PART I

INTRODUCTION

Overview

The Oregon silverspot butterfly (*Speyeria zerene hippolyta*) is a small, darkly marked coastal subspecies of the Zerene fritillary, a widespread butterfly species in montane western North America. The historical range of the subspecies extends from Westport, Grays Harbor County, Washington, south to Del Norte County, California. Within its range, the butterfly is known to have been extirpated from at least 11 colonies (2 in Washington, 8 in Oregon, and 1 in California).

We, the U.S. Department of the Interior, Fish and Wildlife Service, listed the Oregon silverspot butterfly was listed as a threatened species with critical habitat in 1980 (USDI 1980; 45 FR 44935). We completed a recovery plan for this species in 1982 (USDI 1982). The species recovery priority number is 3, indicating a high degree of threat and high recovery potential (USDI 1983; 48 FR 43098).

At the time of listing, the only viable population known was at Rock Creek-Big Creek in Lane County, Oregon, and was managed by the U.S. Forest Service (Siuslaw National Forest). The Siuslaw National Forest developed an implementation plan (Clady and Parsons 1984) to guide management of the species at Rock Creek-Big Creek and Mount Hebo (Mt. Hebo) in Tillamook County, Oregon. Additional Oregon silverspot butterfly populations were discovered at Cascade Head, Bray Point, and Clatsop Plains in Oregon, on the Long Beach Peninsula in Washington, and in Del Norte County in California.

The probability of survival of four populations has been increased by management efforts of the Siuslaw National Forest and The Nature Conservancy, however, some threats to the species remain at all of the sites. Populations at Clatsop Plains have declined since their discovery and the population at the Long Beach Peninsula may be extirpated.

The current distribution of the Oregon silverspot butterfly includes three distinct (but in some cases co-occurring) ecosystem types — montane/grasslands, marine terraces and headlands, and stabilized dunes. This revised recovery plan

recognizes the value of spreading the risk of global extinction of the subspecies by recommending protection of six habitat conservation areas that collectively include all of each of these ecosystem types.

Actions listed in this revised recovery plan are designed to help the recovery process continue until the butterfly no longer needs special protection afforded by the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.).

Taxonomy and Description

The true fritillary, or silverspot butterflies, comprise the genus *Speyeria* within the family Nymphalidae and include 13 species restricted to North America. Ten species have a complex, polytypic population structure with over 100 geographic subspecies. Eight species and 36 subspecies of *Speyeria* are found in the Pacific Northwest.

The Oregon silverspot butterfly (Figures 1 and 2) is 1 of 15 subspecies of *S. zerene* (Boisduval 1852). 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 may occur. These include: (1) the *bremnerii* group in the Pacific Northwest west of the Cascade Range and on the Northern 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 Oregon silverspot butterfly is one of five subspecies in the *bremnerii* group. Historical distributions of these subspecies are illustrated in Figure 3, together with the distribution of the Oregon silverspot butterfly (*S. z. hippolyta*).

Figure 1. Oregon silverspot butterfly, top view
Photo by Richard Szlemp, U.S. Fish and Wildlife Service.

Figure 2. Oregon silverspot butterfly, side view
Photo by Richard Szlemp, U.S. Fish and Wildlife Service

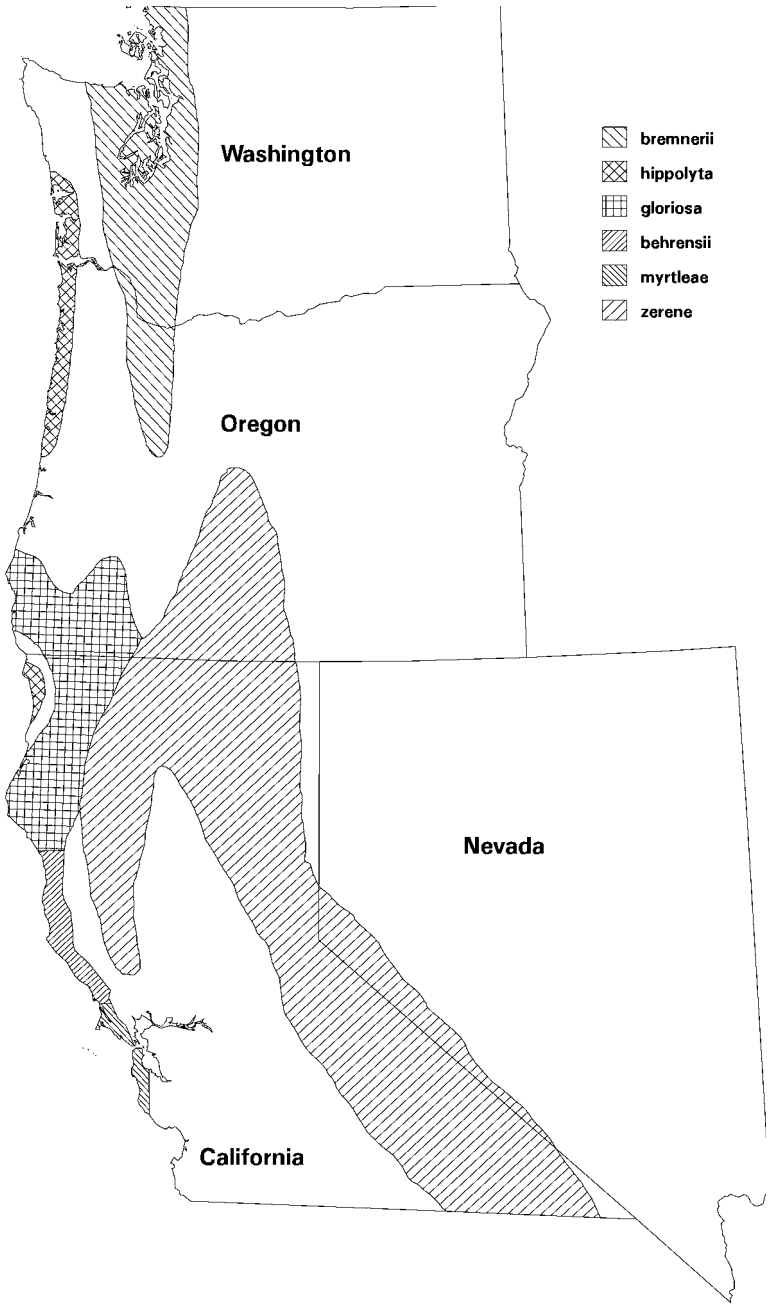


Figure 3. Distribution of the five subspecies of the *bremnerii* group of *Speyeria zerene* and typical *Speyeria zerene zerene*.

Several of these subspecies have declined as a result of human disturbances and ecological succession (Hammond and McCorkle 1984b). For example, the valley silverspot butterfly (*S. z. bremnerii*) has become extinct in the Oregon portion of its range, although it is still found in Washington. We listed the Myrtle's silverspot butterfly (*S. z. myrtleae*) as endangered. We are reviewing the status of the Behren's silverspot butterfly (*S. z. behrensii*).

Diagnostic characters of the *bremnerii* group are as follows:

1. Ground color on dorsal wings is medium to reddish orange with heavy dark basal suffusion.
2. Veins of dorsal male forewing thickened with dark androconial scales.
3. Ventral hindwing with a dark reddish brown disc.
4. Ventral hindwing with a narrow yellow to lavender submarginal band.
5. Ventral hindwing with small, metallic silver spots in discal, median, and submarginal areas of the wing.

By contrast, dorsal wings of the *zerene* group are also medium to reddish orange, but they lack heavy basal suffusion. Male forewing veins are usually thin or only slightly thickened with dark scaling. On the ventral hindwing, the *zerene* group has a purple-brown or purple-red disc, a narrow lavender submarginal band, and the small spots may be either silver or unsilvered creamy-white.

As discussed by McCorkle and Hammond (1988), the Oregon silverspot butterfly differs from other subspecies of the *bremnerii* group by its coloration and small size. In addition, the Oregon silverspot butterfly differs from related taxa in physiology and larval development rates. These differences appear to be specific adaptations to a harsh, coastal environment characterized by fog and cold wind throughout much of the year. A slow caterpillar development rate synchronizes the adult flight season with best coastal weather conditions in late August and September. Moreover, the wide range of individual variation in developmental rates may serve to compensate for variable and unpredictable weather conditions from year to year. Unique diagnostic characters for the five subspecies of the *bremnerii* group are listed below in Table 1. The characters are based partly on data from McCorkle and Hammond (1988).

Table 1. Diagnostic characters for the subspecies of the *bremnerii* group.

subspecies	characters			
	wings (lengths in millimeters [mm])	disc color	submarginal band color	caterpillar develop-ment rate
Oregon silverspot butterfly (*S. z. hippolyta*)	small (male forewing length 24 to 29 mm mean = 27 mm)	dark reddish brown	clear yellow	very slow
Valley silverspot butterfly (*S. z. bremnerii*)	medium to large (male forewing length 28 to 32 mm, mean = 30 mm)	dark reddish brown	clear yellow submarginal band	fast
Gloriosa silverspot butterfly (*S. z. gloriosa*)	medium to large (male forewing length 28 to 32 mm, mean = 30 mm)	dark reddish brown	40% with yellow submarginal band, 60% with lavender or tan band, often with reddish suffusion over band	slow
Behren's silverspot butterfly (*S. z. behrensii*)	medium (male forewing length 28 to 30 mm, mean = 29 mm)	dark reddish brown	lavender	slow
Myrtle's silverspot butterfly (*S. z. myrtleae*)	medium to large wing (male forewing length 28 to 32 mm, mean = 30 mm)	reddish brown with extensive yellow suffusion	clear yellow	slow

Geographic Distribution

Historically, the Oregon silverspot butterfly was distributed along the Washington and Oregon coasts from Westport in Grays Harbor County south to about Heceta Head in Lane County (Figures 3 and 4) and was closely associated with the distribution of early blue violet (*Viola adunca*), the primary larval host plant. In addition, there is a disjunct cluster of populations north of Crescent City in Del Norte County, California. At least 20 separate localities were known for the butterfly in the past. Both the butterfly and its coastal grassland habitat were probably much more common in the past (Ripley 1983).

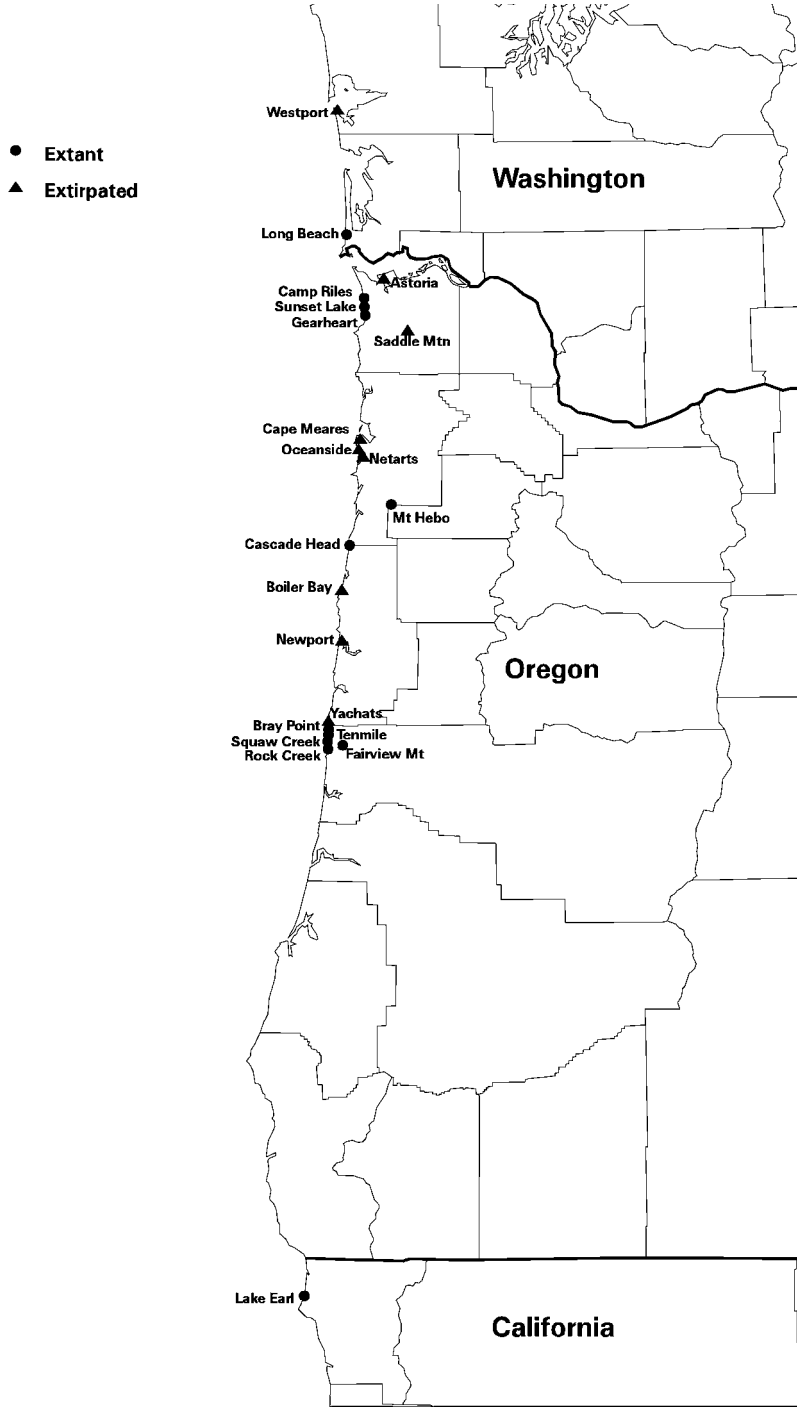
Oregon silverspot butterfly populations currently occur at only six sites. One is in Del Norte County (Lake Earl), two are in Lane County (Rock Creek-Big Creek and Bray Point), and two are in Tillamook County (Cascade Head and Mt. Hebo). The population at a sixth site in Clatsop County (Clatsop Plains) has declined in recent surveys with only one Oregon silverspot butterfly documented in 1998 (VanBuskirk 1993, 1998).

The California populations are approximately 240 kilometers (150 miles) south of the nearest populations of the Oregon silverspot butterfly in Lane County, Oregon. Intervening populations of other silverspot butterflies (*S. zerene*) are distributed along the southern Oregon coast from Cape Ferrelo in Curry County north to Seven Devils Wayside in Coos County. These have been identified as the gloriosa silverspot butterfly (Hammond 1992a).

Oregon silverspot butterflies are likely extirpated from Long Beach Peninsula. The last confirmed sighting there was during a 1990 survey (Sayce 1990), however, subsequent surveys in 1992, 1996, 1997, and 1998 did not document any Oregon silverspot butterflies. Oregon silverspot butterfly habitat monitoring on Long Beach Peninsula indicates a declining population trend for early blue violet (Hays 1996). Washington Department of Fish and Wildlife is working to restore and expand existing habitat.

Historically, Oregon silverspot butterflies likely exhibited a metapopulation structure, i.e, a group of populations inhabiting a mosaic of habitat patches where extinction of local populations in particular patches were re-colonized by individuals from adjacent patches (Hanski and Gilpin 1997). Habitat fragmentation and subsequent isolation of Oregon silverspot butterfly populations on the present-day landscape have resulted in discrete populations which are

Figure 4. Distribution of the Oregon silverspot butterfly.



presumed to be isolated from one another. One notable exception is the Rock Creek-Big Creek / Bray Point habitat complex. Oregon silverspot butterfly habitats at Rock Creek-Big Creek and Bray Point are owned and managed by the Siuslaw National Forest. Rock Creek-Big Creek and Bray Point are separated by an 8 kilometer (5 mile) corridor, bisected by Highway 101, comprising primarily private residences and two small, undeveloped State waysides. The Nature Conservancy marked butterflies at both sites and documented interchange from the northerly Bray Point south to Rock Creek-Big Creek (VanBuskirk and Pickering 1999), indicating that Oregon silverspot butterflies are able to disperse at least 8 kilometers (5 miles) in the direction of the prevailing wind. This suggests that habitat management activities for Oregon silverspot butterflies should be based on a landscape context in which habitat patches are enhanced to encourage dispersal and interchange between habitats consistent with metapopulation dynamics.

Population Status

The Nature Conservancy has conducted annual population censuses for Oregon silverspot butterflies at the four central coast sites in Oregon since 1990. These sites are: Cascade Head, Mount Hebo, Bray Point, and Rock Creek-Big Creek. Surveys are based on transect counts and provide a population index based on a geometric mean, which provides a conservative method to determine long-term trends and stability of the individual populations at each site (Pickering 2000). It is important to note that although The Nature Conservancy's data span 11 years, they coincide with a period in which both habitat quality and silverspot numbers may be far below historic levels. Thus, the mean population indices for each site should be understood to be the mean during a recent time period and may not represent the mean of historic, or even stable, Oregon silverspot butterfly populations.

Oregon silverspot butterfly populations at the four central coast sites appeared to have been relatively stable between 1985 and 1990 (Hammond 1988b), however populations at all four sites exhibited a marked decline in 1993 following cool, wet spring weather conditions (Pickering 1998b, 2000). Populations at Rock Creek-Big Creek in 1993 were reduced to nearly 80 percent below the 11-year mean for that site, Cascade Head and Mount Hebo each dropped by approximately 60 percent from their respective historic means, and Bray Point dropped by 20 percent.

Oregon silverspot butterfly populations rebounded slightly in 1994 and 1995, but have declined annually starting in 1996 (Pickering 1998b, 2000). Mount Hebo, the largest and most stable population of all four central coast sites, had a 2000 population index that was 20 percent below the 11-year mean. The Oregon silverspot butterfly populations at Rock Creek-Big Creek have experienced declines for the last 5 survey years, dropping 50 percent below the 11-year mean in 2000. Bray Point populations experienced similar declines, such that the 2000 population was too low to provide meaningful survey results. Cascade Head populations experienced a large decline in 1998 as well as 1993, but increased slightly in 1999 and 2000. This may be due, in part, to a population augmentation effort using captive reared larvae, however, the 2000 Oregon silverspot butterfly population at Cascade Head remained 63 percent below the 11-year mean for that site. The 2000 Oregon silverspot butterfly population status at Cascade Head, Rock Creek-Big Creek, and Bray Point indicate that populations are at risk and future efforts to simultaneously augment populations and improve habitat conditions will be vital.

Very little is currently known about Oregon silverspot populations in Del Norte County, California. Population size and total habitat extent at Point St. George-Lake Earl has not been determined, however, a 1998 Oregon silverspot butterfly population survey on habitat owned by California Department of Fish and Game estimated that there were 62 Oregon silverspot butterflies on State land (U.S. Army Corps of Engineers 2000). California Department of Fish and Game owns approximately one-third of the potential habitat in Del Norte County. Hammond speculates that population levels on State land have declined by over 90 percent in the last 10 years (U.S. Army Corps of Engineers 2000), however annual surveys of total habitat have not been conducted to provide a quantitative basis for these estimates. Early blue violet habitat is known to exist from Lake Earl to Point St. George, but the area has not been extensively inventoried for Oregon silverspot butterflies.

Life Cycle, Habitat Requirements, and Limiting Factors

Life cycle and Population Dynamics– The Oregon silverspot butterfly has six larval instars and a pupal stage before metamorphosis into the adult. Newly hatched first-instar larvae immediately enter diapause (physiological dormancy) after eating the lining of the eggshell. They remain in diapause until host plants send up new growth in spring. Caterpillars are cryptic in habits and feed until

pupation in the summer. Very little is known about the biology of the caterpillar or pupae.

Adult emergence starts in July and extends into September. Many males appear several weeks before most females emerge, as is typical of *Speyeria* butterflies. Mating usually takes place in relatively sheltered areas. Adults will often move long distances for nectar or to escape windy and foggy conditions.

McCorkle and Hammond (1988) observed a wide range of individual variation in development rates both between and within family lines when caterpillars were reared under uniform conditions in the laboratory.

Little is known about factors affecting population dynamics of the Oregon silverspot butterfly, although a summary of available information is provided in a status report by the Washington Department of Fish and Wildlife (1993).

Habitat Requirements and Limiting Factors– The Oregon silverspot butterfly occupies three types of grassland habitats. One type consists of marine terrace and coastal headland "salt spray" meadows as exhibited at Cascade Head, Bray Point, Rock Creek-Big Creek, and portions of the Del Norte site. The second consists of stabilized dunes as found at the Long Beach Peninsula, Clatsop Plains, and the remainder of the Del Norte site. Both of these habitats are strongly influenced by proximity to the ocean, with mild temperatures, high rainfall, and persistent fog. The two habitats differ in topography, soils, and exposure to winds. The dune habitat has lower relief, highly porous soils, and less exposure to winds. The third habitat type consists of montane grasslands found on Mount Hebo (Hammond 1991c) and Fairview Mountain. Conditions at these sites include colder temperatures, frequent orographic cloud cover, significant snow accumulations, less coastal fog, and no salt spray.

Each of these habitat types must provide two key resources — caterpillar host plants and adult nectar sources — as well as other suitable environmental conditions. Each habitat patch has a unique combination of these resources, a situation that reduces risk of regional extinction of the subspecies.

Caterpillar host plant. Caterpillars of the Oregon silverspot butterfly feed primarily on early blue violets. Stands of early blue violets sufficient to provide enough food for Oregon silverspot butterfly caterpillars on the Oregon Coast occur only in relatively open and low-growing grasslands, where violets may be

an abundant component of the plant community (Hammond and McCorkle 1984a). Small stands of violets found in small forest clearings isolated from open grasslands are not adequate to support the butterfly.

Although early blue violets are the primary food source, caterpillars are known to feed on a few other species of the genus *Viola* as well. On Mt. Hebo, both oviposition and caterpillar feeding have been observed on yellow stream violets (*V. glabella*). At Lake Earl, large populations of Aleutian violets (*V. langsdorfii*) grow in boggy areas adjacent to sites with early blue violets and probably serve as secondary food plants for silverspot caterpillars.

Historic early blue violet abundance distributed in patches in grassland habitat at Long Beach Peninsula were 25 to 35 violets per square meter (square yard) (D. Hays, Washington Department of Fish and Wildlife, pers. comm. 2001). VanBuskirk (1993) randomly sampled violet densities in Oregon silverspot habitats, finding that the mean violet densities at Cascade Head were 45 violets per square meter (square yard). Singleton (1989) found that the mean density of early blue violets in oviposition areas at Cascade Head was 75 violets per square meter (square yard). A 1991 Oregon silverspot habitat study of Mount Hebo, Cascade Head, Bray Point, and Rock Creek habitats revealed that butterflies oviposited in areas that had a mean of 20 to 100 violets per square meter (square yard) (McIver *et al.* 1991). Early blue violet abundance has declined at all Oregon silverspot habitat areas in Oregon, likely due to competition from non-native vegetation. However, documentation of higher violet densities from these studies should provide a reference point for site managers to use in setting management objectives and target goals for early blue violet abundance.

Female Oregon silverspot butterflies oviposit, or lay eggs, within or adjacent to areas which contain early blue violets. Singleton (1989) found that females seemed to preferentially search for ovipositing sites in areas with vegetation heights of 22 to 25 centimeters (8.6 to 10 inches). Areas with taller vegetation were not searched. Violet density influenced the number and location of eggs laid, with areas of higher violet densities used for ovipositing most frequently (Singleton and Courtney 1991). However, as time searching for oviposition sites increased, density of violets in areas selected for oviposition decreased, indicating that oviposition is not always an indicator of suitable larval habitat. In addition, Singleton and Courtney (1991) stated that areas maintained in very short vegetation but having low violet density could be ecological “sinks” in that females may oviposit in habitats which do not have suitable larval habitat.

Nectar sources. Oregon silverspot butterflies may travel relatively long distances for nectar, and movements of up to hundreds of meters (yards) between open meadows and forest fringes may be in response to differences in nectar availability. Observations suggest that distribution, abundance, and temporal availability of nectar sources may affect stability of Oregon silverspot butterfly populations. Populations in habitats lacking broad availability of nectar throughout the entire flight period may have greater risks of extinction. Oregon silverspot butterflies were found to use nectar species in direct relation to the proximity to violets. Morlan (1987b) suggested that development of habitat mosaics which provide nectar sources in close proximity to violets were important to enable Oregon silverspot butterflies to obtain energetic requirements in the harsh, coastal environments. The Nature Conservancy recommends that at least five different species of native nectar plants be maintained at a density of no fewer than five flowering stems per square meter (square yard) in habitat areas (D. Pickering, The Nature Conservancy, pers. comm. 2001). Site managers should ensure that each habitat area maintains nectar sources in flower throughout the entire flight period of the Oregon silverspot butterfly.

Nectar plants most frequently used by the Oregon silverspot butterflies are members of the aster (composite) family, including the following native species: Canada goldenrod (*Solidago canadensis*), dune goldenrod (*Solidago spathulata*), California aster (*Aster chilensis*), pearly everlasting (*Anaphalis margaritacea*), dune thistle (*Cirsium edule*), and yarrow (*Achillea millefolium*). Oregon silverspot butterflies are also known to nectar[2] on two common introduced species, tansy ragwort (*Senecio jacobaea*) and false dandelion (*Hypochaeris radicata*). Less frequently used species in the aster family include introduced thistles in the genus *Cirsium*, chaparral broom (*Baccharis pilularis*), smooth hawksbeard (*Crepis capillaris*), and woolly sunflower (*Eriophyllum lanatum*). The flowering seasons of these species overlap, providing an array of nectar choices for adult butterflies through the flight season. Tansy ragwort, California aster, and pearly everlasting are generally available later in the flight season. When available, tansy ragwort is used by the Oregon silverspot butterfly as well as many other co-occurring butterfly species.

Tansy ragwort is toxic to cattle and is classified as a noxious weed, so it is a target of eradication efforts using herbicides and biological agents. Although this

[2] "nectaring" is seeking out nectar-bearing flowers and feeding on nectar.

species rapidly invades disturbed areas, its local densities often decline after several years without disturbance.

False dandelion proliferates under mowing regimes, producing large basal leaves which can suppress early blue violet growth (Hays and Johnson 1998, Pickering *et al.* 1993). Research on Oregon silverspot butterfly population dynamics indicated that even when false dandelion is the most abundant nectar plant, it is not the most frequently used species for nectaring by silverspot butterflies (Pickering *et al.* 1993). Butterflies observed nectaring on false dandelion spent more time flying and less time nectaring than those using goldenrod, perhaps due to the increased number of flower heads per goldenrod plant (Pickering *et al.* 1993).

Vegetation dynamics. Three factors affect rates of succession of the Oregon silverspot butterfly's grassland habitats: soil conditions, salt spray and mist from breaking waves, and disturbance regimes. Without these limiting factors, succession is rapid under favorable growing conditions at coastal marine terrace and dune habitats. And while succession is somewhat slower at coastal mountain sites, successional changes in habitat conditions are one of the major remaining threats at all Oregon silverspot butterfly sites.

Soil depth and texture limits vegetation growth, phenology, and succession. Thin rocky soils maintain low open grassland structure on the steepest slopes of coastal salt spray meadows at Cascade Head, Central Coast, and Del Norte sites and in montane grasslands at Coastal Mountain sites. Low water-holding capacity of sandy soils of stabilized dune habitats on Long Beach Peninsula, Clatsop Plains, and Del Norte sites may affect abundance and condition of early blue violets. Lower moisture levels in these sandy soils in years with low rainfall may cause violets to senesce (age and die) before Oregon silverspot butterfly caterpillars can pupate.

Disturbance regimes have changed dramatically over the past 150 years. Eolian (wind) transport of sand by dry summer winds was a primary disturbance mechanism on the Clatsop Plains prior to large-scale soil stabilization projects by the U.S. Soil Conservation Service in the mid-1930's (Hanneson 1962, Wiedemann 1984). Other disturbances such as landslides, small mammal activity, and windthrow, as well as herbivory by invertebrates, small mammals, and large native ungulate grazers are thought to have played a secondary role in creating or maintaining open conditions. Presence of charcoal in soil samples

indicates that fire, primarily set by native Americans, was an important factor that maintained Oregon's coastal grassland communities and their endemic species (Ripley 1983). The timing, extent, and frequency of fires in the area prior to European settlement is not well documented. Most fires likely occurred in late summer and early fall, although some may have occurred in January or February during short dry periods that are typical at that time of year. Some reduction in frequency of coastal fires as early as the 1850's has been documented, but fires continued to be frequent until the early 1900's. Severe fires in 1845 and 1910 converted substantial portions of Mt. Hebo from forest to grassland. Since then, fire frequencies on the Oregon Coast have been greatly reduced and the extent of coastal grasslands has declined dramatically (Ripley 1983).

Grazing by domestic animals replaced fire as the major disturbance agent at many of these grasslands in the early 1900's. Fire and grazing have different effects on composition and function of grasslands communities, although both reduce thatch depth and maintain the open character of the grassland. At many Oregon silverspot butterfly sites, the extent of grazing by domestic animals has been reduced, or grazing has been eliminated. While heavy grazing can denude vegetation and reduce habitat quality for Oregon silverspot butterfly, light to moderate grazing can result in reduction of invasive woody plants and maintain early successional grassland habitats conducive to Oregon silverspot butterfly use.

Influence of exotic vegetation. Loss of these major disturbance patterns has accelerated succession at many Oregon silverspot butterfly sites (Ripley 1983). A number of plants increase under lower disturbance levels, including shrubs (*e.g.*, chaparral broom, salal [*Gaultheria shallon*], berry [*Rubus* spp.], rose [*Rosa* spp.]), tree (*e.g.*, Sitka spruce [*Picea sitchensis*], shore pine [*Pinus contorta* var. *contorta*], red alder [*Alnus rubra*], western redcedar [*Thuja plicata*]), and ferns (*e.g.*, bracken fern [*Pteridium aquilinum*] and sword fern [*Polystichum munitum*]). Lack of historic disturbance regimes has probably accelerated expansion of several non-native species which threaten Oregon silverspot butterfly populations, in addition to encouraging native shrub and tree growth.

The spread of non-native plants has reduced, degraded, or eliminated habitat for the Oregon silverspot butterfly at many sites. Most notable of the non-native shrubs is Scotch or Scots broom (*Cytisus scoparius*). Introduced grasses represent the most imminent threat 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 exotic grasses produce particularly tall or dense stands which eliminate native plants (Hammond 1994a). Effects of mowing and other management techniques on false dandelion, exotic 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.

Both abundance of early blue violets and levels of Oregon silverspot butterfly oviposition activity have been inversely correlated with vegetation height and thatch depth (Singleton 1989, McIver *et al.* 1991, Pickering *et al.* 1992). 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 note, however, that in the years subsequent to removal of woody overstory, some sites were invaded by perennial, exotic grasses which 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, thus it is unknown if violets would respond vigorously to removal of grass (D. Pickering, The Nature Conservancy, pers. comm. 2001).

Macroclimate, topography, and microclimate. The Oregon Coast is an extreme environment for butterflies because of unpredictable cloudy, foggy, windy, and rainy weather during summer and early autumn. Air mass movements interact with regional and local topography to determine cloudiness and wind. Both coastal fog banks and cold fronts bring inclement weather. Coastal fog affects areas below about 488 meters (1,600 feet) elevation, above which clear and relatively calm conditions may predominate. In contrast, cold air masses immediately behind rain-producing cold fronts form orographic clouds above about 305 meters (1,000 feet) elevation when the immediate coast can be clear. Simultaneous differences in weather conditions between coastal salt-spray meadow, coastal dune, and coastal mountain sites, therefore, are common. These microclimatic differences reduce the risk that macroclimate conditions could cause region-wide population declines or extinction.

Frequency of opposing air masses associated with varying weather conditions change through the flight season. Coastal winds are strongest and fog is most frequent in July and early August. Rainstorms associated with cold fronts, in

contrast, are least frequent in July and early August, but become more common in late August and September. Patterns of these events are highly variable from year to year.

High winds can limit adult flight, making wind shelter an important component of habitat suitability. Strong winds on clear days in summer generally come from the northwest. South winds almost invariably bring clouds and rain, and east winds are usually hot and dry but are seldom strong. Topographic shelter can provide comparatively wind-free areas on steep south-facing slopes. Relatively small ridges and hollows can also provide sufficient wind shelter for adult flight when wind speeds are moderate, but they are not usually effective at high wind speeds.

Risk of total reproductive failure from inclement weather is spread among individuals in a local population by the long period of adult emergence, which can extend from mid-July into early-September. This increases the probability that some portion of the population will encounter suitable flight conditions or avoid extreme summer storms that can cause direct mortality.

The long period of adult emergence is likely due to both genetic and environmental variation. Caterpillars inhabiting different slope exposures experience different temperature regimes depending upon solar exposure and wind exposure. Because winds are primarily from the northwest, north-facing slopes not only receive reduced insolation, but also are more wind-exposed. Conversely, south-facing slopes tend to be wind sheltered and receive higher insolation, hence they confer caterpillars and adults added thermal advantages. Even relatively low relief can create distinct microclimates for caterpillars.

Threats and Reasons for Listing

The Oregon silverspot butterfly was listed as a threatened species, effective on October, 15, 1980 (45 FR 44935). Critical habitat was designated at the same time. Lands included in the critical habitat are those that were known to be occupied by the butterfly at the time: portions of Section 15 and the south half of Section 10 that are west of a line parallel to and about 450 meters (1,500 feet) west of the eastern section boundaries of Sections 10 and 15, T16S, R12W, Willamette meridian, Lane County, Oregon.

Investigations in the 1970's and early 1980's had revealed that most historical populations of the Oregon silverspot butterfly were extirpated. Its distribution has been reduced by development, agriculture, invasion by exotic vegetation, and natural succession. Additionally, extant populations were threatened by habitat loss and degradation from natural succession, exotic species, off-road vehicles, grazing, and erosion. Direct effects to populations from road kills (collisions with vehicles) and pesticides were also noted as problems. Take was also a threat.

At the time the species was listed, only one viable population (Rock Creek-Big Creek) of the Oregon silverspot butterfly was known, while three weak populations were known at Tenmile Creek, Clatsop Plains, and Long Beach Peninsula. A proposed development and vegetative succession were threats that significantly increased the risk of extinction of the Rock Creek-Big Creek population. At the time of listing, designation of critical habitat was considered prudent to allow Federal agencies the fullest range of actions they could undertake within their authorities to conserve the butterfly and its habitat. Since then, four additional populations (at Mt. Hebo, Cascade Head, Bray Point, and Del Norte County) have been documented.

Despite the discovery of additional populations, the Oregon silverspot butterfly remains threatened. Threats of habitat loss and degradation persist at many sites. Long-term survival of the species will require an active and ongoing commitment to habitat management. Additional research is needed to better understand habitat requirements, population dynamics, exotic vegetation control, and habitat enhancement techniques.

We are aware of illegal trade in listed, protected, and rare butterflies. Collection of a number of butterfly species that exist in small colonies, or repeated handling and marking (particularly of females and in years of low abundance), can seriously damage 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 colonies will be founded. Butterfly collectors pose a threat because they may be unable to recognize when they are depleting colonies 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 effect 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. We have listed several butterfly species due to imperilment by collectors. Incidents of unauthorized take of the Oregon silverspot butterfly by butterfly collectors have been discovered and indictments were obtained (U.S. Dept. of Justice 1993).

Conservation and Management

Recovery and management of the Oregon silverspot butterfly began with extensive surveys of habitat conditions and butterfly populations throughout the range of the subspecies (Hammond 1990b; Hammond and McCorkle 1982, 1985b; Pickering and Macdonald 1994; Pyle 1985a, 1985b; Sayce 1990, 1991; VanBuskirk 1993). In addition, intensive inventories of habitat conditions have been conducted at: Mt. Hebo (Hammond *et al.* 1980; McIver *et al.* 1991; Pickering *et al.* 1992); Rock Creek-Big Creek (McCorkle *et al.* 1980; McIver *et al.* 1991; Pickering *et al.* 1992); Cascade Head (Vander Schaaf 1983a; Bergen 1985; McIver *et al.* 1991; Pickering *et al.* 1992); and Clatsop Plains (Courtney 1990; Hammond 1988b, 1988c, 1990b, 1991d; Hammond and McCorkle 1985b). Inventories, research, recovery actions, and management activities have primarily been focused within the areas shown in Appendix A.

After these inventories were completed, the Siuslaw National Forest (Clady and Parsons 1984) and The Nature Conservancy (Vander Schaaf 1983b) developed interim plans for implementing recovery actions. Later, management plans were completed for five habitat areas on the Siuslaw National Forest (Mt. Hebo, Roads End, Rock Creek-Big Creek, Bray Point, and Fairview Mountain; Hammond 1989) and for Camp Rilea on the Clatsop Plains by its owner, the Oregon State Military Department, Oregon National Guard (Hammond 1998b).

Habitat rehabilitation for the Oregon silverspot butterfly has begun, mainly at Rock Creek-Big Creek, Mt. Hebo, Cascade Head, Clatsop Plains, and Long Beach Peninsula. Monitoring has been conducted to determine responses of early blue violets, other vegetation, and butterflies to various treatments (Arnold 1988; Diehl 1988; Hammond 1986, 1987, 1988a, 1990a, 1991a, 1991b, 1993, 1994a,

1944b, 1997a, 1997b, 1998c; Hammond and McCorkle 1984a, 1985a; Hays 1996, 1997; Hays and Johnson 1998; McIver *et al.* 1991; Morlan 1987a, 1987b, 1987c; Singleton 1989; Vander Schaaf 1984; Zika 1986).

Evaluation of potential sites for expansion of existing populations or establishment of additional populations was initiated in the 1980's. The Siuslaw National Forest identified two possible sites and implemented management and restoration actions. These sites were Fairview Mountain near the Central Coast Habitat Conservation Area, and Roads End near Cascade Head Habitat Conservation Area. Attempts to introduce butterflies from Rock Creek-Big Creek and from Mt. Hebo populations to Fairview Mountain in 1985 and again in 1991 were unsuccessful (Hammond and McCorkle 1991). It has been determined that Roads End and Fairview Mountain may be too small to support independent populations of Oregon silverspot butterfly, but could potentially function as part of a larger metapopulation if habitat restoration successfully provides for movement of butterflies between these sites and adjacent occupied habitats.

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, those being the conservation of listed species and their habitats. 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 affects activities conducted, funded, or authorized by a Federal agency, through section 7(a)(2) of the Endangered Species Act.

In addition, we, the U.S. Fish and Wildlife Service, enforce the prohibitions against take under section 9 of the Endangered Species Act and issue permits pursuant to section 10 of the Endangered Species Act for take 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. Such section 10 “incidental take” permits are issued only when the applicant submits a satisfactory habitat conservation plan. “Take” of any endangered or threatened animal is prohibited without such a permit. The term “take” as defined in section 3 of the Endangered Species Act 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 which 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). 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.

We have entered into cooperative agreements with each State resource agency with jurisdiction for invertebrates in the range of the Oregon silverspot butterfly. These agreements allow the State resource agency to develop conservation programs for the species and apply for Federal funds through section 6 of the Endangered Species Act. A number of research projects, surveys, and recovery actions for the species have been cooperatively funded as part of the section 6 program of grants to the States.

We have recently developed several strategies to administer the Endangered Species Act in a more proactive and effective fashion for private landowners. One program which we have initiated is the Habitat Conservation Plan Program in which landowners are issued an incidental take permit. If a project proposed by a private landowner is likely to result in take of Oregon silverspot butterflies, a permit authorizing the incidental take is needed before the project can proceed. This permit would be issued under section 10(a)(1)(B) of the Endangered Species Act. 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. An incidental take permit 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. 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 and certain exemptions from the requirements of the National Environmental Policy Act.

Another option is the Safe Harbor Agreement. We issued the final policy on Safe Harbor Agreements on June 17, 1999. Safe Harbor Agreements provide incentives and reduce disincentives to private landowners to foster the recovery of listed species. Through the Safe Harbor option, we would provide assurances to landowners that the use of their property will not be subject to additional restrictions under the Endangered Species Act due to voluntary conservation activities which benefit and attract listed species (*e.g.*, restoration of native grassland habitats, removal of invasive brush). 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. Net conservation benefits for the Oregon silverspot butterfly may include an increase in population numbers and reduction in habitat fragmentation on the Clatsop Plains.

The following sections provide an overview of habitat characteristics and management, monitoring, and research activities at each of the eight occupied sites (Figures 5 through 11). These sites have been grouped into six habitat conservation areas based upon geographic proximity and/or similarity of habitat. Each habitat conservation area includes one or more existing populations of the Oregon silverspot butterfly and four have potential habitat for management of at least two populations.

Long Beach Peninsula Habitat Conservation Area– The Long Beach Peninsula is a sand spit in Pacific County on the southwestern Washington coast. Approximately 12 hectares (30 acres) between Loomis Lake and the Pacific Ocean are managed for Oregon silverspot butterfly habitat. Meadow habitat is approximately 6 hectares (15 acres). An additional 6 hectares (15 acres) is a mix of forest fringe and restored meadow habitat. The habitat is dissected by Highway 103 and numerous residential roads and homes. The town of Long Beach is to the south and the town of Ocean Park is to the north.

The Long Beach Peninsula is composed of sands transported and deposited by the Columbia River. These sands are fine, grey-brown in color, and dominate area soils. A series of dunes and swales occurs from west to east on the peninsula.

Vegetation on the peninsula is a mosaic of freshwater sloughs, lakes, and marshes surrounded by forests and grasslands. Upland forests are dominated by shore pine, Sitka spruce, and western hemlock (*Tsuga heterophylla*). Hooker's willow (*Salix hookeriana*) forms woodlands on wetter sites. Native grasslands are

dominated by red fescue (*Festuca rubra*) and tufted hairgrass (*Deschampsia cespitosa*) in wetter areas. Native shrubs include nootka rose (*Rosa nutkana*), Pacific blackberry (*Rubus ursinus*), and bracken fern. Natural vegetation has been dramatically altered by introduction of European beachgrass (*Ammophila arenaria*), which stabilizes the sands.

Oregon silverspot butterflies historically occurred in several locations along the Washington coast from Long Beach north to Lake Ozette (Pyle 1989, Hinchliff 1996). Surveys for this species between 1975 and 1990 detected very few individuals along the Long Beach Peninsula (Pyle 1985, Sayce 1990) with the last sighting of a silverspot butterfly in Washington occurring near Long Beach in 1990 (Sayce 1990). Currently, no areas of Long Beach Peninsula are known to be occupied by Oregon silverspot butterflies.

Most of the potential Oregon silverspot butterfly habitat on the Long Beach Peninsula is privately owned. The Washington Department of Fish and Wildlife initiated a habitat acquisition and rehabilitation program in 1990 and has acquired 8 hectares (20 acres) of silverspot habitat.

Four sites on the peninsula are being rehabilitated for the Oregon silverspot butterfly. Two sites are owned by the Washington Department of Fish and Wildlife (totaling 8 hectares [20 acres]). Another is at Loomis Lake State Park (2 hectares [5 acres]), and a fourth site is privately owned. Mowing and tree cutting have been the principal management tools. In 1996, monitoring of early blue violets and other rare plants, tree and shrub removal, and monitoring of mowing effectiveness was initiated (Hays 1996). In 1997, mature early blue violets were planted in an 8-meter by 8-meter (roughly 25-foot by 25-foot) experimental plot and early blue violet seeds were overcast at 25 selected locations (Hays 1997). In 1998, in addition to what was done previously (monitoring for presence and survival of early blue violet transplants and seedlings, and mowing), researchers conducted limited experimental trials involving herbicide and saltwater application, biological control, and burning to determine their effectiveness at controlling invasive weeds (Hays and Johnson 1998). Additional planting of mature early blue violets and over-seeding with early blue violets are conducted annually.

The State plans to increase protection for the Oregon silverspot butterfly by making additional acquisitions or conservation easements, continuing the grassland management program, and removing timber to create two east-west

corridors for butterflies to nectar and travel to larval habitat west of State Route 103.

Clatsop Plains Habitat Conservation Area– The Oregon silverspot butterfly inhabits an area on the Clatsop Plains, Clatsop County, Oregon that is approximately 8 kilometers (5 miles) long and 1.6 kilometers (1 mile) wide. The habitat is bisected by Oregon Coast Highway (U.S. 101) and is fragmented by development. While habitat areas and butterfly use are somewhat continuous throughout the 8-kilometer (5-mile) stretch, three habitat areas have been distinguished: Camp Rilea, Sunset Lake-Caleb Lake, and Del Rey Beach.

Overall habitat characteristics are similar to those of the Long Beach Peninsula, with a mosaic of freshwater sloughs, lakes, and marshes surrounded by forests and grasslands. The Clatsop Plains dunes are rapidly being built up due to influence of the Columbia River jetty. Beginning in the 1930's, European beachgrass and shore pine were planted in an effort to stabilize the dunes. These species have significantly modified Oregon silverspot butterfly habitat. The more recently introduced Scotch broom and non-native grasses have become a major threat to Oregon silverspot habitat on the Clatsop Plains.

The Oregon silverspot butterfly's primary breeding habitat occurs in a narrow corridor of secondary dunes and deflation plains about 0.8 kilometer (one-half mile) from the ocean along Neacoxie Creek and Sunset Lake west of Highway 101. These dunes have been stabilized for 20 to 60 years and are dominated by non-native grasses such as sweet vernal (*Anthoxanthum odoratum*), annual fescues (*Festuca* spp.), and annual bromes (*Bromus* spp.). Native remnants contain species such as red fescue, sand dune sedge (*Carex pansa*), and dune goldenrod. Younger dunes closer to the ocean, dominated by American dunegrass (*Elymus mollis*) and European beachgrass, generally have much lower concentrations of early blue violets. Highly porous soils at the Clatsop Plains make this the most drought-sensitive of all of Oregon silverspot butterfly sites.

Oregon silverspot butterfly populations on the Clatsop County (Clatsop Plains) have declined in recent surveys with only one Oregon silverspot butterfly documented in 1998 (VanBuskirk 1993, 1998). This individual was sighted near the Oregon Military Department owned Camp Rilea, previously the stronghold of the Clatsop Plains Oregon silverspot butterfly population. Oregon silverspot butterflies have not been documented at Camp Rilea since 1995 (Hammond 1998a).

Oregon silverspot butterflies eclose (emerge) from early July through September, but appear to abandon the breeding habitat during the middle of the flight period in August. This may result from a lack of sufficient nectar resources. Little is known about how Oregon silverspot butterflies migrate from breeding habitat or where they migrate to. Oregon silverspot butterflies have been seen in groups in inland forest fringe habitat near Caleb Lake (Hammond and McCorkle 1985b) and individually in dunes west of breeding habitat (D. Pickering, The Nature Conservancy, pers. comm. 1998).

Conservation opportunities on private lands. Most Clatsop Plains habitat is privately owned. In 1992 and 1993, habitat surveys were conducted by Hammond and McCorkle (1985b), Hammond (1988c), and The Nature Conservancy (Pickering and Macdonald 1994; VanBuskirk 1993). Private land owners have been informed of the potential presence of Oregon silverspot butterlfy habitat, and some landowners have shown interest in habitat management. Several landowners have entered into conservation agreements with us to minimize the effects of residential development on Oregon silverspot butterfly habitat and have followed a mowing regime that is intended to benefit early blue violets while providing limited control of some invasive species. However, these efforts have either been of short duration or on very limited acreages of land. Potential exists for landowners to enter into Safe Harbor Agreements or Habitat Conservation Plans. These options would provide conservation benefits for the Oregon silverspot butterfly while reducing landowner liability by ensuring coverage under the Endangered Species Act. Development of Habitat Conservation Plans or Safe Harbor Agreements on a county-wide scale would expedite the review and issuance of building permits within Oregon silverspot butterfly habitat areas while providing compliance with the Endangered Species Act. Large-scale, or programmatic, Safe Harbor Agreements or Habitat Conservation Plans would be accomplished with Clatsop County, or another local governing body, as the primary applicant.

Oregon Military Department land. The Oregon Army National Guard initiated management for the Oregon silverspot butterfly on its lands at Camp Rilea in 1990 and 1991 (Hammond 1991b). This work has included clearing Scotch broom and mowing grassland where dense thatch had developed. Timing and frequency of mowing has been altered on the more intensively-managed areas of prime habitat to prevent mortality of Oregon silverspot butterfly caterpillars and pupae during the summer growing season. In 1991, about 18 hectares (45 acres) of habitat were rehabilitated for the Oregon silverspot butterfly at Camp Rilea.

Of this, 6 hectares (14 acres) were considered prime breeding habitat (Hammond 1991b). Oregon silverspot butterflies responded favorably to this work during 1991. Males were observed for the first time at Camp Rilea, along with 20 to 30 females that were observed ovipositing in prime habitat areas throughout September 1991 (Hammond 1991b). The estimated size of the Oregon silverspot butterfly population on Camp Rilea increased from 6 to10 in 1988, to 40 to 60 in 1991, then gradually declined to zero by 1996 (Hammond 1991b, 1992b, 1998a). An estimated 13 hectares (32 acres) on Camp Rilea were in fair to excellent condition for early blue violets in 1998, which was the same as in 1997 (Hammond 1998a). Annual mowing of habitat areas has been recommended at Camp Rilea, particularly in areas overgrown with exotic bent grass (Hammond 1994b, 1998a). Additional techniques, such as less intensive mowing, fire, herbicide, or seeding with native species should be explored at Camp Rilea to improve habitat conditions and provide for increase nectar availability.

Coastal Mountains Habitat Conservation Area–

Mt. Hebo. Subalpine grasslands on Mt. Hebo support the largest extant population of Oregon silverspot butterflies. A population of 1,000 to 3,000 adults currently occupies approximately 26.3 hectares (65 acres) of meadow at an elevation of 945 meters (3,100 feet) on the plateau-like summit.

Mt. Hebo was once almost completely forested. Severe fires in 1845 and 1910 eliminated tree cover and allowed the spread of grassland species from their previously limited distribution around rock outcrops. Topography of the site includes gentle and moderate slopes (1 to 15 degrees) in all compass directions, with some steep slopes in adjacent areas. A relatively wide array of microclimates in the open grasslands are available for caterpillars, a circumstance that likely spreads out adult emergence times, buffering the Mt. Hebo population against extinction.

Mt. Hebo usually experiences clear weather during episodes of coastal fog, but the site can be affected by orographic clouds. Saturation of soil by snow melt at the beginning of the growing season, and relatively cool temperatures and high annual rainfall act to reduce local effects of the region's dry summers.

The Mt. Hebo grasslands are partially discontinuous within a matrix of shrubland and forest habitat. Early blue violets occur in very dense stands within the grasslands. A road system provides non-forested dispersal corridors between disjunct grassland patches, and adult butterfly movement along these corridors

appears to be encouraged by presence of abundant nectar and protection from wind. All nectar species except asters are common, with goldenrods particularly abundant along roads.

Wind protection is afforded by forest fringes and local topography. Forest fringe areas support abundant, diverse nectar sources, with fringe areas on wind-protected sides of meadows most often used. Rolling terrain provides small pockets of wind protection in drainage swales and in the lee of ridges.

The thin rocky soils and relatively short growing season at Mt. Hebo act to retard invasion of grasslands by salal and conifers, and buildup of grass thatch. However, the immediate successional threat to open grasslands is bracken fern, which forms dense closed stands up to 1 meter (3 feet) tall. Bracken fern suppresses growth of early blue violets and is thought to impede the butterfly's access to violets or other plants growing under it.

The Siuslaw National Forest has designated the Mt. Hebo area for protection of Oregon silverspot butterflies and has been managing habitat since 1983. Many opportunities are available to rehabilitate habitat for the butterfly's benefit. Trees and shrubs have been mowed, burned, and cleared by hand. Treated areas have been heavily used by butterflies (summary in Hammond 1993). Habitat management activities are more fully described in the Implementation Plan developed for the Siuslaw National Forest (Hammond 1989).

The primary vegetation control method at Mt. Hebo has been mowing with tractor mowers and weed eaters. Mowing was tested as a control for dense stands of bracken fern beginning in 1985. Several years of mowing reduced bracken fern height and number of fronds, as well as its distribution. Early blue violet growth increased in some areas, in some cases as spectacularly as at Rock Creek-Big Creek (Hammond 1987). Success depended on the number of mowings and their timing. Tractor mowing was discontinued in 1996 due to concerns about soil disturbance and the difficulty of avoiding small patches of nectar sources, however, mowing with weed eaters has continued.

On more rugged areas, bracken fern and other brush species were removed with hand tools, and debris piled and burned. Measured regrowth of huckleberry and serviceberry was substantial, with that of salal more moderate. Hand slashing effectively checked invasion by brush and trees, although cleared land has not been generally repopulated with suppressed or seedling early blue violets.

Prescribed fire has been used on a limited basis to maintain grassland habitat at Mt. Hebo. Several months after mowing, approximately 2 hectares (5 acres) of grassland were burned to remove additional cover, and to dispose of slash residues. Results of these treatments were discussed above.

In addition to management of existing meadows, efforts have been taken to restore grassland habitat on a former U.S. Air Force radar site. The facility was removed during 1986 to 1987, and the site was leveled. This left 5 hectares (12 acres) of rock and bare soil as potential butterfly habitat. Small pieces of meadow sod containing early blue violets and other native plants were transplanted into portions of the area on an experimental basis in May 1988, and on a larger scale in 1989. In addition, seeds of several types of wild flowers were planted. Initial observations suggested that these transplants survived well, but the site was subsequently invaded by reed canary grass and Scotch broom (M. Clady, U.S. Forest Service, pers. comm. 2001). The radar site had not been well colonized by silverspot butterflies as recently as 2000 (D. Pickering, The Nature Conservancy, pers. comm. 2001). Further changes in the area's vegetation are being monitored closely.

Fairview Mountain. Fairview Mountain is 6 kilometers (4 miles) inland from Rock Creek-Big Creek but its habitat characteristics are more similar to Mt. Hebo. The site includes 4 hectares (9 acres) of grassland classified as fair to excellent quality habitat with abundant early blue violets (Hammond 1991a), although invasion by shrubs, trees, and bracken fern require long-term management.

The Siuslaw National Forest developed and implemented a management plan to enhance Oregon silverspot butterfly habitat at Fairview Mountain (Hammond 1989). Management consisted of hand clearing the relatively sparse invading stands of Douglas-fir (*Pseudotsuga menziesii*), salal, and bracken fern as well as limited mowing. Management was implemented from 1988 to 1991 but efforts have not continued due to lack of funding. Invasion by bracken fern continues to be a serious problem over much of the site.

Efforts to establish an independent population of the Oregon silverspot butterfly at Fairview Mountain have been unsuccessful. Initial efforts to establish butterflies began in June 1985, when 450 caterpillars reared from eggs taken from 4 females captured at Rock Creek-Big Creek were introduced in the upper meadows. In August 1985, 20 adult butterflies from Mt. Hebo were released in

the lower meadows. In subsequent years, abundance of adult silverspot butterflies was monitored. A few individuals were seen at Fairview Mountain annually from 1986 to 1989 but the population died out between 1989 and 1990.

In the spring of 1991, 263 captive-reared caterpillars from Mt. Hebo stock were introduced to the site. During the 1992 flight season, 20 to 30 adults were observed (Hammond and McCorkle 1991). Five adults were observed over six separate occasions during the 1992 flight season. Butterflies were not observed in 1993 and 1994, and no further surveys have been conducted..

Hammond (1994a) has concluded that two to three times as much meadow habitat would be needed to support a viable population. Fairview Mountain may be within Oregon silverspot butterfly dispersal distance to the Rock Creek-Big Creek and Bray Point populations, based on documentation of silverspot dispersing up to 8 kilometers (5 miles) (VanBuskirk and Pickering 1999). This indicates that, if habitat is enhanced within the larger Rock Creek-Big Creek / Bray Point habitat complex and corresponding increases in Oregon silverspot butterfly populations occur, Fairview Mountain could become a potential habitat component within the larger metapopulation.

Cascade Head Habitat Conservation Area– Cascade Head is a basaltic coastal headland rising abruptly from sea level to 370 meters (1,200 feet) elevation at the mouth of the Salmon river estuary. Oregon silverspot butterflies were discovered at Cascade Head in 1982. The preserve is owned and managed by The Nature Conservancy and totals 113 hectares (280 acres) of mixed forest and grassland habitats. Most of the headland is forested with red alder, Sitka spruce, and western hemlock, with 80 to 93 hectares (200 to 230 acres) of coastal grassland, largely located on its south-facing slope. Primary Oregon silverspot habitat is located on approximately 20 hectares (50 acres) of the upper portion of grassland between 240 and 370 meters (800 and 1,200 feet) elevation. However, butterflies have been seen in low numbers throughout the grassland and in adjacent clearings to the east. Secondary habitat to the east is in private ownership, the bulk of which is controlled by the Cascade Head Ranch Homeowners Association.

The Oregon silverspot butterfly population at Cascade Head has not recovered from the low numbers observed in 1993. Studies at Cascade Head have documented a gradual decline in early blue violet abundance in untreated areas at the Cascade Head preserve (Gasser *et al*.1997; Pickering 1998a). The population

has continued to experience a decline that Pickering (1998b) believed may be related to a decline in habitat quality.

Vegetation and management. The Cascade Head grassland contains native California brome (*Bromus carinatus*), California oatgrass (*Danthonia californica*), blue wildrye (*Elymus glaucus*), and red fescue. All of the major nectar plants are present, except dune goldenrod, and most are abundant. Shrubs are not abundant, but bracken fern and sword fern are common in the grassland. The site presently experiences problems with invasive exotic species such as velvet grass, orchard grass, sweet vernal grass, and blackberry as well as by native successional species such as Sitka spruce, alder, bracken fern, and chaparral broom.

Over 15 years of habitat management experimentation at Cascade Head indicates that management of coastal grasslands for Oregon silverspot butterfly food and nectar sources is best achieved using combinations of fire and mowing treatments rather than broadcast treatments of entire sites. This is largely due to differential responses to treatments by individual non-native species as well as to seasonal fluctuations in all components of the grassland community (Pickering *et al.* 2001).

Prescribed fire was first used successfully by The Nature Conservancy in the fall of 1983, when 5 hectares (12 acres) on the upper slopes and bench were burned. Monitoring the following year showed significant increases in early blue violet densities (up to 550 percent) at several burned sites on steeper slopes. Another prescribed burn carried out in 1988 (Singleton 1989) on the flat upper slopes and sheltered nectaring habitat had similar results.

Since 1996, The Nature Conservancy has initiated randomized complete block experimental design (with five blocks and three treatments) to determine the effectiveness of different habitat management techniques in a grassland environment (Pickering 1998a, Pickering *et al.* 2001). The treatments consisted of fall burning and mowing/raking as well as a control. Individual treatment areas were approximately 10 meters by 30 meters (30 by 90 feet). When these treatment areas were examined for early blue violets in 1997, the burned plots had six times as many seedlings as the control. Seedling abundance in mowed units was similar to the controls. Burning was also the most effective technique to stimulate mature early blue violet plants (Pickering 1998a).

Monitoring of nectar source responses to management indicates that burning had a slightly positive to benign effect while mowing had a negative effect on nectar species. Fall burning resulted in a temporary positive response in early blooming nectar plants, however, the sampling design was not adequate to detect whether treatment effects extended to mid-season and late blooming nectar sources (Pickering *et al.* 2001). Burning was also shown to significantly increase frequency of dune thistle over other treatments, although no increase in flowering density was detected. Mowed areas had significantly lower flowering stem density of Canada goldenrod over control plots, although flowering stem densities declined in all treatments in 1998.

Non-native grasses and forbs were not suppressed by either mowing or burning treatments. However, the positive effect of fall burning on early blue violets may benefit Oregon silverspot butterfly populations, making burning a preferential management technique over mowing at Cascade Head (Pickering *et al.* 2001).

Population augmentation. In 1999, a partnership was formed between Oregon Zoo of Portland, Lewis and Clark College of Portland, The Nature Conservancy, and Oregon Natural Heritage Program to initiate a captive rearing program for Oregon silverspot butterflies. The initial focus was to augment the Cascade Head population using the protocol of Hammond and McCorkle (1991). The project was authorized under a Memorandum of Understanding with us and a Recovery Permit to The Nature Conservancy. The project was funded by us through section 6 of the Endangered Species Act. Ten gravid adult female Oregon silverspot butterflies were captured, seven of which laid eggs in captivity (Andersen *et al.* 2001). A total of 191 larvae or pupae were released at Cascade Head (Pickering 2001). The effort was apparently successful, as the overall index of abundance for the Cascade Head Oregon silverspot butterfly population was 160, an increase of 21 percent over 1999 (Pickering 2000). Captive rearing efforts will be continued in the future to augment the Cascade Head and other central coast Oregon silverspot butterfly populations.

Roads End Headland. Roads End is a grassy headland located across the Salmon River estuary from Cascade Head in Lincoln County, Oregon. This site needs habitat restoration, but could provide an important future contribution toward maintaining a viable Oregon silverspot butterfly metapopulation within the Cascade Head habitat conservation area. It includes about 7 hectares (18 acres) of Siuslaw National Forest grassland, of which some 2.6 hectares (6.5 acres) on south- and west-facing slopes appear suitable for early blue violets. Only 0.2

hectare (0.5 acre) was considered good violet habitat in 1991, which is insufficient to support an Oregon silverspot butterfly population (Hammond 1991a).

In 1986, the Siuslaw National Forest began efforts to expand the area and to improve habitat quality on the upper meadows. Areas were mowed and subsequently burned for several years. In the upper meadows, mowing and burning failed to increase abundance of early blue violets, but did stimulate growth of dune thistle. Introduced grasses, already abundant, were also stimulated. Management attempts were discontinued following 1989, at which point the upper meadow was considered unmanageable until more effective techniques are developed to manage exotic grasses.

The lower, steeper slopes at Roads End comprised sparse grassland vegetation and early blue violets in 1987. Burning of small plots, initiated in 1987, reduced competing vegetation on the slopes and encouraged growth of early blue violets. However, this area was subsequently invaded by perennial exotic grasses and no further management was attempted after 1989. The habitats were not known to support Oregon silverspot butterflies in 2000. However, proximity of Roads End to the Cascade Head population could allow this site to contribute to long term recovery of the Oregon silverspot butterfly if future habitat restoration attempts were successful. This site would be an ideal area to investigate new methods for eradication and control of exotic grasses and restoration of native coastal grassland community components, including early blue violets and native nectar sources.

Central Coast Habitat Conservation Area: Rock Creek-Big Creek– Located between the mouths of Rock Creek and Big Creek in Lane County, this site was the only known viable population of Oregon silverspot butterflies in 1980, thus was designated as critical habitat. The critical habitat area comprises 177.1 hectares (437.5 acres), including 95 hectares (235 acres) of meadow, shrubland, and forest administered by the Siuslaw National Forest. The Oregon Department of Transportation administers 1.4 hectares (3.5 acres) and 80.5 hectares (199 acres) are privately owned.

The Siuslaw National Forest administers approximately 20 hectares (50 acres) that contain potential butterfly habitat. The Siuslaw National Forest has been doing the majority of butterfly conservation work in this area since 1980. Activities have included land acquisition, rehabilitation, and monitoring of

butterfly populations on three distinct types of habitat: marine terrace grasslands west of Highway 101; steep, south-facing slopes east of Highway 101; and sheltered riparian meadows along Rock Creek and Big Creek.

Despite intensive management efforts at Rock Creek-Big Creek since 1980, there has been a net loss of breeding habitat, as measured by early blue violet presence and condition (Hammond 1990a, 1991a, 1993). This is reflected in low numbers of butterflies per unit of habitat (McIver *et al.* 1991; Pickering 1995; Pickering *et al.* 1992, 1993). Hammond (1991a) classified habitat quality as poor to very poor in most areas. Subsequent study has shown that this situation is due to rapid spread of exotic heath grass (*Danthonia decumbens*) at this site. Without management, the Oregon silverspot butterfly population at this site would likely have been even more seriously reduced in size and close to extirpation (Hammond 1990a, 1991a).

Population status and threats. Using qualitative annual population surveys, Hammond estimates that between 1980 and 1991, the Oregon silverspot butterfly population at Rock Creek-Big Creek fluctuated between about 200 and 400 individuals, but in 1992 to 1994 the population declined to only about 100 individuals (Hammond 1997a, 1998c). Quantitative transect surveys indicate that a declining trend in Oregon silverspot butterfly populations has occurred annually at Rock Creek-Big Creek since 1996 and a 50 percent drop occurred between 1999 and 2000 (Pickering 2000).

The first intensive mowing management was conducted at Rock Creek-Big Creek in 1994. Both quantitative and qualitative population surveys indicated that the 1995 Oregon silverspot population increased, possibly related to an initial positive violet response to the treatment (Hammond 1997a, Pickering 2000), however silverspot populations have been declining since 1996 (Pickering 2000). No quantitative monitoring of habitat responses to treatments has occurred, but generally, it appears that the habitat has experienced degradation caused primarily by encroachment of perennial non-native grasses which suppress growth of early blue violets and nectar sources.

The primary management technique has been multiple annual mowing events, a cost effective management technique that has proven to be very effective on control of salal and other woody species. Mowing also temporarily provides a reduction of non-native grass height and thatch accumulation conducive to ovipositing habitat (Hammond 2000), however, mowing does not contribute to

non-native grass eradication and may actually increase grass density at the expense of early blue violets and nectar sources in the long-term. It is imperative that long-term solutions to non-native grass eradication and control are found and implemented to ensure that important Oregon silverspot butterfly habitat components of violets and nectar sources are maintained and enhanced.

Another threat to habitat at Rock Creek-Big Creek is coastal erosion. An estimated 3 to 6 meters (10 to 20 feet) of the seaward western margin of meadow was lost in the 1980's, mostly during severe winter storms. Future large erosion events could occur during large storm events, particularly if mean sea level on the Pacific Coast continues to rise at present rates. Coastal erosion is discussed in Komar (1998).

Marine terraces. The Siuslaw National Forest owns and manages approximately 8.5 hectares (21 acres) of salt-spray meadow habitat located on the west side of Highway 101. Meadow habitat near the ocean was originally given top priority for rehabilitation, with increasing density of early blue violets as the primary objective (Hammond 1989).

The salt-spray meadows are wind swept with very little wind protection. In 2000, salt-spray meadows were the primary location for Oregon silverspot butterfly oviposition (laying eggs) at Rock Creek-Big Creek, although some nectaring also occurs in these areas (Hammond 1990a, 1991a, 1993, 1997a). Use was concentrated in these areas during periods of low wind velocity. Historically, these meadows were flat, open, native grass-dominated systems, but underwent succession to brush-dominated systems in the absence of fire and other natural disturbances regimes (Clady and Parsons1984, Hammond and McCorkle 1984b, Ripley 1983).

Mowing initiated in 1985 and continued through 2000 has effectively controlled the encroachment of woody brush and trees into the salt-spray meadows. The 1985 treatment was followed up with burning of the dried residual material which resulted in a late season flush of violet growth during the same year. Areas with 10 to 20 years of extensive brush cover exhibited successful violet emergence. The early blue violet's ability to persist for long periods under dense brushy overstory has been attributed to substantial energy reserves concentrated in its rootstalks (Hammond 1986). However, encroachment of non-native grasses, specifically heath grass and bent grass, has occurred since 1985, suppressing

violet growth and threatening the Oregon silverspot butterfly habitat quality (Hammond 2000).

Management solutions which reduce non-native grasses in a manner compatible with enhancing early blue violets and nectar sources should be investigated and implemented. Hammond (2000) recommended intensifying mowing treatments or experimenting with grass-specific herbicides. Intensified mowing treatments as a solution should be viewed with caution in light of research which indicates mowing does not increase violets and may actually preclude some nectar sources from flowering (Pickering *et al.* 2001, Hays and Johnson 1998).

Steep slopes. On steeper, more rugged terrain east of Highway 101, approximately 8.5 hectares (21 acres) has been acquired and is managed for Oregon silverspot butterflies. Due to the steep topography, habitats east of the highway have not been managed as intensively, thus brush and tree encroachment continues to be a problem. Non-native grass is also a problem on the steep slopes.
Brush and tree cover on north-facing slopes are beneficial as wind protection areas, allowing butterflies to take refuge in habitat areas on the lee side, and thus should not be cut. Management techniques should focus on maintaining open meadow conditions on south-facing slopes by hand removal of brush and trees. Enhancement of nectar species and early blue violet patches should be focused in areas which benefit from wind protection. It is important to maintain a suite of habitat variables in each habitat type to accommodate shifts in habitat use by Oregon silverspot butterflies (Hammond 1990a).

Management plan. The Oregon Silverspot Butterfly Forest Implementation Plan for the Siuslaw National Forest (Hammond 1989) provided management planning for butterflies through 1996. Prescribed burning was a technique that initially appeared to benefit early blue violets (Hammond 1989, 1993), however, as non-native grass cover increased this technique produced mixed results and was abandoned. Habitat conditions and threats have continued to shift over time. Progress toward meeting management objectives should be reassessed, results from studies of management techniques at other sites should be considered, and an updated management plan should be developed and implemented.

Bray Point. The population at Bray Point appears to be a geographically peripheral survivor of the former Tenmile Creek population in the Central Coast habitat conservation area. The site includes three distinct forest openings located

on steep and predominantly south-facing slopes. The primary habitat is approximately 2 hectares (6 acres) in extent and is located in the northernmost opening. The Oregon silverspot butterfly population has declined dramatically with the 2000 population index at 99 percent below the 11-year mean, although survey numbers were so low that results are difficult to interpret (Pickering 2000). Dispersal of Oregon silverspot butterflies from Bray Point to Rock Creek-Big Creek has been documented, however, the source/sink dynamics of these two populations are currently unknown (VanBuskirk and Pickering 1999). It is possible that loss of the Bray Point population could have negative impacts on the Rock Creek-Big Creek population as well (Pickering 2000).

Bray Point rises sharply from coastal bluffs to 180 meters (600 feet) elevation. The site's southern exposure provides shelter from predominantly northwesterly winds. The grassland flattens into a small hilltop meadow to the east. Sweet vernal grass dominates the steep south slopes, and red fescue is also present. Most nectar species are present. Pacific blackberry and bracken fern cover significant portions of the lower slopes.

A management plan for the site was completed in 1989 (Hammond 1989) and work commenced in 1993 with hand slashing of trees and shrubs. Management to increase the violet population at Bray Point is considered to be imperative to maintain the population (Pickering 2000), however, competition from non-native grasses make it unclear which management technique would be most effective. A comprehensive strategy to reduce non-native grasses and to enhance early blue violets should be developed with consideration given to use of prescribed burning (Pickering 2000).

Del Norte Habitat Conservation Area– The only population known to be extant in Del Norte County, California extends from Lake Earl to just northeast of Point St. George just north of Crescent City. It is the largest unmanaged population of Oregon silverspot butterflies. Individual butterflies have also been observed in the Pelican State Beach area roughly 16 kilometers (10 miles) north near the Oregon border.

The Del Norte population occurs in meadows on a deflation plain behind a coastal dune complex. The habitat's sandy soil is saturated just below the surface. Where stands of early blue violet occur, the dominant grass is tufted hairgrass, but in slightly elevated areas early blue violets occur in association with European beachgrass. The habitat is subject to salt spray from the nearby beach, and its

climate is moderated by winds, rain, and coastal fog. Tansy ragwort and California aster are the dominant nectar species, with some goldenrod also present.

Recent habitat analysis on State lands at Lake Earl involved mapping and monitoring of early blue violets in 1998 and 1999 and of water levels and adult butterflies in 1999. The study area was restricted to the State parks-owned portions of the Oregon silverspot butterfly habitat extending from the north shore of Lake Talawa north almost to Kellogg Road. No private lands were included in the study. The Oregon silverspot butterfly population size on State lands was estimated at 62 in 1998 (U.S. Army Corps of Engineers 2000).

Management of water levels in Lake Earl is important to survival of the Oregon silverspot butterfly at this location. In Del Norte County, early blue violets only occur in sand dune habitat with low wet areas sustained by subsurface water. If water levels are too high, important habitat areas can be inundated, resulting in the death of butterfly larvae and their host plants. Further information should be developed on the short and long-term effects of various lake level elevations on Oregon silverspot butterflies, caterpillar host plants, and adult nectar sources. One estimate, by the U.S. Army Corps of Engineers (2000), suggests that maintaining water levels within a range of 2 to 2.4 meters (6.5 to 8 feet) during May and June would provide sufficient moisture to maintain violet habitat without submerging it.

Management of water levels should be consistent with maintaining habitat and populations of Oregon silverspot butterflies based on the best available information, however, conservation of Oregon silverspot butterflies at Lake Earl will require sensitivity to other resources at Lake Earl and its vicinity, which has many competing resources and issues in addition to the Oregon silverspot butterfly. Lake Earl is widely recognized as a valuable wetland/fish and wildlife habitat. It is located within, and is the focus of, Lake Earl State Wildlife Area. Lake Earl would be considered a Resource Category 1 under the 1981 Mitigation Policy of the U.S. Fish and Wildlife Service — meaning it is an important wetland. Lake Earl is utilized by the endangered tidewater goby (*Eucyclogobius newberryi*), threatened bald eagle (*Haliaeetus leucocephalus*), threatened western snowy plover (*Charadrius alexandrinus nivosus*), peregrine falcon (*Falco peregrinus*), salmonid fishes, waterbirds, *Oenothera wolfii* (an evening-primrose of conservation interest), and other species of special concern.

Recovery Strategy

The primary criterion for listing the Oregon silverspot butterfly was the present or threatened destruction, modification, or curtailment of habitat or range (45 FR44935). Destruction or impairment of habitat quality on coastal salt spray meadows was specifically mentioned. Criteria 1 and 2 of the Recovery Objectives address loss and degradation of habitat by providing guidance on permanent protection and management of important habitat areas for recovery of Oregon silverspot butterfly.

Protection of Habitat– The sites known to be occupied by the Oregon silverspot butterfly have been grouped into six habitat conservation areas based upon geographic proximity, similarity of habitat, and potential for genetic exchange (Figures 5 through 11 in Appendix A). The butterfly must be made secure in all six of the habitat conservation areas to maintain its existing distribution and to maintain the genetic diversity of its existing populations. At the present time, four of the six habitat conservation areas support at least one existing population of the Oregon silverspot butterfly. For recovery, each of these four habitat conservation areas should support at least two viable populations. The Long Beach habitat conservation area is likely capable of supporting one population. At the Clatsop Plains habitat conservation area, one larger population dispersed over three geographic areas should be possible. Currently available information suggests the minimum size for a population to be viable is approximately 200 to 500 butterflies (Franklin 1980).

Habitat quality varies between habitat conservation areas and may vary from year to year. More habitat may be needed to sustain a viable population at the Long Beach or the Clatsop Plains habitat conservation area than at the Coastal Mountain or Cascade Head habitat conservation areas. However, data are not yet available to determine specific habitat acreage objectives for each habitat conservation area. Additionally, data on mortality rates, dispersal, and habitat variables are needed to refine habitat conservation area boundaries, develop alternative habitat conservation area designs, and to analyze or better model population viability.

Until significant new information can be obtained about the species' habitat requirements, the highest priority (or need) will be to protect habitat to maintain existing populations of Oregon silverspot butterflies, especially in areas where most of the habitat remains unprotected or unmanaged (such as at Long Beach,

Clatsop Plains, and Del Norte habitat conservation areas) or where population numbers are low or declining (such as the Central Coast, Cascade Head, Clatsop Plains, and the Long Beach habitat conservation areas). Additional habitat may be protected through fee acquisitions from willing sellers, Habitat Conservation Plans, Safe Harbor Agreements, conservation easements, and other forms of management agreements. Additional habitat surveys and inventories will be needed (particularly at Long Beach, Clatsop Plains, and Del Norte) to identify areas that need protection and areas that require management to maintain or increase available habitat.

Augmentation– Augmentation is an attempt to increase the size of a population by collecting female butterflies from a site, allowing them to oviposit in captivity, captively rearing the larvae, 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 population from becoming non-viable 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 populations should be a priority over attempts to reintroduce or establish new populations, especially in situations where captive rearing facilities or donor stock may limit the number and scale of augmentation events that are possible in a given year. Augmentation should be considered on protected and managed Oregon silverspot butterfly habitat if: a) the population 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) populations decline to 30 percent or more below the long-term population mean, as calculated from The Nature Conservancy annual population indices, or d) if the history or the environmental conditions of the specific population indicate that population levels are so low as to be at risk of extirpation. If populations are augmented, the introductions should be made into protected, good quality habitat or improving managed habitat.

In addition to augmentation, steps must be taken to identify and rectify the cause of the decline. Augmentations may provide temporary increases to the population to buffer against stochastic events, but unless the proximate causes of decline are remedied, the decline will likely continue. Augmentation should be done under a plan which includes goals for the populations to signal the end point for the action.

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 adapt management in response to shifting habitat needs and threats. Comprehensive management plans are needed for all Oregon silverspot butterfly habitats, particularly for habitat conservation areas 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 Oregon silverspot butterfly populations will be important to evaluate the effectiveness of management. Populations censuses should be coordinated to extend over the species' range wherever possible. Monitoring methods should be consistent throughout the species' range. Census data collected consistently over a sufficient period of time, coupled with long-term habitat management, will be particularly important in evaluating the butterfly's status and viability of populations.

As existing populations are protected and managed, the emphasis in conserving the species will shift toward determining whether viable populations are being sustained. If populations prove to be non-viable and at high risk for extinction, additional habitat should be restored and protected.