

Draft Recovery Plan for Behren's Silverspot Butterfly

(Speyeria zerene behrensi)



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

(November 2003)

Region 1
U.S. Fish and Wildlife Service
Portland, Oregon

Approved: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Manager, California/Nevada Operations Office
Region 1, U.S. Fish and Wildlife Service

Date: _____

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An electronic version of this recovery plan will also be made available at <http://www.r1.fws.gov/ecoservices/endangered/recovery/default.htm>.

Electronic comments on the draft recovery plan can be sent via e-mail to: fw1_behrensilverspot@fws.gov

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EXECUTIVE SUMMARY

Current status: The Behren's silverspot butterfly (*Speyeria zerene behrensii*) is listed as endangered, and likely occurs at a single location near Point Arena, Mendocino County, California. Little is known about the distribution and status of the subspecies. Historic and baseline numbers for the butterfly's range-wide and site specific metapopulations do not exist. We believe the Behren's silverspot butterfly has been extirpated from five previously known locations throughout its range, although surveys need to be conducted to substantiate this conclusion. The number of individuals of the Behren's silverspot butterfly is likely declining due to the degradation and loss of habitat as a result of development and agricultural pressures.

Habitat Requirements and Limiting Factors: The Behren's silverspot butterfly occupies early successional coastal terrace prairie habitat that contains the caterpillar's host plant, early blue violet (*Viola adunca*), adult nectar sources, and adult courtship areas. Additionally, Behren's silverspot butterflies may also inhabit coastal sand dune systems. Habitat characteristics and availability are not well understood for the subspecies; however, inferences can be made by comparing site-specific characteristics to similar habitats used by the closely related Oregon silverspot butterfly (*Speyeria zerene hippolyta*) and Myrtle's silverspot butterfly (*S. z. myrtleae*). 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.

Threats include invasion by exotic species, 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. Surveys of historic and potential habitat sites need to be completed to determine if the Behren's silverspot butterfly occurs on those lands, or if the sites are suitable for future introductions. Management is needed to maintain sufficient habitat at the extant site to sustain the subspecies, curtail vegetative succession, and reduce

other threats to the subspecies and/or its habitat. Other metapopulations of the Behren's silverspot butterfly need to be discovered or established.

Recovery Priority: 3C, per criteria published in the Federal Register (U.S. Fish and Wildlife Service 1983a, 1983b). The priority is based on its 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 (housing and agricultural development).

Recovery Objective: Recover the subspecies to the point where it can be delisted.

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 metapopulations are protected in perpetuity;
- 3) adequate funding for management of all sites is assured and adaptive management plans have been developed and are being implemented; and
- 4) annual monitoring has shown that the range-wide population cumulatively supports a minimum of 8,000 adults for 10 consecutive years, with no individual protected metapopulation having fewer than 500 adults in any year and no recent (within 3 years) severe (10 percent or greater) declines.

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 through active implementation of management plans; and

3) each of the 6 protected metapopulations supports a minimum viable population of 500 adult butterflies for at least 10 years, with a range-wide total population of at least 9,000 adult butterflies during the same period.

Actions Needed:

1. Protect existing habitat.
2. Determine ecological requirements, population constraints, and management needs.
3. Monitor population status and habitat.
4. Reduce take and sources of mortality.
5. Undertake public information and outreach programs

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 2014, downlisting might be considered by 2024, and delisting might be considered by 2034. However, the date of recovery remains highly uncertain due to the private ownership and lack of management agreements for the extant population, and the current lack of surveys in potential suitable habitat. The viability of the extant population is unknown.

Total Estimated Cost of Recovery: \$10,191,000 + additional costs that cannot be estimated at this time.

Major costs include acquisition of habitat for the majority of the Point Arena metapopulation, and subsequent operation expenses. Funding is also necessary for exploration of other potential sites and coordinated management.

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I. INTRODUCTION

A. Overview

The Behren's silverspot butterfly (*Speyeria zerene behrensii*) is a coastal subspecies of the Zerene silverspot (*Speyeria zerene*), a member of the brush-foot family (Nymphalidae). The Zerene silverspot has six recognized subspecies distributed in northern California, Oregon, and Washington (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 California to Long Beach in Washington (U.S. Fish and Wildlife 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 recently 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 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 a single extant site on private land near Point Arena, Mendocino County, California. 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 these 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 listed as threatened in 1980 (U.S. Fish and Wildlife Service 1980), and the Myrtle's silverspot butterfly was listed as endangered in 1992 (U.S. Fish and Wildlife Service 1992).

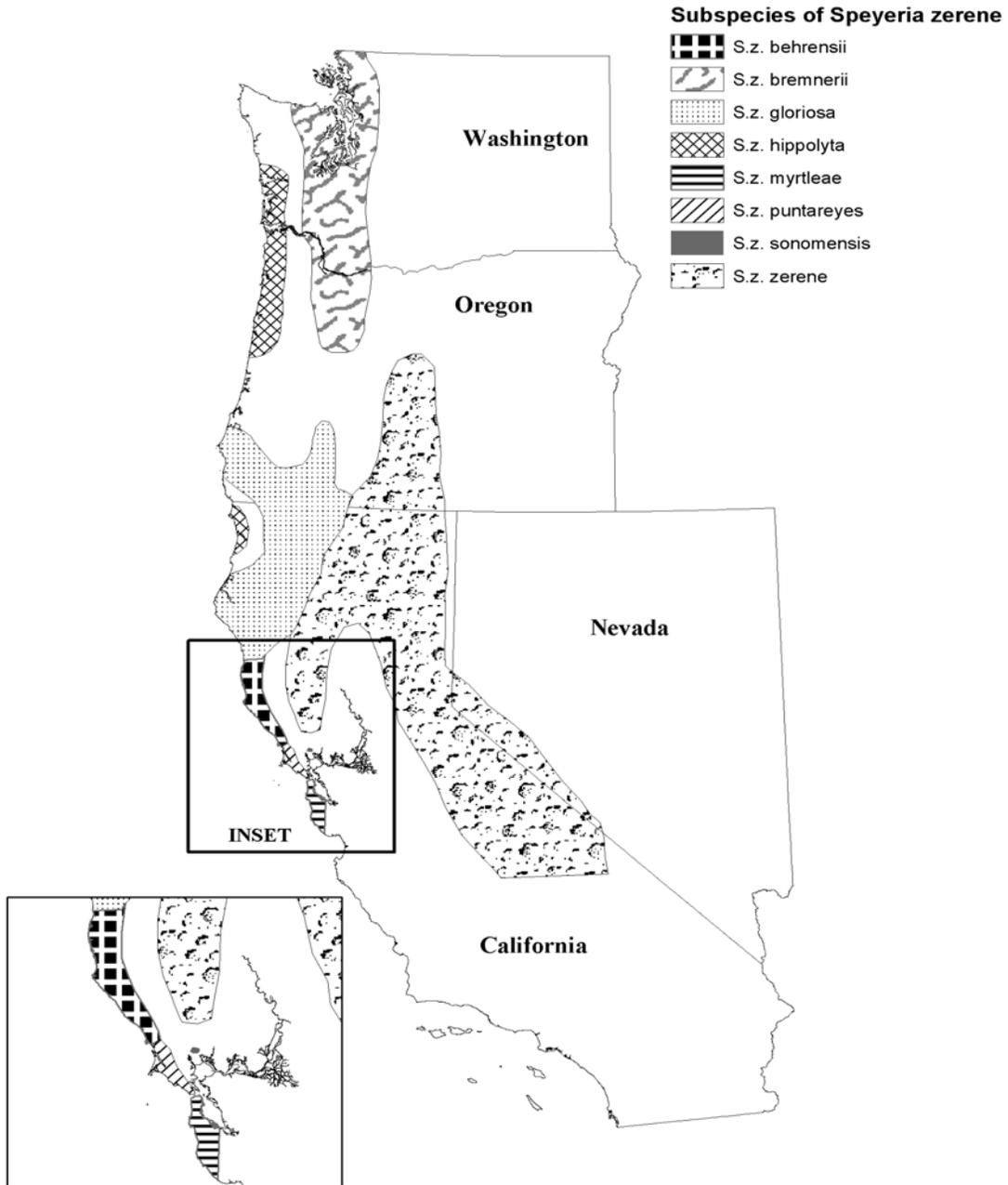


Figure 1. Distribution of subspecies of the *Speyeria zerene* complex of silverspot butterflies in the northwestern United States. The *sonomensis* and *puntareyes* subspecies have been recently described and are being evaluated by taxonomists.

We (the U.S. Fish and Wildlife Service) listed the Behren's silverspot butterfly as an endangered species on December 5, 1997 (U.S. Fish and Wildlife Service 1997). 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. Actions listed in this recovery plan are designed to help initiate the recovery process which would 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. Taxonomy and Description

Thirteen species of true silverspot butterflies are known to occur and are restricted to North America. The genus *Speyeria* is a member of a complex group of 10 species, having a polytypic (i.e., having many forms) population structure with over 100 geographic subspecies. Eight species and 36 subspecies of *Speyeria* are found in the Pacific Northwest. 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; (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. The Behren's silverspot butterfly is one of six subspecies in the *bremnerii* group (Figure 1).

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). It is a medium-sized butterfly with a wingspan of approximately 5.5 centimeters (2.2 inches). 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).

The Behren's silverspot butterfly (*Speyeria zerene behrensii*) 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 in size and also lighter in color than the Behren's silverspot butterfly.

Emmel and Emmel (1998) described the Point Reyes silverspot butterfly (*Speyeria zerene puntareyes*) from Marin and southern Sonoma Counties, California. The populations described as *S. z. puntareyes* were split from *S. z. myrtleae* based on geographic proximity and phenotypic differences. The merits of the *S. z. puntareyes* taxon are being considered, and if widely accepted, it may replace *S. z. myrtleae* as the subspecies that interfaces with *S. z. behrensii* near the Russian River in Sonoma County. Silverspot butterfly populations near Jenner in central coastal Sonoma County appear to have intermediates between the Myrtle's/Point Reyes silverspot butterfly and the Behren's silverspot butterfly (Emmel and Emmel 1998). Another recently described closely related subspecies, *S. z. sonomensis*, is found geographically close to the Behren's silverspot butterfly (Emmel et. al. 1998). *S. z. sonomensis* is described from the southern end of the Sonoma Mountains at the northern end of San Francisco Bay. Like *S. z. puntareyes*, the *S. z. sonomensis* subspecies is being evaluated by taxonomists. Variation and hybridization in butterflies is briefly discussed in Garth and Tilden (1986).

C. 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. 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 entire metapopulation. The concept of metapopulations is discussed in Harrison et. al. (1988) and Wells and Richmond (1995).

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 (type location), 2) Point Arena (likely the only remaining extant site), 3) south Anchor Bay headlands, 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.

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. Launer et al. (1992) considered the subspecies near Jenner as most closely related to the Myrtle's silverspot (*S. z. myrtleae*), although Emmel and Emmel (1998) considered the population to belong to the Point Reyes subspecies (*S. z. puntareyes*). Even though the Jenner metapopulation is likely more closely aligned with the Myrtle's silverspot butterfly, it has been considered similar to the Behren's silverspot butterfly (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). Generally, we believe that the Behren's silverspot butterfly's distribution is north of the Russian River, and the Myrtle's silverspot butterfly occupies the area to the south. Until the Point Reyes silverspot butterfly subspecies is widely accepted, 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. Additionally, some older records from the 1930's, 1940's, and into the 1970's, indicate that *S. z. behrensii* may have extended as far north as Orick, Humboldt County, California. However, the Humboldt County records are most likely *S. z. gloriosa* (Figure 2), which exhibits a range of phenotypic variation overlapping with *S. z. behrensii*.

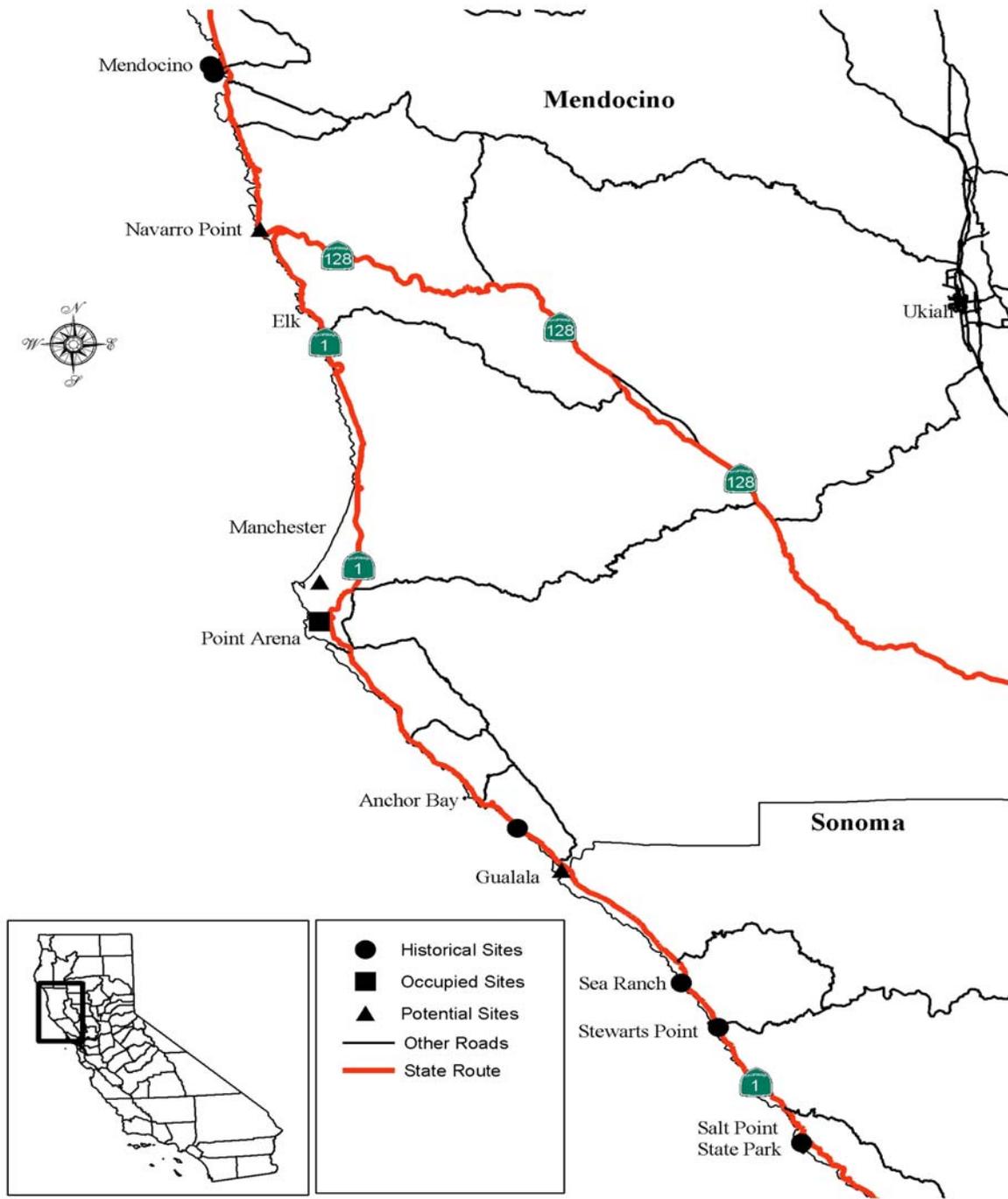


Figure 2. Distribution of historic, occupied, and potential Behren's silverspot butterfly (*Speyeria zerene behrensii*) habitat in Mendocino and Sonoma Counties, California.

D. Population Status

Little is known regarding the status (i.e., population size or trend) of the Behren's silverspot butterfly. Limited surveys have been conducted, primarily to determine the presence of the butterfly at previously known sites. There is no documentation in the records that quantifies the number of individuals at a specific site, or on a range-wide basis. Repeated surveys would be needed to establish a baseline and population trend. Consequently, no data are available regarding the population trends for the butterfly. We believe it likely that the overall population numbers are declining, based on increased development and agricultural pressure occurring within the subspecies' range. A monitoring program to determine trends at site locations and throughout the butterfly's range is required before the population status can be adequately determined.

Some researchers believe that a population size of at least 50 individuals is needed to avoid short-term inbreeding depression (Franklin 1980). 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. Franklin (1980) suggested that a metapopulation should contain at least 500 individual adult butterflies to maintain evolutionary potential, which is a component of a species' viability. Interbreeding between populations within a metapopulation likely balances genetic drift with mutation, providing the diversity necessary for a viable metapopulation.

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. Consequently, recovery criteria for the Behren's silverspot butterfly (see section II.B below) were established using 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.

Relatively recent surveys indicate that the Behren's silverspot butterfly is extant (i.e. known to occur) at Point Arena (J. Ebner, personal observation 1998). This location is on private land, making it difficult to survey. Private ownership, however, also likely limits access by collectors, affording some protection to the metapopulation. Approval from the landowner is required to access the site and conduct surveys. Acquisition of the Point Arena metapopulation's habitat is likely to occur soon. Our understanding is that the landowners have agreed to a selling price, and several State and Federal agencies have contributed towards the agreed to amount.

The status of the Mendocino headlands, south Anchor Bay headlands, Stewarts Point, and north Salt Point metapopulations remains uncertain. The Sea Ranch metapopulation is believed to have been extirpated as a result of residential development and fire suppression. Surveys are needed to determine its status. The Mendocino headlands and north Salt Point locations appear to contain suitable habitat, on lands managed by the California Department of Parks and Recreation (State Parks). Surveys at those locations in cooperation with State Parks are needed to determine if the Behren's silverspot butterfly occupies the sites. The south Anchor Bay and Stewarts Point locations are on private property. Approval (preferably in writing) from the landowners is required prior to initiation of surveys.

Suitable habitat exists at other locations (Figure 2). The Mendocino Land Trust owns and manages lands at Navarro Point, just north of the mouth of the Navarro River, Mendocino County. Other potential sites include habitat at the south end of Manchester State Park, Mendocino County, and Gualala Point Regional Park, Sonoma County. All suitable habitat should be surveyed in cooperation with landowners to determine use of these sites by the butterfly.

E. Life Cycle, Habitat Requirements, and Limiting Factors

1. Life Cycle and Population Dynamics - 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 3). However, other violets (*Viola* spp.) are likely used as well. Upon hatching, the caterpillars (i.e. larvae) wander a short distance and spin a silk pad upon which they pass the fall and winter. The newly hatched first-instar larvae eat the lining of the eggshell prior to their pre-diapause (i.e. physical dormancy) movement. The larvae are dark-colored with many branching, sharp spines on their backs. The larvae immediately seek out the food plant upon termination of their diapause in the spring. They pass through five instars (i.e. stages of development) before forming a pupa within a chamber of leaves that they draw together with silk. The adults emerge in about 2 weeks and live for approximately 3 weeks.

Depending upon environmental conditions, the flight period of this single-brooded butterfly ranges from July to August.

Adult males patrol open areas in search of newly emerged females.

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 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,



Figure 3. Early blue violet (*Viola adunca*).

larval development appears to be faster in the Behren's silverspot butterfly. Both the earlier flight period and increased larval development rate in the Behren's silverspot butterfly may be a response to generally warmer temperatures at southerly latitudes.

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 (J. 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 (J. Ebner, personal observation 1998). Newly emerged males can be difficult to approach. Adults may feed on nectar 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 (J. 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 also uses coastal sand dune systems, it is likely that the Behren's silverspot butterfly will do so 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) caterpillar host plants, and 2) adult nectar sources. Distribution of the Behren's silverspot butterfly is highly dependent on these resources. 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: *altafescue* (*Festuca arundinacea*), blackberry (*Rubus vitifolius*), bracken (*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, violets (*Viola* spp.) need to be a component of the vegetative composition of the site, as they are the butterfly's larval host plant. Nectar sources, such as yellow bush lupine, need to be available to foraging adults during the July to September flight period. Behren's silverspot butterflies were observed foraging on thistles (*Cirsium* sp.) at the extant Point Arena location (J. Ebner, personal observation 1998). Violets occur in isolated patches at the Point Arena location, possibly a result of soil moisture and cattle grazing (J. Watkins, personal observation 2002).

Coastal sand dune systems in California have been greatly modified by anthropogenic development, including building, roads and other infrastructure, reduction in beach deposited sediments, and the introduction of invasive nonnative 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. 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 (*Baccaris 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).

3. Threats and Limiting Factors

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.

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, 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 larvae have not been studied.

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 aboriginal peoples, was an important factor that maintained coastal terrace prairie habitat. The timing and frequency of the historic fire regime is not well understood for the Mendocino and Sonoma coasts. Most fires probably occurred in late summer and early fall, although some may have occurred in January or February during dry periods.

Exotic vegetation - Loss of major disturbance patterns has accelerated succession at historic and potential Behren's silverspot butterfly sites (Figure 4). 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 historic disturbance regimes has probably accelerated expansion of several nonnative plant species that threaten Behren's silverspot butterfly populations, in addition to encouraging native shrub and tree growth.

The spread of nonnative plants has likely reduced, degraded, or eliminated habitat for the Behren's silverspot butterfly at several sites. Scotch or Scots broom

(*Cytisus scoparius*) is one of the most notable nonnative shrubs due to its showy yellow flowers.

Another dominant nonnative invader of coastal terrace prairies is the Himalayan blackberry (*Rubus discolor*).

Introduced grasses represent one of the most imminent threats to habitat maintenance. Nonnative 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 exotic grasses produce particularly tall or dense stands which eliminate native plants (Hammond 1994). Effects of vegetation management techniques on nonnative 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 abundance of early blue violets and levels of Oregon silverspot butterfly oviposition (i.e. egg deposition) activity to be 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. 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 dormant early blue violets that subsequently have initiated vigorous growth (Hammond 1986). It is important to



Figure 4. Shore pine (*Pinus contorta*) invading Behren's silverspot butterfly habitat.

note, however, that in the years subsequent to removal of woody overstory, some sites were invaded by perennial, exotic 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, exotic grass-dominated system has never been demonstrated; therefore, it is unknown if violets would respond vigorously to removal of grass (D. Pickering, personal communication 2001).

Livestock grazing - Grazing by domestic animals replaced fire as the major disturbance agent at many of the historic and potential butterfly sites (Figure 5). 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 heavy grazing can denude vegetation and reduce habitat quality for the Behren's silverspot butterfly, 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. 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. Overgrazing of host plants and trampling could be a significant source of butterfly mortality. 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.



Figure 5. Cattle grazing in Behren's silverspot butterfly habitat.

Development -

Agricultural, residential, and commercial development (Figure 6) have removed or degraded habitat for the Behren's silverspot butterfly. 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. Coastal terrace prairie has been converted to agricultural uses, especially row crops. The Sea Ranch residential community probably resulted in the degradation and loss of Behren's silverspot butterfly habitat. Fire suppression associated with settlement of the region has greatly increased the rate of succession.



Figure 6. Residential development in Behren's silverspot butterfly habitat.

Butterfly collecting - We are aware of illegal trade in listed, protected, and rare butterflies. 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 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 a very few individuals from a site by a few collectors. Unscrupulous 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.

F. Conservation and Management

We have 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 utilize their authorities in the furtherance of the purposes 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. Critical habitat designation has the potential to affect activities conducted, funded, or authorized by a Federal agency, through section 7(a)(2) of the Endangered Species Act.

We 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. These agreements would allow State resource agencies to develop conservation programs for the 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.

In addition, we enforce the prohibitions against take under section 9 of the Endangered Species Act. 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. “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).

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 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. The Habitat Conservation Plan would describe how the person applying for an incidental take permit would minimize and mitigate, to the maximum extent practicable, the impacts of the proposed action on the species. Incidental take permits may also require environmental analysis under the National Environmental Policy Act. A project with minor impacts may qualify as a “Low Effect” Habitat Conservation Plan, which would allow a streamlined review process. 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.

Another recently developed option for private landowners is the Safe Harbor program. We issued our final policy on Safe Harbor Agreements on June 17, 1999 (U.S. Fish and Wildlife Service 1999). 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. Landowners provide voluntary conservation activities (e.g., restoration of native coastal terrace prairie habitats, removal of invasive brush) that benefit and attract listed species. Under a Safe Harbor Agreement, participating landowners would be allowed to return their property to its original baseline condition at some time in the future provided a net conservation benefit is achieved. An example of net conservation benefits for the Behren's silverspot butterfly may include an increase in population numbers and improved habitat condition.

G. 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 (U.S. Fish and Wildlife Service 1997). 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.

1. Protection of Habitat - At present, the only extant site for the Behren's silverspot butterfly is offered for sale. Federal and State resource and conservation agencies are working to purchase the property to ensure its

conservation. However, the threat of development, primarily residential development, is of the utmost concern.

Locating additional occupied sites and identifying suitable habitat that can be managed for the conservation of the Behren's silverspot butterfly, should reintroduction prove to be warranted, are essential measures to ensure the long-term viability of the subspecies. Without additional metapopulations, the entire existing population of Behren's silverspot butterfly is vulnerable to development or to random fluctuations in population parameters or the environment. Consequently, downlisting and delisting criteria have been developed that provide for multiple metapopulations throughout the butterfly's historic range that are secure from the threats of development and of random fluctuations in population parameters and environmental conditions. These criteria include range-wide population numbers to ensure that the subspecies can withstand cycles of population declines. Range-wide population declines are of concern because the butterfly has a limited historic range. An event that affects one metapopulation may affect another due to their relatively close proximity to one another. The range-wide population can likely rebound from a random event at a single location if target numbers are reached.

Until significant new information can be obtained about the habitat requirements and distribution of the subspecies, the highest priority will be to protect habitat to maintain the existing Point Arena metapopulation of Behren's silverspot butterfly. As additional sites are discovered or identified for butterfly recovery, they may be protected through fee acquisition from willing sellers, Habitat Conservation Plans, Safe Harbor Agreements, conservation easements, and other forms of management agreements.

2. 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. Augmentation of existing subpopulations within the Point Arena metapopulation should be considered, provided that studies indicate that the habitat and overall risk to the metapopulation warrant the effort. Augmentation should be considered on protected habitat if: a) the metapopulation shows a persistent drop in numbers over time, b) observed population numbers remain low after 2 consecutive years of favorable weather and habitat conditions, c) numbers decline to 30 percent or more below the long-term population mean, or d) the history or the environmental conditions of the site indicate that the number of individuals is so low as to risk extirpation of the metapopulation. If populations are augmented, the introductions should be made into protected, good quality habitat, or improving managed habitat.

Augmentation should not be undertaken without first attempting to determine and rectify the cause of the decline. Augmentations may provide temporary increases to a metapopulation to buffer against random population fluctuations and environmental events, but unless the proximate causes of the decline are remedied, the decline will likely continue. Augmentation should be conducted under a plan that includes a goal for the metapopulation to signal the end point for the action.

3. 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 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. To avoid wasted effort, the receiving site must be well characterized prior to introduction and determined to be able to support a metapopulation of its own. The source population must be able to sustain itself without the reproductive contribution from the females collected at that location. Like augmentation, reintroduction should be conducted under a plan that includes a goal for both the receiving and source metapopulations to trigger an end point for the action.

The objective of reintroduction would be to establish a metapopulation of Behren's silverspot butterfly at an unoccupied historic location, or a new location

with high quality habitat where the threats are low. Reintroduction should be considered only after a comprehensive range-wide survey has been conducted to determine: 1) historic locations for the Behren's silverspot butterfly, 2) location of previously unknown metapopulations at unsurveyed sites, and 3) if the source metapopulation can support the removal of hatch year offspring to another location.

4. Management of Habitat - Management of protected habitats is necessary to deal with 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. Effective management will be long-term, but must include at least qualitative monitoring that will be used to adopt management in response to shifting habitat needs and threats.

Comprehensive management plans are needed for all extant and potential Behren's silverspot butterfly localities, particularly for metapopulations with multiple land ownerships. Habitat management techniques should be continually refined to evaluate habitat conditions and effectiveness of management, and management plans should be periodically updated based upon new information.

As conservation or management plans are implemented, monitoring of Behren's silverspot butterfly numbers will be important to determine the effectiveness of management. Population censuses should be coordinated to extend over the subspecies' range wherever possible. Monitoring methods should be consistent throughout the subspecies' range. Census data collected consistently over a sufficient period of time, coupled with long-term habitat management, will be particularly important in evaluating the status and viability of the metapopulations.

As existing metapopulations are protected and managed, the emphasis in conserving the subspecies will shift toward determining whether viable metapopulations are being sustained. If metapopulations prove to be nonviable and at high risk for extinction, additional habitat should be restored and protected, and augmentation and reintroduction considered.

II. RECOVERY

A. Objective and Criteria

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. In part, this goal can be accomplished by ensuring the number of individuals in a metapopulation is sustainable, and that the butterfly's distribution represents its former range.

The primary objective of this recovery plan is to recover the Behren's silverspot butterfly sufficiently to allow delisting in 20 to 30 years. 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 draft plan are comparable to criteria developed previously for the closely related Myrtle's and Oregon silverspot butterflies.

B. Recovery Criteria

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 have been established (discovered or reintroduced) at protected sites;
- b) all metapopulations are protected in perpetuity;
- c) adequate funding for management of all sites is assured and adaptive management plans have been developed and are being implemented; and

d) annual monitoring has shown that the range-wide population cumulatively supports a minimum of 8,000 adults for 10 consecutive years, with no individual protected metapopulation having fewer than 500 adults in any year and no recent (within 3 years) severe (10 percent or greater) declines.

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 have been established at six protected locations: two in Sonoma County and four in Mendocino County;

b) the six protected metapopulations are managed in perpetuity for the Behren's silverspot butterfly through the active implementation of management plans; and

c) each of the 6 protected metapopulations supports a minimum viable population of 500 butterflies for at least 10 years, with a range-wide total population of at least 9,000 butterflies during the same period.

C. Narrative Outline of Recovery Actions

Recovery actions for the Behren's silverspot butterfly are outlined below in stepdown format. Recovery actions are linked with threats and recovery criteria in Appendix A.

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 Behren's silverspot butterfly is currently known to occur on private lands that are not retained by a land trust. The known extant site exists on a ranch in the area near Point Arena. Purchase of suitable habitat from willing sellers, development of conservation easements and management agreements are tools that can be used to secure habitat for the butterfly. As noted above, this site is likely to be acquired in the near future;

1.1.1. Develop a habitat conservation strategy for the Point Arena metapopulation.

Suitable habitat in the Point Arena area 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.

1.1.2. Determine willingness of landowners identified in task 1.1.1 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, the Natural Resource Conservation Service's Wildlife Habitat Improvement Project funds, and weed management programs. The

California Department of Fish and Game should be a lead State agency seeking funding from section 6 and other sources.

1.1.3 Map habitat areas for the Point Arena metapopulation.

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.

1.1.4 Protect habitat for the Point Arena metapopulation.

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 should be the lead agency. We can provide funding through the Coastal Wetland Grant funds and section 6 of the Endangered Species 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 U.S. Fish and Wildlife Service.

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. Additionally, the Mendocino Land Trust and the 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.

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.

We will contact land owners having potential butterfly habitat to query them regarding their plans for the property and their interest in participating in the recovery of the Behren's silverspot butterfly. We will work with willing participants to provide technical assistance with management and development of easements, obtain grant funding to implement management actions, and provide regulatory assurances through the Safe Harbor Program, as necessary. We will encourage the development of Habitat Conservation Plans where incidental take is unavoidable.

1.2.3 Survey and map habitat areas on all ownerships.

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 identified in task 1.2.1.

Potential habitat 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. 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 U.S. Fish and Wildlife Service.

1.3 Develop and implement management plans for habitats protected in tasks 1.1 and 1.2.

1.3.1 Develop management plans.

Develop a site-specific management plan 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 updated and revised every 3 to 5 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 towards 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 southerly distribution.

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 reserve configuration 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 the 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.

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 utilized. 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.

Nonnative grasses such as bent grass, European beach grass, heath grass, orchard grass, velvet

grass, reed canary grass, and tall fescue commonly invade meadows, crowding out low-growing early blue violet and nectar plants needed by the butterfly. Managers wishing to control invasive nonnative 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 nonnative 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.

Mowing and burning have been used successfully for almost 10 years at some Oregon silverspot butterfly sites to reduce competing grasses and herbs, and to improve conditions for early blue violets. Additionally, early blue violet seeds have been broadcast to expand violet populations.

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 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 have negative impacts on nectar species.

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. 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 or mowing, but this procedure can be expensive.

These techniques should be refined as additional information becomes available.

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.

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. Changes to the management methods used should be based on the results of monitoring until the desired effects are achieved.

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. They are 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*). It is important to determine the habitat requirements of these species, and to assess the effects that management for the Behren's silverspot butterfly may have on them.

2.3 Determine the optimum methods of re-introducing the butterfly into restored or unoccupied habitat.

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 sole remaining area 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.

Additionally, artificial introduction techniques 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 captive bred individuals 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). All introductions will be conducted in adherence to applicable Federal, State, and local laws, regulations, and policies, including our Controlled Propagation Policy (U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration 2000).

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 caterpillars into restored or unoccupied habitat.

Oregon silverspot butterfly caterpillars have been successfully released at Cascade Head, Oregon (Pickering 2001) using methods modified from Hammond and McCorkle (1991). 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 metapopulation.

Because the Point Arena metapopulation may be the sole remaining location for the Behren's silverspot butterfly, sources of mortality must be determined. This task is essential to the survival and recovery of the subspecies. Research is to determine if there are sources of adult or larval mortality 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 towards its recovery objectives. 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 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.

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.

Researchers and managers should consider techniques and methodologies developed to monitor the related Oregon silverspot butterfly when developing guidelines for the Behren's silverspot butterfly. 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.

The 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 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 prescribe burn and type of burn, equipment used in mowing, and mowing height). (Refer to task 3.3). Guidelines need to include monitoring that provides for the evaluation of management action effectiveness.

3.5 Develop a monitoring plan for the Point Arena metapopulation 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 will 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.

3.6 Implement a monitoring plan for the Point Arena metapopulation 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.

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. 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 task 3.

Law enforcement agencies, including the Law Enforcement branch of the U.S. Fish and Wildlife 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 site to be managed 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 actions and their contribution through compliance with protective measures.

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, Narrative Outline of Recovery Actions. 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.

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
- Total Cost – Projected cost from start to completion of action.

Acronyms used in the Implementation Schedule:

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

Implementation Schedule for Behren's Silverspot Butterfly Draft Recovery Plan

Action Priority	Action Number	Action Description	Action Duration	Responsible Parties	Cost Estimate (in \$1,000 units)					Comments/Notes
					Total Costs	FY 03	FY 04	FY 05	FY 06	
1	1.1.1	Develop a habitat conservation strategy for the Point Arena metapopulation.	2	BLM DPR FWS* CDFG	2 1 1 1		1 1 1 1	1 - - -		
1	1.1.2	Determine willingness of landowners identified in action 1.1.1 to participate in recovery of the Behren's silverspot butterfly.	2	FWS* CCC*	1 2	1 2				
1	1.1.3	Map habitat areas for the Point Arena metapopulation.	3	FWS DPR CDFG BLM*	2 5 1 5	2 5 - -	- - - 1	- - 1 4		
1	1.1.4	Protect habitat for the Point Arena metapopulation.	1	FWS CCC*	1,000 9,000	1,000 9,000				
1	1.2.1	Develop a strategy for conservation of potential habitat.	2	FWS* DPR SCP	1 2 1		1 1 1	- 1 -		
1	1.2.2	Determine willingness of landowners with potential habitat to participate in recovery of the Behren's silverspot butterfly.	1	CCC* FWS*	1 1		1 1			
1	1.2.3	Survey and map habitat areas on all ownerships.	1	FWS*	40	40				

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Action Priority	Action Number	Action Description	Action Duration	Responsible Parties	Cost Estimate (in \$1,000 units)					Comments/Notes
					Total Costs	FY 03	FY 04	FY 05	FY 06	
1	1.2.4	Protect habitats identified in action 1.2.1.	TBD	FWS* DPR* SCP*	TBD					Cost depends on specific habitats identified
1	1.3.1	Develop management plans.	4	FWS*	40	35	2	2	1	
1	1.3.2	Implement management plans.	4+	TBD	8	-	2	2	2	
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* DPR FWS	5 1 -	- 1 -	5 - -			
1	2.4.1	Determine the potential sources of mortality at the Point Arena metapopulation.	3	FWS*	3	-	1	1	1	
1	3.1	Determine appropriate parameters to determine population trends.	1	FWS*	2		2			
1	3.2	Determine appropriate parameters to determine habitat trends.	1	FWS*	2		2			
1	3.3	Develop monitoring guidelines and techniques for tracking population status.	1	FWS*	2		2			
1	3.4	Develop monitoring guidelines and techniques for tracking habitat status and habitat management activities.	1	FWS*	2		2			

Implementation Schedule for Behren's Silverspot Butterfly Draft Recovery Plan

Action Priority	Action Number	Action Description	Action Duration	Responsible Parties	Cost Estimate (in \$1,000 units)					Comments/Notes
					Total Costs	FY 03	FY 04	FY 05	FY 06	
1	3.5	Develop a monitoring plan for the Point Arena metapopulation, and populations subsequently identified.	1	TBD	TBD					Costs depend on extent and number of populations.
1	3.6	Implement a monitoring plan for the Point Arena metapopulation and other documented sites.	5	TBD	TBD					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 nectar source plants.	4	FWS*	4		1	1	1	
2	45 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		-	-	-	Begin FY 2004. Costs depend on extent and number of populations.
2	2.2.1.1	Control exotic grass.	5+	BLM* DPR* SCP*	5 5 5		1 1 1	1 1 1	1 1 1	Needed for Point Arena metapopulation;
2	2.2.1.2	Increase or maintain early blue violet density.	5+	BLM* DPR* SCP*	5 5 5		1 1 1	1 1 1	1 1 1	

Implementation Schedule for Behren's Silverspot Butterfly Draft Recovery Plan

Action Priority	Action Number	Action Description	Action Duration	Responsible Parties	Cost Estimate (in \$1,000 units)					Comments/Notes
					Total Costs	FY 03	FY 04	FY 05	FY 06	
2	2.2.1.3	Establish or maintain nectar plant abundance and density.	5+	BLM*	5	-	1	1	1	
				DPR*	5	-	1	1	1	
				SCP*	5	-	1	1	1	
2	2.2.1.4	Control trees.	5+	BLM* DPR* SCP*	TBD	- - -	- - -	- - -	- - -	Costs depend on extent and number of populations.
2	2.2.1.5	Control brush.	5+	BLM* DPR* SCP*	TBD	- - -	- - -	- - -	- - -	Costs depend on extent and number of populations.
2	2.2.1.6	Monitor/control exotic forbs.	5+	BLM* DPR* SCP*	TBD	- - -	- - -	- - -	- - -	Costs depend on extent and number of populations.
2	2.2.1.7	Monitor effectiveness of management actions.	5+	BLM* DPR* SCP*	TBD	- - -	- - -	- - -	- - -	Costs depend on extent and number of populations.
2	2.2.2	Determine effects of selected management methods on nontarget species.	5	TBD	TBD	-	-	-	-	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	TBD	TBD	-	-	-	-	Need for captive propagation to be assessed; partners not yet identified

Implementation Schedule for Behren's Silverspot Butterfly Draft Recovery Plan

Action Priority	Action Number	Action Description	Action Duration	Responsible Parties	Cost Estimate (in \$1,000 units)					Comments/Notes
					Total Costs	FY 03	FY 04	FY 05	FY 06	
2	2.3.2	Determine methods for the release of reared Behren's silverspot butterfly caterpillars into restored or unoccupied habitat	5	TBD	TBD	-	-	-	-	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	TBD	TBD	-	-	-	-	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	TBD	TBD	-	-	-	-	Need for captive propagation to be assessed; partners not yet identified
Priority 2 actions subtotal					49					
3	4	Reduce take.	cont	FWS*	-	-	-	-	-	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: \$10,191,000 + additional costs that cannot be estimated at this time										

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APPENDIX A. 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
B	Collection by amateur insect collectors and for scientific research	1(c), 2(b)	4
D	Inadequate protection under CEQA and CESA	N/A	Beyond scope of recovery plan, would require legislative action
D	Lack of land management plans protecting the species	1(c), 2(b)	1.3, 2.2
E	Use of insecticides	1(c), 2(b)	1.3, 2.4, 4
E	Excessive grazing by livestock	1(c), 2(b)	1.3, 2.1, 2.2, 2.4, 3.2, 3.4, 3.5, 3.6, 4
E	Loss of food plants due to invasion of grassland habitat by nonnative plant species.	1(c), 2(b)	1.3, 2.1, 2.2, 2.4, 3.2, 3.4, 3.5, 3.6, 4
E	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
E	Habitat fragmentation	1(a), 1(b), 2(a)	1.1, 1.2, 2.1, 3.2, 3.4, 3.5, 3.6, 4

LISTING FACTOR	THREAT	RECOVERY CRITERIA	ACTION NUMBERS
E	Genetic drift and inbreeding due to isolation of small populations	1(d), 2(c)	2.3, 2.4, 3.1, 3.3, 3.5, 3.6, 3.7
E	Vulnerability to random fluctuations in population size or demographic parameters due to small population size	1(a), 1(d), 2(a), 2(c)	2.3, 2.4, 3.1, 3.3, 3.5, 3.6, 3.7

Listing Factors:

- A. The Present or Threatened Destruction, Modification, or Curtailment Of Its Habitat or Range
- B. Overutilization for Commercial, Recreational, Scientific, 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

Recovery Criteria

1 Downlisting

- a) three metapopulations in Mendocino County and one in Sonoma County are established discovered or reintroduced at protected sites;
- b) all metapopulations are protected in perpetuity;
- c) adequate management funding secured and adaptive management plans have been developed and are being implemented; and
- d) range-wide population of at least 8,000 adults for 10 consecutive years, with all 4 metapopulations over 500 adults and no recent severe declines.

2 Delisting

- a) metapopulations have been established at six protected locations: two in Sonoma County and four in Mendocino County;
- b) actively implemented management plans in perpetuity for these six metapopulations; and
- c) range-wide population of at least 9,000 adults for 10 consecutive years; with all 6 metapopulations over 500 adults.