopulation numbers by killing caterpillars. For example, some wasp and fly larvae feed on butterfly caterpillars and can affect local butterfly populations. However, no parasitoids or parasites are known to affect the Behren's silverspot butterfly, although no studies have been conducted to determine if this indeed the case.

Predation has been observed on the Oregon silverspot butterfly (Walker, pers. comm. 2014). A white-crowned sparrow (*Zonotrichia albicollis*) entered an enclosure containing Oregon silverspot butterflies being released at a restored habitat site near Agate Meadow, consuming most of the adult butterflies. Although predation by sparrows may occur in nature, it has not been reported. Spiders have been observed capturing Oregon silverspot butterflies at Mt. Hebo, Oregon (Walker, pers. comm. 2014); however, their predation is not believed to be a significant threat to butterfly populations.

Appendix B

SUMMARY OF THREATS AND RECOMMENDED RECOVERY ACTIONS

LISTING FACTOR	THREAT	RECOVERY CRITERIA	ACTION NUMBERS
A	Urban development	1(b), 2(a)	1.1, 1.2, 2.4, 3.2, 3.4, 3.5, 3.6, 4
A	Conversion of land to agricultural use (row crops)	1(b), 2(a)	1.1, 1.2, 2.4, 3.2, 3.4, 3.5, 3.6, 4
A	Exotic vegetation and habitat succession	1(b), 2(a)	1.1, 1.2, 2.4, 3.2, 3.4, 3.5, 3.6, 4
A	Loss of food plants due to successional changes in habitat caused by fire suppression	1(c), 2(b)	1.3, 2.1, 2.2, 2.4, 3.2, 3.4, 3.5, 3.6, 4, 5
B	Collection by amateur insect collectors and for scientific research	1(c), 2(b)	4, 2.4
D	Inadequate protection under CEQA and California Endangered Species Act	N/A	Beyond scope of recovery plan. Would require legislative action

LISTING FACTOR	THREAT	RECOVERY CRITERIA	ACTION NUMBERS
D	Lack of land management plans protecting the species	1(c), 2(b)	1.3, 2.2, 3.1, 3.3, 3.5, 3.6, 4, 5

Listing Factors:

A. The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

C. Disease or Predation [no threats known for this species]

D. The Inadequacy of Existing Regulatory Mechanisms

E. Other Natural or Manmade Factors Affecting its Continued Existence

Appendix C

Survey Protocol: Behren's Silverspot Butterfly (BSB), *v1, July 2006*

Method (adapted from method developed for Oregon Silverspot Butterfly (OSB) by Debbie Pickering of Oregon TNC, based on the 'Pollard Walk' butterfly survey method):

1. Transects are marked into 50-m segments. Transect start and end points are clearly marked by wooden stakes or metal rebar. Transect length will vary, according to habitat configuration.

2. Initiate surveys when wind is <10mph, and air temperature at least 60E F (see #9 below).

3. Conduct surveys between 1000-1600 (10am and 4pm).

4. One person walks transect slowly, looking forward and scanning the 180-degree area forward of the observer, scanning a 15m radius from side to side, at about one 180-degree scan per 2 steps). Target walking speed is 3 seconds per meter (2.5 minutes per 50m segment = 20m per minute); this works out to about 0.75 mi/hr. Record all BSB observed within 15 m of the transect line that you are walking, and none beyond. Walk carefully to avoid trampling or otherwise harming the butterflies or, especially, their larvae, which feed on early violets (*Viola adunca*). Learn to identify the early violet so that you can avoid it. Carry binoculars and use them (sparingly) to identify alighted (resting or nectaring) butterflies. At the end of the transect, you include butterflies seen in the 15m in front of you as you stand on transect end point.

5. On data sheet, record weather conditions for each transect. Use meter for temp and wind, rate sky conditions as the % of sky obscured by cloud/fog. Pause at end of each segment and record number of BSB observed in segment. If sun conditions change from those recorded at start of transect (if sun comes out, or goes behind cloud), note in comment lines, indicating for which segments it differed.

6. *How to deal with potential double counts*: If sightings are separated by 1 complete visual sweep of the survey area (i.e., once back and forth) without seeing an BSB, then BSBs spotted on following scans are counted as new individuals. If not separated by a full sweeps, then it is not counted, unless you know for certain that the individuals are different (e.g., distinguishing characteristics, you see both at once, or you see one leave area).

7. Within a transect, choose starting point (transect end) by toss of coin. If transects are consecutive in a line, choice of the starting point for first transect will determine starting end for several.

8. Where multiple transects, randomize the order in which they are surveyed on any survey day, to avoid potential confounding effects of time-of-day in which survey is conducted. This can be done by pulling pieces of paper out of a hat, or by a series of coin tosses.

9. Wait for 'average' weather conditions before starting the first transect: temperature at least 60E F, wind less than 10 mph (measured 4-6 feet above ground level), and dry air - no fog, drizzle or rain. For a transect, weather conditions should be weather ranking 1, 2, or 3 before starting; between transects, you can wait for weather to improve before starting. Refer to the Weather Rankings table for how to rate survey conditions.

10. Once a transect is begun, complete it, even if weather changes, noting weather changes on form. If doing only the southern 400m of Transect 5 (as discussed below on pg 2) complete the 400m.

11. Our goal is to 1) complete weekly surveys for each transect during the flight period, roughly from late June or early-July through early September, varies from year to year and dates need to be confirmed for BSB (in 2006, we are starting late intentionally), and 2) to do all the transect surveys on one day, to minimize the chances of individuals moving and being counted more than once.

Data Entry

1. Use the data forms provided. Please fill out all data fields. Record BSB numbers observed in each 50-m segment, using segment sequence indicated on transect maps. For all transects, segment 0 starts at northern or western end of transect (or closest approximation). Send data forms to Arcata Fish and Wildlife Office, 1655 Heindon Rd., Arcata, CA 95521. Fax 707-822-8411 (attn: John Hunter; john_e_hunter@fws.gov)

2. For each transect, please record also the number of butterflies observed nectaring on the different species of nectar plants during the census.

3. Here is how we deal with weather during OSB surveys, and which we propose to start with:

If one transect or part of a transect drops to level 4 while doing a transect, the data can be used as long as the average of all the weather codes for surveys that day at the site is 3 or better (lower). If the average is >3 or if it is between 2 and 3 and <

50% of the segments were sunny, that census gets dropped and substitute the average of the week before and the week after.

Training and Quality Control

1. OR trains new OSB crew members for 2-3 weeks. Due to limited time for FWS trainers, we recommend that surveyors team up with the more experienced butterfly observers for the first 2-3 weeks of surveys, and work on each other's skills during this period.

2. Become familiar with the common butterflies you may encounter during surveys, to allow quick identification of species encountered, and to minimize confusing BSB with other species.

3. Before new crew members work alone, conduct simultaneous survey counts with experienced surveyors, with the goal of new members having counts within 10-15% of experienced surveys.

Other Notes

1. Transect length varies, according to habitat configuration.

2. Because of private property concerns, it is critical that transect routes and surveyors remain on the public lands or the public road system at all times when conducting surveys.

3. Behren's transects are numbered from north to south:

T1: Manchester SP: 350m: about 1km north of campground. Consists of 2 parallel N-S lines (150&200m)

T2: Manchester SP: 350m: runs roughly N-S, from N of KOA to near NE corner of KOA

T3: Manchester SP: 700m: located entirely on paved road system of Stoneboro Rd; roughly N-S, bends

T4: Stornetta Ranch: 300m: runs W-E, north of road with cypress row, near "old milk barn"

T5: Stornetta Ranch: 1250m: runs N-S, from road to old Loran Stn, to just south of cypress row along road to lighthouse. Transect 5 is long (1250m). If logistics prevent sampling the entire T5, then give priority to sampling the southern 400m (segments 850-1250m), as this traverses the area of highest violet density and greatest management interest.

Sources for Weather Forecasts and Current Weather Conditions in Survey Area

7-Day weather forecasts: http://www.wrh.noaa.gov/eka/ click the map near Point Arena for general area forecast, then click new map in survey area for point forecast for survey area

For current weather: This link has current weather at the Pt. Arena Lighthouse http://weather.hometownlocator.com/Local-Weather.php?config=&forecast=zandh&pands=K89Q

and for Fort Bragg:

http://www.wrh.noaa.gov/eka/obs/sforoso72

Table 1. Behren's Silverspot Butterfly Monitoring Weather Rankings (adapted from OSB system)

Code	Rank	Temp	Sky Conditions	Moisture	Wind
1	Optimal	> 65°F	Full Sun	Dry	< 5 mph
2	Opt to sub	(if 1 category is in sub-opt. range but the rest are still opt.)			
3	Sub-optimal	60-65°F	Partly cloudy	Dry to damp veg'n or light fog	5-15 mph
4	Sub to marg.	(if 1 category is in the marg. range but the rest are still sub-opt.)			
Generally, censuses are not done if weather is below this level					
5	Marginal	55-60°F	Partly sunny or overcast	Wet vegetation or heavy fog	15-20 mph
6	Poor	< 55°F	Overcast	Rain	> 20 mph

Data Sheet Behren's Silverspot Butterfly Surveys

v July 15 2006

Surveyor(s):

(Note if surveyors vary among transects on this data sheet)

Transect segments are uniquely numbered in 50m increments, with '0' at the N or W end; if survey starts at S end of a transect, record data starting in right-hand block, e.g '450-500m' for a 500m transect

			Weather					---TIME---		----------TRANSECT SEGMENT COUNTS----------									
Start (N/S)	Transect	Date	WTHR CODE	Temp	Wind mph	Moisture	O'cast	Start	End	0-50m	50-100m	100-150m	150-200m	200-250m	250-300m	300-350m	350-400m	400-450m	Comments
	1 (SP)																x	x	0-150m on W line, 150-350m on E line
	2 (SP)																x	x	
	4 (BLM)															x	x	x	
	3 (SP)																		
										450-500m	500-550m	550-600m	600-650m	650-700m					
	3 (cont'd)														X	x	x	x	
										0-50m	50-100m	100-150m	150-200m	200-250m	250-300m	300-350m	350-400m	400-450m	
	5 (BLM)																		
										450-500m	500-550m	550-600m	600-650m	650-700m	700-750m	750-800m	800-850m		
	5																	x	
										850-900m	900-950m	950-1000m	1000-1050m	1050-1100m	1100-1150m	1150-1200m	1200-1250m		
	5*																	x	

Note: Transect 5 (1250m long) requires 3 lines of data form. If unable to survey the entire transect, survey at least the southern 8 segments (850m-1250m)

Diagonal in data squares: left of diagonal: record BSB numbers. Right of diagonal: record "s" if sun shining while surveying segment; "c" if not

Other notes (e.g., if nectaring observed, please note BSB numbers & nectar species, transect and segment#):

Weather Codes

Code	Rank	Temp	Sky Conditions	Moisture	Wind
1	Optimal	> 65°F	Full Sun	Dry	< 5 mph
2	Opt to sub	(if 1 category is in sub-opt. range but the rest are still opt.)			
3	Sub-optimal	60-65°F	Partly cloudy	Dry to damp veg'n or light fog	5-15 mph
4	Sub to marg.	(if 1 category is in the marg. range but the rest are still sub-opt.)			
		Generally, censuses are not done if weather is below this level			
5	Marginal	55-60°F	Partly sunny or overcast	Wet vegetation or heavy fog	15-20 mph
6	Poor	< 55°F	Overcast	Rain	> 20 mph

Appendix D

Distribution and Abundance data as presented in the 2012 5-year status review. The entire status review can be found on the Arcata Fish and Wildlife website at: http://www.fws.gov/arcata/es/inverts/BehrensSS/bss_bfly.html

Surveys conducted during 2004-2006 and 2006 (Pratt 2004; Arnold 2006) and subsequent population monitoring surveys (Liebenberg 2011a, b) indicate that the current range of the Behren's silverspot butterfly extends from near the town of Manchester in the Point Arena area south to Salt Point State Park. The species occurs at several known locations near Point Arena, which together may represent a metapopulation: Manchester State Park (two sites), Stornetta Public Lands, and on at least two sites on private lands northeast and south of Point Arena (Pratt 2004; Arnold 2006; Liebenberg 2011a, b). Other populations occur at Stewarts Point and Salt Point State Park, both located in Sonoma County. These sites were occupied at listing (Service 1997), and Stewarts Point was occupied in 2005 (Arnold 2006), and Salt Point in 2011 (Liebenberg 2011b).

In 2010 and 2011, surveys for the species were conducted on previously unsurveyed sites on private lands between extreme northern Sonoma County (Sea Ranch) and the Point Arena area, in areas where aerial imagery indicated the potential presence of suitable habitat. Twelve properties were visited from 1 to 4 times; a single Behren's silverspot was observed during these surveys, on a private parcel about 1 mi (1.6 km) south of the City of Point Arena (Liebenberg 2011b).

Abundance

Although individual butterflies have been observed at Salt Point, Stewarts Point, and in the Point Arena-Manchester area in the past 5-10 years, the size and viability of populations are unknown (Arnold 2006). Regular monitoring, such as along established transects, is required to determine population and range-wide trends. Transects designed to help address these questions were established in the Point Arena area on Stornetta Public Lands and Manchester State Park in 2006, and at Salt Point in 2010, as a result of cooperative efforts from staff at California State Parks, Bureau of Land Management (BLM), and the Arcata Fish and Wildlife Office. In total, there have been 1.8 mi (2.95 km) of 30 m-wide fixed-width transects established near Point Arena on Stornetta Public Lands and Manchester State Park, and 1.2 mi (1.95 km) of similar transects established in Salt Point State Park; these have been surveyed annually since being established.

The survey protocol is adapted from a standardized method (Pollard and Yates 1993) and has been used for monitoring Oregon silverspot butterfly populations since 1990 (Pickering *et*

*al.*1992). The protocol calls for weekly surveys of all transects throughout the Behren's flight season, conducted under weather conditions favorable to butterfly flight.

Since the last 5-year review, results from those monitoring surveys are available. A standard way to present results from this survey protocol is an annual index of abundance, which is the total number of Behren's silverspot butterflies observed during all the weekly surveys for that year, within a given population. This annual index of abundance does not represent a population estimate; the survey method is not designed to estimate population size, but rather samples a portion of habitat and provides an index to compare relative abundance across years. The annual index for the Point Arena area (Manchester State Park plus Stornetta Publics Lands) from 2006 through 2011, when adjusted for missing surveys, has ranged from 0 to 39, with a mean of 15.7 observed per year (standard deviation = 15.3; Service, unpubl. data 2012a). At Salt Point, the data are less complete, because poor weather and other factors resulted in many weeks without usable survey data. Interpolation was needed to estimate numbers for those weeks, as the annual index is based on summing of weekly survey counts throughout an entire flight season, so having weeks with missing data would result in an underestimate. The resulting Salt Point annual index was 7 for 2010, and 13 for 2011 (Service, unpubl. data 2012a). Because of the interpolation, these annual index estimates are higher than the actual number of butterflies observed at Salt Point (2 in 2010 and 3 in 2011; Liebenberg 2011b).

An index of butterfly density can be derived by dividing the adjusted annual index by the area surveyed by transects. At both Point Arena and Salt Point, the average annual density is roughly 2 butterflies per hectare (ha) (slightly under 1 per acre (ac)) for both sites. These are the first estimates of this type for Behren's, and suggest a relatively low density, compared to the Oregon silverspot butterfly, where densities based on the same methods are typically considerably higher, averaging about 30 per ha for the Oregon silverspot butterfly population in Del Norte County, California (Service, unpubl. data 2012a; Falxa and Imper 2012). While the number of weeks with missing data argues for caution in interpreting the Salt Point data, it is apparent that densities are low compared to those observed for the closely-related Oregon silverspot butterfly.

No clear population trend is apparent to date for Point Arena, with the highest counts observed in 2006, 2010, and 2011. Perhaps coincidentally, these three years had the wettest springs for the period, based on March-June precipitation data from Fort Ross, about 35 mi (56 km) to the south on the coast. In 2008, the year when no butterflies were detected on surveys, the March-June period was extremely low at 0.9 in. (2.3 cm), compared to the 2006-2011 average of 9.6 in. (24.3 cm) for this period. While the highest annual index occurred in the most recent year (2011), the high variability between years suggests that more years of data are needed to determine population trends for the Point Arena area. For the other known populations, similar data do not

exist, with no monitoring to date at Stewarts Point, and only 2 years of data for Salt Point, too little to evaluate trend.

Citations from 5-year status review

Arnold, R. 2006. Final report: Surveys for the endangered Behren's silverspot butterfly and its habitat during 2005 and 2006 in coastal Sonoma and Mendocino Counties, CA. Entomological Consulting Services, Ltd., Pleasant Hill, California.

Falxa, G., and D. Imper. 2012. Summary, Oregon silverspot butterfly surveys, Del Norte County Population. Unpublished report. U.S. Fish and Wildlife Service, Arcata, California. 6 pp.

Liebenberg, A.M. 2011a. Annual progress report – 2010: Behren's silverspot and Point Arena mountain beaver project. Unpublished report submitted to U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata, California. Prepared by California Department of Parks and Recreation.

Liebenberg, A.M. 2011b. Annual progress report – 2011: Behren's silverspot and Point Arena mountain beaver project. Unpublished report submitted to U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata, California. Prepared by California Department of Parks and Recreation.

Pickering, D., D. Salzer, and C. Macdonald. 1992. Population dynamics and habitat characteristics of the Oregon silverspot butterfly (*Speyeria zerene hippolyta*). Report to the Siuslaw National Forest. The Nature Conservancy, Portland, Oregon. 104 pp.

Pollard, E., and T.J. Yates. 1993. Monitoring butterflies for ecology and conservation. Chapman and Hall, London.

Pratt, G. F. 2004. Report to U.S. Fish and Wildlife Service. 2004 Survey for the Lotis Blue. Entomology Department, University of California, Riverside.

[Service] U.S. Fish and Wildlife Service. 1997. Endangered and Threatened Wildlife and Plants: Determination of Endangered Status for the Callippe Silverspot Butterfly and the Behren's Silverspot Butterfly and Threatened Status for the Alameda Whipsnake: Final Rule. Federal Register 62(234): 64306-64320.

[Service] U.S. Fish and Wildlife Service. 2012a. Unpublished data. Data and associated summaries from population monitoring surveys for Behren's silverspot and Oregon silverspot

butterflies. On file at Arcata Fish and Wildlife Office, U.S. Fish and Wildlife Service, Arcata, California.