Oregon silverspot butterfly
(*Speyeria zerene hippolyta*)

5-Year Status Review
Summary and Evaluation

Photo by Mike Patterson

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Newport Field Office
Newport, Oregon

5-YEAR STATUS REVIEW

Species Reviewed: Oregon silverspot butterfly (*Speyeria zerene hippolyta*)

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5-YEAR STATUS REVIEW
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1.0 GENERAL INFORMATION

1.1 Reviewers:

Lead Regional Office:
Interior Region 9, Portland Regional Office

Lead Field Office:
Oregon Fish and Wildlife Office – Newport Field Office
Anne Walker/Michele Zwartjes (Lead reviewers)

Cooperating Field Office(s):
Arcata Fish and Wildlife Office
Washington Fish and Wildlife Office

Cooperating Regional Office(s):
Interior Region 10, Sacramento Regional Office

1.2 Methodology used to complete the review:

In accordance with section 4(c)(2) of the Endangered Species Act of 1973, as amended (ESA), the purpose of a 5-year status review is to assess each threatened species and endangered species to determine whether its status has changed and it should be classified differently or removed from the Lists of Endangered and Threatened Wildlife and Plants. This review is a synthesis of information compiled in the U.S. Fish and Wildlife Service's (Service) Newport Field Office with review and input from the cooperating field and regional offices, Siuslaw National Forest (NF), Oregon Zoo, Woodland Park Zoo, The Nature Conservancy (TNC), Oregon Parks and Recreation Department (OPRD), and Washington Department of Fish and Wildlife (WDFW). This document represents an updated compilation of the best scientific data that has become available since the 2012 Oregon silverspot butterfly 5-year review (U.S. Fish and Wildlife Service [USFWS] 2012).

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

We published the *Federal Register* notice announcing the initiation of this review on April 20, 2017 (82 FR 18665) (USFWS 2017). This notice opened a 60-day request for information through June 19, 2017, although

new information will be accepted at any time. We did not receive any information in response to the announcement of this review.

1.3.2 Listing history:

Original Listing
FR notice: 45 FR 44935 (USFWS 1980)
Date listed: July 2, 1980
Entity listed: Oregon silverspot butterfly (*Speyeria zerene hippolyta*)
Classification: Threatened

1.3.3 Associated rulemakings:
Note: Critical habitat was designated at the time of listing.

Establishment of a Nonessential Experimental Population of Oregon Silverspot Butterfly in Northwest Oregon.
FR notice: 82 FR 28567 (USFWS 2017)
Date: June 23, 2017

1.3.4 Review History: This is the second 5-year status review for the Oregon silverspot butterfly. The first status review was completed on January 3, 2012 (2012 Oregon silverspot butterfly 5-year review; USFWS 2012); that review concluded with a recommendation to uplist the species to endangered status.

1.3.5 Species' Recovery Priority Number at start of this 5-year status review:
The recovery priority number for the butterfly is 3C, indicating a high degree of threat and a high recovery potential, with the potential for conflict with development or other economic activities.

1.3.6 Current Recovery Plan or Outline
Name of plan or outline: Revised Recovery Plan for the Oregon Silverspot Butterfly (*Speyeria zerene hippolyta*) (USFWS 2001)
Date issued: August 22, 2001
Dates of previous revisions, if applicable:
Final revised recovery plan for the Oregon silverspot butterfly; notice of availability issued November 30, 2001 (66 FR 59807)
Draft revised recovery plan for the Oregon silverspot butterfly; notice of availability issued April 17, 2000 (65 FR 20480)
Oregon Silverspot Butterfly Recovery Plan, September 22, 1982

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate?

_____ ***Yes***
__X__ ***No***

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

__X_ ***Yes***
____ ***No***

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

____ ***Yes***
__X_ ***No***

Since the revised recovery plan was completed in 2001, new information has been acquired through population monitoring, research efforts, reintroductions, and changes to the amount and/or locations of available habitat for recovery efforts. See section 2.2.3.

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria?

____ ***Yes***
__X_ ***No***

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

According to the recovery criteria from the Revised Recovery Plan for the Oregon Silverspot Butterfly (*Speyeria zerene hippolyta*), delisting can occur when the following criteria have been met (USFWS 2001, p. iv).

1) At least two viable Oregon silverspot butterfly populations exist in [each of the following] protected habitat conservation areas (Figure 1): Coastal Mountains, Cascade Head, and Central Coast in Oregon; and Del Norte County in California; and at least one viable Oregon silverspot butterfly

population exists in protected habitat in each of the following areas: Long Beach Peninsula, Washington, and Clatsop Plains, Oregon. This includes development of comprehensive management plans.

2) Habitats are managed in the long term to maintain native, early-successional grassland communities. Habitat management maintains and enhances early blue violet abundance, provides a minimum of five native nectar species dispersed abundantly throughout the habitat and flowering throughout the entire flight period, and reduces the abundance of invasive nonnative plant species.

3) Managed habitat at each population site supports a minimum viable population of 200 to 500 butterflies for at least 10 years.

Figure 1 identifies the habitat conservation areas for Oregon silverspot butterfly established in the recovery plan as well as the known currently occupied sites, recently established nonessential experimental populations (Saddle Mountain State Natural Area [SNA] and Nestucca Bay National Wildlife Refuge [NWR]), and future potential reintroduction sites. Rangewide, recovery criteria 1, 2 and 3 have not been met in terms of the number of populations, the size of the existing populations over time, the amount of habitat available, and the quality of the habitat in terms of providing sufficient numbers of violets and nectar plants. No site-specific comprehensive management plans have been completed. The Nestucca Bay NWR has a comprehensive draft in progress, and the OPRD has a management plan for their property that is part of the Rock Creek-Big Creek population area, within the Oregon central coast habitat conservation area.

At the time of the last Oregon silverspot butterfly 5-year review (USFWS 2012, p. 8), the Mount Hebo and Lake Earl populations were thought to be stable and self-sustaining. However, both populations have experienced recent declines so are no longer considered to be so (see Table 1). Two new nonessential experimental populations have recently been established at Saddle Mountain SNA and Nestucca Bay NWR in Oregon, which provide a conservation benefit to the species as a hedge against extinction, expand the species' current range, and advance recovery efforts toward the 10 populations needed to meet recovery criteria. Habitat restoration is ongoing while management plans and habitat improvement options are being developed at most sites. Table 1 provides a summary of the current status of all known populations of the Oregon silverspot butterfly.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat:

Central to the life cycle of the Oregon silverspot butterfly is the abundance of the caterpillar host plant, the early blue violet (*Viola adunca*). The female butterfly

lays her eggs on the early blue violet, which serves as the nearly exclusive food source for the developing larvae. Field studies have demonstrated that female butterflies select areas with high violet densities for egg-laying (USFWS 2001, p. 12; Damiani 2011, p. 7). Based on laboratory studies, a single Oregon silverspot butterfly requires 200 to 300 violet leaves to develop from caterpillar to pupa. In the wild, a caterpillar would therefore require a clump of approximately 16 violet plants to complete its development, assuming each violet could provide about 12 to 20 leaves. Based on studies of other butterflies, nectar abundance and quality are also important to adult survival and particularly fecundity (Boggs and Ross 1993, p. 433; Schultz and Dlugosch 1999, p. 232; Mevi-Schutz and Erhardt 2005, p. 411). Plants that provide nectar to adult butterflies include, but are not limited to, yarrow (*Achillea millefolium*), pearly everlasting (*Anaphalis margaritacea*), Pacific aster (*Symphyotrichum chilensis*), Canada goldenrod (*Solidago canadensis*), tansy ragwort (*Senecio jacobaeae*), and edible thistle (*Cirsium edule*).

Oregon silverspot butterflies inhabit three types of early successional grassland habitats (accordingly, please note the terms grasslands, prairies, or meadows may all be used to refer to Oregon silverspot butterfly habitats in this document). One habitat type consists of marine terrace and coastal headland "salt spray" meadows as exhibited at Cascade Head, Bray Point, Rock Creek-Big Creek, Nestucca Bay NWR, 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 and Saddle 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 essential resources — caterpillar host plants and adult nectar sources — as well as other suitable environmental conditions. Stands of early blue violets sufficient to provide enough food for Oregon silverspot butterfly caterpillars occur only in relatively open and low-growing grasslands.

2.3.1.1 New information on the species' biology and life history:

No new information has become available that would significantly alter our understanding of the species' biology and life history since the last 5-year review of the species. The biology, habitat, and life history of the Oregon silverspot butterfly is discussed at length in the *Revised Recovery Plan of the Oregon Silverspot Butterfly* (*Speyeria zerene hippolyta*) (USFWS 2001,entire) and the *5-year Review of the Oregon Silverspot Butterfly* (USFWS 2012, entire) and are hereby incorporated by reference.

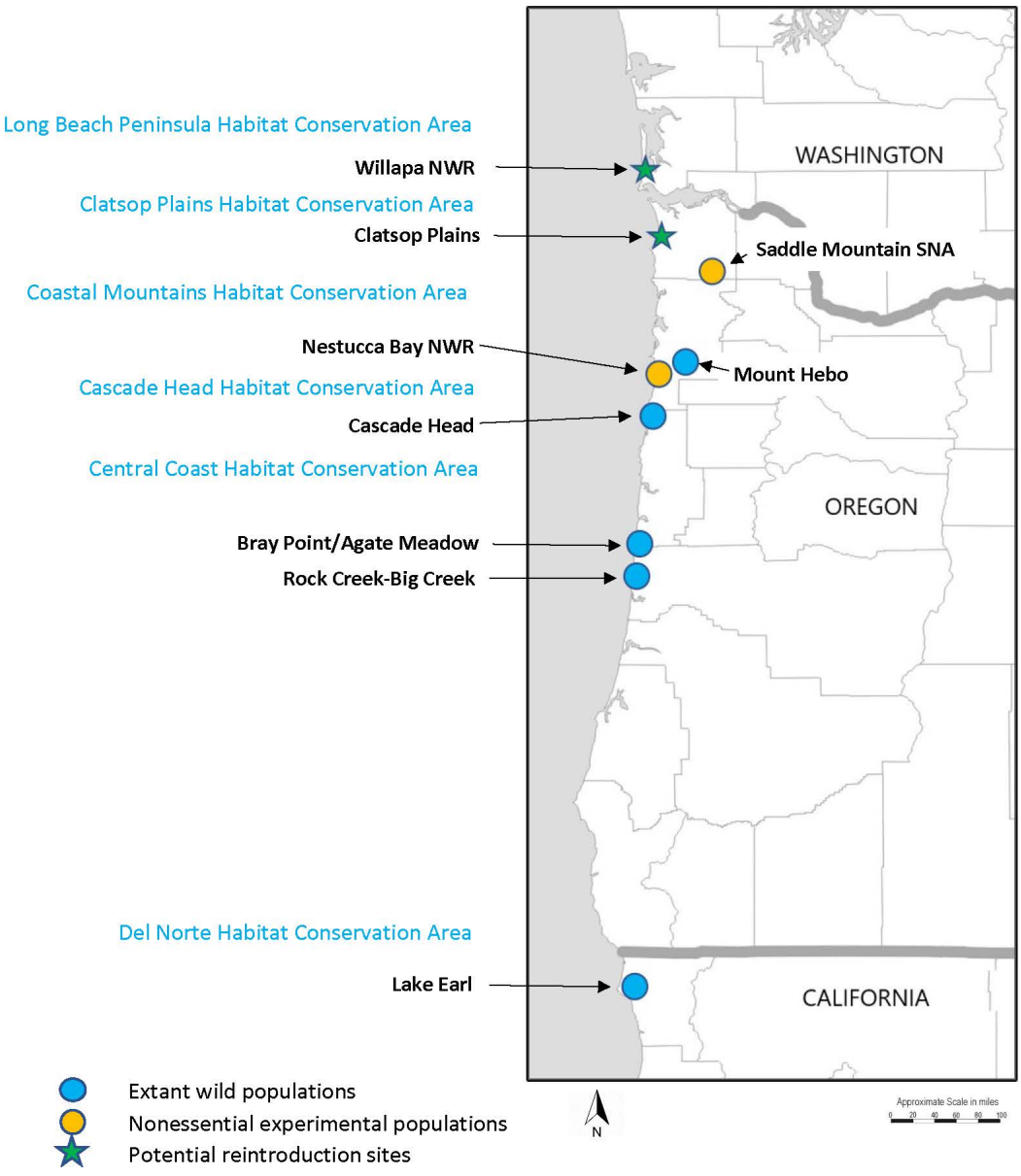

Figure 1. Oregon silverspot butterfly recovery habitat conservation areas, occupied sites, and potential reintroduction locations.

Table 1. Summary of status of Oregon silverspot butterfly populations. Populations in italics denote recently established nonessential experimental populations.

Habitat Conservation Area	Location	Recovery Criteria # pops.	Known #pops	Habitat Acres	Habitat condition	Pop. Index Count (2019)	Primary Ownership	Current 5-year trend
Long Beach Peninsula, Washington	Southwest Washington	1	0	120	Degraded, restoration in progress	Last observed 1990	Washington Department of Fish and Wildlife, Willapa National Wildlife Refuge, Natural Resource Conservation Service Easement	Likely extirpated
Clatsop Plains, Oregon	Northwest Oregon	1	0	130	Degraded, restoration in progress	Last observed 1998	Private property	Likely extirpated
Saddle Mountain, Oregon	Northwest Oregon	N/A	1	60	Suitable	41*	Oregon Parks and Recreation Department	N/A, new population
Coastal Mountain, Oregon	Mount. Hebo	2	1	65	Suitable	1,171*	Siuslaw National Forest	Increasing with augmentations
	Fairview Mt.			4	Too small	0		N/A
Cascade Head, Oregon	Oregon Central Coast	2	1	50	Degraded, restoration in progress	12*	The Nature Conservancy, Siuslaw National Forest	Declining
Nestucca Bay NWR, Oregon	Oregon Central Coast	N/A	1	30	6 acres suitable, 25 acres undergoing restoration	17*	US Fish and Wildlife Service	N/A, new population
Central Coast, Oregon	Bray Point, Oregon Central Coast	2	2	6	Degraded, 2-4 acres suitable	2*	Siuslaw National Forest, Private	Declining
	Rock Creek-Big Creek, Oregon Central Coast			30	Degraded, restoration in progress	151*	Oregon Parks and Recreation Department, Siuslaw National Forest	Increasing with augmentations
Del Norte (Lake Earl), California	Northwest California	2	1	42[1]	Mix of suitable and degraded, restoration in progress	1	California Department of Fish and Wildlife, California State Parks (few Private)	Declining

* indicates the populations have been established or augmented with captive-reared individuals that are included in the population index counts if observed

[1] Habitat area approximate and based primarily on grasslands with early blue violets. Does not include some areas with dispersed nectar plants and few or no violets, and some potential habitat is on private lands and has not been assessed for suitability.

2.3.1.2 Abundance, population trends (*e.g.* increasing, decreasing, stable), demographic features (*e.g.*, age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Historically, the Oregon silverspot butterfly was distributed along the Washington and Oregon coasts from Westport in Grays Harbor County, Washington, south to Heceta Head in Lane County, Oregon, with a disjunct population located north of Crescent City in Del Norte County, California. Historically, at least 20 separate locations were known to support Oregon silverspot butterfly, which were discovered over the period 1895 to 1975 (McCorkle *et al*. 1980, pp. 7-8). Currently there are seven extant populations: five wild populations and two recently reintroduced populations. The wild populations are located at Rock Creek-Big Creek, Bray Point, Cascade Head, and Mount Hebo, Oregon, and at Lake Earl in Del Norte County, California. The two nonessential experimental populations were established at Nestucca Bay NWR in Tillamook County, Oregon in 2017, and at Saddle Mountain SNA in Clatsop County, Oregon in 2018.

Standardized butterfly survey methods using a modified Pollard method (Pollard 1977, p. 116) have been conducted at four occupied sites in Oregon annually for 30 years (1990 to 2019) (Pickering 2008, p. 13; Patterson 2020, p. 12) (See Appendix I). California's Lake Earl site has been monitored using the same method annually from 2005 through 2019 (USFWS 2018, p. 6; Clint Pogue, pers. comm. 2019). Butterfly surveys at Saddle Mountain are conducted using a different method, with counts conducted from multiple stationary locations due to the steep terrain. All survey results produce an *index of abundance* value, which provides a *relative* population measure from year to year (see Table 2 for the index counts over the past 10 years). Index counts are not designed to estimate population size but do provide a measure to evaluate year-to-year variation; index counts will almost always be lower than the total population size, and should not be interpreted as a census value.

Butterfly populations can fluctuate dramatically in response to local weather events. Populations are most at risk when unfavorable weather conditions occur in consecutive years. In 1993, cool wet spring weather is thought to have been responsible for population crashes at four Oregon populations (Pickering 1995, p. 6). Drought conditions in 2014 and 2015 likely caused the largest Oregon silverspot butterfly population at Mount Hebo to dramatically decline. The index count for the Mount Hebo population, the largest wild population of Oregon silverspot butterfly, has averaged 1,369 butterflies over the past 20 years (2000 to 2019). The index count at Mount Hebo declined to 120 butterflies in 2015, precipitating the need to augment this once large and stable population

with captive-reared butterflies (Table 1). The Oregon silverspot butterfly population at Lake Earl in California, which was the second largest of all the populations between the years 2008 to 2015, experienced a significant decline between 2016 and 2019; a single Oregon silverspot butterfly was observed on survey transects in 2019. Populations at the 5 other sites remain small and in decline, with just over 200 butterflies counted between them during surveys in 2019 (Table 1). With the exception of Lake Earl, all populations are being augmented with captive-reared butterflies to increase population size.

Although we do not have data on the historical distribution of the Oregon silverspot butterfly, we presume that populations were distributed such that individuals could move between them at least on occasion, which would buffer these naturally variable populations from local extirpation.

Table 2. Oregon Silverspot Butterfly Relative Index of Abundance 2010 – 2019.

Location	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Mt. Hebo	1,334	1,377	3,091	1,489	582	120	461 (597[1])	379 (531[1])	764 (59[1])	1,171 (285[1])
Cascade Head	610 (1017[1])	643 (1089[1])	103	88	87 (89[2])	20 (48[1])	13 (47[1])	9	5	12 (140[2])
Bray Pt./Agate Meadow	140 (1356[1])	204 (560[1])	341 (851[1], 259[2])	133 (672[1])	105 (631[1], 93[2])	3 (477[1])	26 (139[1])	NA	4	2 (171[2])
Rock Creek/Big Creek	426 (665[2])	352	251 (734[1], 259[2])	302 (582[1])	199 (723[1])	158 (301[1])	115 (67[1])	82 (162[1])	45	151 (300[2])
Lake Earl	352	625	491	332	438	264	89	7	4	1
Nestucca Bay NWR								59 (927[2])	21 (105[1])	17 (458[2], 12[3])
Saddle Mt.									27 (545[2])	41 (504[2])
TOTAL	**2,862**	**3,201**	**4,277**	**2,344**	**1,411**	**565**	**704**	**536**	**870**	**1,395**

Number of captive-reared Oregon silverspot butterflies released as pupae[1], caterpillars[2], or adults[3] per site, by year.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (*e.g.*, loss of genetic variation, genetic drift, inbreeding, *etc*.):

The *Controlled Propagation and Reintroduction Plan for the Oregon Silverspot Butterfly (Speyeria zerene hippolyta*) (Van Buskirk 2010, entire) provides information relevant to population augmentations and reintroductions of the Oregon silverspot butterfly. The most genetically diverse population was thought to be the Lake Earl population, which was likely the source for all other extant populations of the Oregon silverspot butterfly to the north (VanBuskirk 2010, p. 8). The Mount Hebo population was thought to be less diverse, perhaps being established from a smaller group of founding individuals.

Since the 2012 Oregon silverspot butterfly 5-year review, three studies have been published that provide information on the genetic relationships of Oregon silverspot butterfly and related species. One study focused broadly on genetic relationships of the butterfly genus *Speyeria* (McHugh *et al*. 2013, p. 1247), which found Oregon silverspot butterfly populations to be genetically variable both within and between populations. One of the primary goals of the study was to determine whether the Oregon silverspot butterfly represents a valid "evolutionarily significant unit (ESU)" – in other words, to determine whether *Speyeria zerene hippolyta* is a valid subspecies – using analyses of both mitochondrial (mtDNA) and nuclear DNA (nDNA). The results between the mtDNA and nDNA were inconsistent, leading the researchers to conclude there is insufficient evidence to invalidate the status of *S. z. hippolyta* as a distinct ESU, especially in light of morphological, developmental, and ecological traits recognized as specific to the subspecies (McHugh *et al*. 2013, p. 1248). Another analysis of *Speyeria* mitochondrial and nuclear DNA found mtDNA does not reliably identify species at a broad geographic scale and recommends sampling across the whole genome, underscoring the point that the genetics of *Speyeria* are extremely complex and challenging to decipher (Campbell *et al.* 2019, p.1). In 2012, genetic sampling of all Oregon silverspot butterfly populations was initiated to examine population structure following population augmentations with butterflies from Mount Hebo to other coastal sites. Using mtDNA, 32 different haplotypes were identified within all populations of Oregon silverspot butterfly. Results from the Rock Creek-Big Creek site found haplotypes that likely originated from the releases of captive stock originating from Mount Hebo, as well as coastal haplotypes, indicating this population is now likely the most genetically diverse (Miller *et al.* 2016, p. 17).

All Oregon silverspot butterfly populations are currently isolated from one another by significant distances and natural genetic exchange is highly unlikely to occur. In addition, with the decline of the Lake Earl population between 2016 and 2019, the loss of genetic diversity has been

significant, as the Lake Earl population historically possessed the highest genetic diversity within the subspecies (Van Buskirk 2010, p. 10). The continued release of captive-reared butterflies from one population to another may be a necessary tool to promote genetic diversity and gene flow among remaining populations.

2.3.1.4 Taxonomic classification or changes in nomenclature:

None

2.3.1.5 Spatial distribution, trends in spatial distribution (*e.g.* increasingly fragmented, increased numbers of corridors, *etc*.), or historic range (*e.g.* corrections to the historical range, change in distribution of the species' within its historic range, *etc*.):

The Oregon silverspot butterfly is now absent from much of its former range, with the loss of at least 11 historically known populations and approximately half of the northern portion of its historical range, which once extended north to Westport, Washington (USFWS 2001, p. 9). Since the 2012 Oregon silverspot butterfly 5-year review, the spatial distribution of the species has increased north by approximately 50 miles (mi) (80 kilometers [km]) and 2 populations have been established within its historical range. This was accomplished by the reintroduction of nonessential experimental populations at Saddle Mountain SNA in Clatsop County, Oregon, and at Nestucca Bay NWR in Tillamook County, Oregon in 2017 and 2018 (see 2.3.1.7 Other: Establishment of Oregon silverspot butterfly nonessential experimental population areas).

As described above (section 2.3.1.3), all extant Oregon silverspot butterfly populations are currently isolated from one another and incapable of genetic exchange, as they are situated well beyond the known dispersal capabilities of the butterfly, estimated at 4.25 mi (6.8 km).

2.3.1.6 Habitat or ecosystem conditions (*e.g.*, amount, distribution, and suitability of the habitat or ecosystem):

<u>Long Beach Peninsula Habitat Conservation Area</u>
The Oregon silverspot butterfly is likely extirpated in Washington, with the last butterfly observed on the Long Beach Peninsula in 1990. The WDFW conducts periodic reviews of State listed species, which includes the Oregon silverspot butterfly. In 2019, the WDFW recommended the species remain classified as endangered in Washington and addressed the future need for reintroductions from captive-reared or wild Oregon populations (Hays and Stinson 2019, entire).

Since the last 5-year review in 2012, additional habitat on the Long Beach Peninsula has been secured and restored for the Oregon silverspot butterfly. Currently habitat within this area is owned and managed by the WDFW, the Service (Willapa NWR), plus a private property easement held by the Natural Resources Conservation Service of approximately 60 acres (ac) (24 hectares [ha]). Properties recently purchased by the Columbia Land Trust combined with other State, Federal, and private properties scattered throughout the Long Beach Peninsula may eventually provide suitable habitat for the butterfly. Together these properties offer the greatest opportunity for restoring suitable habitat to allow for a reintroduction of the Oregon silverspot butterfly on the Long Beach peninsula (Hays and Stinson 2019, p. 11).

The WDFW has been conducting Oregon silverspot butterfly habitat restoration and research on their property for more than 25 years. Appropriate habitat on the peninsula has recently increased from 20 to 29 ac (8 to 9 ha) through private land donations, removal of encroaching shore pines, and restoration.

The Willapa NWR owns and manages a site with approximately 30 ac (12 ha) suitable for habitat enhancement for the Oregon silverspot butterfly. In 2011, the Service, in conjunction with the Institute for Applied Ecology, received funding through a Cooperative Recovery Initiative that set a goal of initiating habitat restoration activities on 5 ac (2 ha) at Willapa NWR in 2015 and implementing an adaptive management approach to develop an additional 12 to 17 ac (4.8 to 6.8 ha) of suitable habitat for the Oregon silverspot butterfly beyond 2017.

Currently, the Willapa NWR is developing a site management and implementation plan specific to maintaining coastal prairie and establishing a viable Oregon silverspot butterfly population. LIDAR (light detection and ranging) data are being used to determine the best elevation at which to plant establish a population of violets plants so they will not be submerged during the wet winters at this low-elevation site. Habitat restoration treatments are ongoing and include topsoil removal, herbicide applications, mowing, dethatching, seeding with native seed, and planting plugs. In 2019, 21,000 violets and 7,000 nectar plants were planted in preparation for a reintroduction of Oregon silverspot butterfly at Willapa NWR in the near future.

Clatsop Plains Habitat Conservation Area

Within the Clatsop Plains Conservation Area in northwestern Oregon, the Oregon silverspot butterfly population is likely extirpated, with the last confirmed sighting in 1998 (Van Buskirk 1998, p. 3). The Clatsop Plains is a large area of mostly privately owned grasslands, previously used for grazing cattle and agriculture and is now being developed for residential

housing. Within this patchwork of developed and undeveloped lands, Oregon silverspot butterfly habitat persists, mostly along what was once a known butterfly flight corridor along Neacoxie Creek.

The North Coast Land Conservancy (NCLC), a non-profit conservation organization, owns and manages six properties in the Clatsop Plains, of which 121 ac (49 ha) are coastal prairie habitat. Scotch broom (*Cytisus scoparius*) that once dominated the prairies has been removed and is being managed with periodic mowing and grazing. From 2013 to 2017, the NCLC partnered in a study with the Institute for Applied Ecology, Willapa NWR, and Lewis and Clark National Historical Park to test treatment techniques to restore degraded prairie habitat in the Clatsop Plains. These treatments included topsoil removal, herbicide, and topsoil inversion. Each treatment had advantages or drawbacks depending on the site characteristics, previous land use, and invasive weed problems, but provided relevant information for land managers to consider when restoring coastal prairies (Bahm and Petix 2017, entire).

Violet surveys conducted on NCLC properties in 2013 and 2017 showed violet densities and abundance increased at multiple locations (Patterson 2017, p. 5), possibly to levels sufficient to support an Oregon silverspot butterfly population. Habitat management combined with suitable weather conditions likely contributed to the increase. The current focus of the NCLC is to increase native nectar plant abundance needed to support a reestablished population of Oregon silverspot butterfly. In 2018, 15,000 seed "bombs" (two parts clay, two parts potting soil, holding native seed) were planted by volunteers and 15,000 nectar plant plugs will be planted to increase nectar plant abundance necessary to support a reintroduced Oregon silverspot butterfly population.

The OPRD is actively working to restore 22 ac (9 ha) of coastal prairie habitat at Sunset Beach State Recreation Site, located in the central portion of the Clatsop Plains Habitat Conservation Area. A management plan is being developed for the site that will use herbicide, topsoil removal, and, if possible, prescribed fire to establish native prairie species.

The Necanicum Watershed Council, NCLC, Oregon Military Department-Camp Rilea, and Lewis and Clark National Historical Park have collaborated on the development of native seed sources to support habitat restoration efforts in the Clatsop Plains. These partners are in the process of creating a Clatsop Plains Pollinator Corridor, converting and linking together restored grasslands of native coastal prairie habitat to support the Oregon silverspot butterfly and other coastal pollinators.

Coastal Mountains Habitat Conservation Area

The Coastal Mountain Habitat Conservation Area includes Mount Hebo and Fairview Mountain on the Siuslaw NF in northwestern Oregon. The Mount Hebo site, a meadow complex of approximately 60 ac (24 ha), differs from most other Oregon silverspot butterfly habitat conservation areas in that it is at an elevation of 3,000 feet [ft] (914 meters [m]) and snow typically covers the meadow areas, often until the early summer months. This may be a factor in preserving the native plant composition of the site compared to the coast sites. Without snow, nonnative invasive plants grow during the winter at coast sites and eventually outcompete the native plants which are dormant during the winter.

The Mount Hebo population is the largest and last stronghold of the species. The 1990 to 2019 butterfly index counts have fluctuated widely from a high of 4,983 butterflies in 1999 to a low of 120 in 2015. In 2019, this population supported 84 percent of the species' total population and is the primary source of females captured for the captive-rearing program. Thus, the loss of this population to a catastrophic event would likely result in the loss of the remaining populations and given that the majority of individuals are restricted to this population the subspecies continues to have a high risk of extinction.

Without fire or active management, the meadow habitat on Mount Hebo will become less suitable for Oregon silverspot butterflies as small trees, bracken fern (*Pteridium aquilium*), salal (*Gaultheria shallon*), thimbleberry (*Rubus parviflorus*), and other shrubs move into the habitat through ecological succession. From 2010 to 2018, habitat conditions deteriorated over most of the meadows at Mount Hebo. This was likely due to a combination of factors including decreased snowpack, the effects of two consecutive drought years in 2014 and 2015, the expansion of invasive species such as oxeye daisy (*Leucanthemum vulgare*) and reed canary grass (*Phalaris arundinacea*), and changes in active management (Hammond 2019, p. 17). In 2019, the Siuslaw NF, Hebo Ranger District, implemented a variety of meadow maintenance and restoration activities on 20 ac (8 ha) targeting areas of dense thimbleberry, salal, bracken fern, and encroaching conifers. The Northwest Youth Corps removed approximately 5,150 small trees and bracken fern on 8.5 ac (3.2 ha). To maintain butterfly flight corridors, an additional 2,000 small trees were removed that were located between meadow areas. Forest Service staff planted approximately 6,500 native plants including early blue violet, goldenrod, and pearly everlasting. The Forest also contracted Oregon silverspot butterfly oviposition surveys to determine the broader characteristics of the habitat where the species lays their eggs on early blue violets, and deployed a series of time-lapse cameras focused on insect use of violet and nectar plants.

The Fairview Mountain site mentioned in the *Revised Recovery Plan for the Oregon Silverspot Butterfly* (USFWS 2001, p. 29) is not known to have historically supported a wild Oregon silverspot butterfly population and currently does not support a butterfly population. Introduced populations in 1985 and 1991 did not persist; the site is likely too small to support a viable population (Hammond 1994, p. 7).

Cascade Head Habitat Conservation Area

The Cascade Head Habitat Conservation Area, which has approximately 50 ac (20 ha) of grassland habitat, is owned and managed by The Nature Conservancy (TNC), and supports one Oregon silverspot butterfly population. The Oregon silverspot butterfly population at Cascade Head experienced significant declines between 1990 and 2000. Since 2000, this population has been augmented with captive-reared individuals in most years. Between 2007 and 2011, more than 500 captive-reared butterflies were released on the site annually. These large-scale releases increased the annual population index counts, however, the population level dropped to near pre-release levels when the augmentations stopped in 2012 to 2013, potentially indicating additional information was needed on the specific habitat requirements of the species. Augmentations between 2014 and 2019 released fewer individuals with the goal of supporting the population and maintaining the population's genetic diversity while habitat research and improvements are underway.

To address the above information gaps, a caterpillar foraging study was undertaken at Cascade Head by Lewis and Clark College researchers to determine the minimum density of host plants needed to support wild caterpillar survival. They found that Oregon silverspot butterfly caterpillars moved randomly and had limited ability to move long distances in search of their host plant, the early blue violet. The study found 4 violets per square meter (m^2) (0.37 violets per square foot [ft^2[) are needed for 80 percent of fourth instar larvae to find a violet within 8 hours, and 8 violets per m^2 (0.74 violets per ft^2) are needed for 50 percent of larvae to reach pupation. Larvae that had to search over longer distances for host plants were more vulnerable to starvation and to predation (Bierzychudek *et al*. 2009, p. 636). Bierzychudek *et al*. (2009) also noted that larvae of all sizes would spend long periods near the rosettes of *Hypochaeris radicata*, a nonnative plant that is abundant at many sites, including Cascade Head. This finding suggests that sites with high densities of this nonnative plant could lead to reduced survivorship of larvae, which might waste energetic resources in the vicinity of *Hypochaeris* instead of encountering the requisite early blue violets. In 2009, violet densities at Cascade Head were approximately 1 per m^2 (0.09 per ft^2) TNC planted approximately 12,000 early blue violets on 1.2 ac (0.48 ha) at Cascade Head in 2010 to increase violet density to 4 plants per m^2 (0.74 per ft^2) (Pickering 2011, p. 4.).

Since the last 5-year review, multiple habitat restoration activities have been implemented at Cascade Head to improve the habitat suitability for the Oregon silverspot butterfly, including prescribed burning, fern and brush removal, and planting and seeding violet host plants, as well as violet density monitoring (Pickering and Dunn 2015, p. 3). Additional restoration actions are proposed for 2020 to 2022.

Central Coast Habitat Conservation Area

The Central Coast Habitat Conservation Area includes Bray Point and the Rock Creek-Big Creek site on the Siuslaw NF and OPRD lands. At the time the species was listed in 1980, the Rock Creek-Big Creek population was thought to be the only viable Oregon silverspot butterfly population, therefore the designation of critical habitat was limited to this conservation area. The critical habitat area is located between Big Creek to the south and Bob Creek to the north along an approximately 2 mi (3.2 km)-long narrow strip bisected by U.S. Highway 101.

Both the Rock Creek-Big Creek and Bray Point sites now support small Oregon silverspot butterfly populations after significant population declines between 1990 and 2019. Beginning in 2004, these populations have been augmented with captive-reared Oregon silverspot butterflies to prevent extirpation. Since the 2012 5-year review, the Rock Creek-Big Creek population has fluctuated between an index count of 302 (2013) to a low of 45 butterflies (2018); population augmentations occurred in all years except for 2018 (Table 1). In 2019, augmentations resumed when additional habitat was restored on the OPRD portion of the butterfly habitat area.

In 2009, the area of butterfly habitat available in this habitat conservation area increased substantially when TNC purchased the Big Creek property, a 193 ac (78 ha) private parcel adjacent to the Siuslaw NF Rock Creek-Big Creek butterfly area. The Big Creek property is dominated by a mature spruce forest, a riparian area along Big Creek, and smaller grassland areas that support the Oregon silverspot butterfly adjacent to the habitat on the Siuslaw NF. The property was subsequently turned over to OPRD and became part of Carl G. Washburne State Park. In 2018, OPRD prepared the Big Creek Site Management Plan, which proposed to enhance an additional 10 ac (4 ha) of meadow habitat for the butterfly. A native plant nursery was created at the nearby OPRD Tugman State Park to grow the native plants needed for habitat restoration. In 2018, 4,800 violets and seeds and native nectar seedlings were planted and invasive plants were removed. In 2019, approximately 300 caterpillars were released directly on the densely planted violets. In 2018, prior to the caterpillar release, the Oregon silverspot butterfly index count for the Rock Creek-Big Creek population, was 45 butterflies. Following the caterpillar release of 2019, the population index count was 151 butterflies (Patterson 2020, p. 13).

Historically, the Siuslaw NF staff managed the habitat at the Rock Creek-Big Creek site by mowing the meadows west of Highway 101 once or twice per year, and sometimes cutting weeds with a line trimmer on the steeper slopes east of the highway. The 12 ac (4.8 ha) of mowed meadows on the west side of Highway 101were once prime breeding habitat for the butterfly. This area is vulnerable to erosion from wave action and is potentially vulnerable to tsunamis. Over time, the habitat has become increasingly degraded by nonnative grasses, such as heath grass (*Danthonia decumbens*) and bentgrass (*Agrostis alba*). These species produce a thick thatch layer and shade and outcompete the native violets. Since the last 5-year review in 2012, habitat conditions on the Siuslaw NF portion of the conservation area have further degraded, indicating that management from 2014 to 2017, comprised of a single fall mowing, was insufficient to maintain the habitat quality necessary to support a viable butterfly population. Between 2017 and 2019, the Siuslaw NF staff planted 10,000 violets and 6,300 nectar plants and changed their mowing regime to enhance habitat quality. The Siuslaw NF has recently established treatment plots in the meadows west of Highway 101 to determine which treatments would be most effective on approximately 3 ac (1.2 ha) of the habitat area. Treatments include a combination of methods to eliminate nonnative grasses, including dethatching, use of a steam machine, or burning, followed by planting native seed. The Siuslaw NF also funded an oviposition (egg laying) research project on the Rock Creek-Big Creek population, which confirmed the butterfly's preference for laying eggs in dense violet patches and identified hot spots of egg laying activity (Van Buskirk 2020, p. 4).

Bray Point, located on the Siuslaw NF, is approximately 6 ac (2.4 ha) and is 5 m (8 km) south of Rock Creek-Big Creek; the intervening area is privately owned. Historically, butterflies were known to move between the Bray Point and Rock Creek-Big Creek site (Van Buskirk and Pickering 1999, p. 3), but these populations have become increasingly isolated due to development of the intervening lands and the Bray Point population is now very small.

A Safe Harbor Agreement established in 2007 between TNC and the Service allowed private landowners to enroll in the Safe Harbor and be eligible to have habitat restoration efforts implemented on their property by TNC staff. As of 2020, the Lincoln Soil and Water Conservation District will take over the role of working with private landowners. Currently, seven landowners located near Bray Point have enrolled to maintain 2.2 ac (0.9 ha) for the butterfly and thousands of violets and nectar plants have been planted on their properties (*i.e.*, butterfly garden plots). Butterfly abundance and the planted violets have been monitored in successive years (Dunn 2018, p. 5). Habitat on these enrolled properties combined with habitat on the Siuslaw NF may eventually

provide a flight corridor, with the private properties providing stepping stones of habitat, reconnecting the Bray Point and Rock Creek-Big Creek populations.

Between 2015 and 2019, population augmentation efforts at Bray Point were scaled back (*i.e.*, fewer individuals released and less frequent releases) due to a lack of suitable sites on the Siuslaw NF. In 2019, 171 caterpillars were released mainly in the above mentioned restored butterfly garden plots. While just two butterflies were observed flying during 2019 butterfly survey transects, the mix of private properties adjacent to the Siuslaw NF make population counts difficult, and it is likely the population is higher than the surveys indicated.

Del Norte Habitat Conservation Area

The historical distribution of the Del Norte Habitat Conservation Area in northwestern California extended from the north side of Lake Earl in Del Norte County northward for about 2.5 mi (4 km) within the coastal dune complex. The northern third of this area, north of Kellogg Road, is entirely within Tolowa Dunes State Park. Butterfly habitat in the southern area, from Kellogg Road south to Lake Earl, occurs on lands in the State's Lake Earl Wildlife Area, the Tolowa Dunes State Park, and some privately owned lots in the Pacific Shores subdivision.

The Del Norte Habitat Conservation Area supports an Oregon silverspot butterfly population that has not been augmented to date. Standardized surveys began in 2005. At the time of the last 5-year review in 2012, this population was considered stable, with multiple years of index counts above 200 butterflies. However, survey results from 2016 to 2019 indicated this population was in severe decline (Table 2). In 2016 the index count was 89 butterflies, in 2017 it had dropped to 7, then 4 in 2018, and finally in 2019 the index count was down to a single butterfly. Due to the severe decline, an augmentation program was initiated in 2018 with the collection of one female that was sent to the captive rearing facility at the Oregon Zoo. The plan was to release her larvae or pupae into the Del Norte Habitat Conservation Area in 2019. However, the eggs laid by the female were not viable, likely because she had not mated. The Sequoia Park Zoo in Eureka, California, is currently prepared to conduct captive-rearing of Oregon silverspot butterflies from Del Norte if it is determined to be the best course of action to prevent the loss of this population.

The Del Norte Habitat Conservation Area is a large area, primarily located on deflation plains (low-lying plains formed by sand blown inland from the foredunes) within a coastal dunes complex. Because not all potentially occupied habitat is surveyed, particularly on private lands, the Del Norte population index may not represent the entire population. In the fall of

2017, additional potential habitat was identified on California State Parks land south of Lake Tolowa and west of Lake Earl. In collaboration with California State Parks (CSP) and California Department of Fish and Wildlife, the Service expanded survey efforts to include previously unsurveyed non-transect locations during the 2018 and 2019 seasons.

While Tolowa State Park is approximately 5,000 ac (2,023 ha), only a small portion of the park has suitable butterfly habitat. Pacific Shores is a subdivision with a road system and about 760 ac (307 ha) divided into 1,535 undeveloped (and undevelopable) lots. About half of these have been purchased with public funds and are now part of the State's Lake Earl Wildlife Area. The subdivision area includes occupied Oregon silverspot butterfly habitat, as well as forest, wetlands, and other unsuitable habitat. Publicly-owned lots within the subdivision form a checkerboard pattern, with few large blocks of habitat. The area surveyed for the population index count occurs along 15 transects covering 42 ac (17 ha), and includes habitat in the State Park, wildlife area, and Pacific Shores.

A dominant feature of this conservation area is Lake Earl, a coastal lagoon characterized by water levels that fluctuate widely due to rainfall and periodic breaching of the lagoon mouth, which results in a rapid lowering of the lake. While natural breaches occur, humans have breached the lagoon mouth to manage for lower lake levels for at least a century. Human caused breaching is controversial, with environmental and other concerns arguing for higher lake levels and property owners arguing for lower levels to reduce flooding of infrastructure and private lands. Currently, lake levels and intentional breaching are managed through a Federal Clean Water Act permit, and for about 20 years, the lagoon has been managed at higher levels than previously.

In the Del Norte area, disturbance regimes have been affected by the removal of livestock grazing (MGW Biological 2009), and the stabilization of dunes with European beach grass (*Ammophila arenaria*). In recent years, some suitable butterfly habitat has been lost to succession. Higher-elevation dune grasslands are being encroached on by coniferous forest and lower-elevation and moister grasslands are being replaced by slough sedge (*Carex obnupta*) and scrub areas dominated by willows and other woody non-conifers. These changes may be due to the management for higher water levels of Lake Earl, as well as human-altered disturbance regimes that affect most coastal grasslands and dune systems (USFWS 2001). To address this loss of habitat, CSP initiated a conifer removal project in 2017, which was funded by a Disney Butterflies-at-Risk grant. The project removed encroaching conifers over 13.1 ac (5.3 ha) of Oregon

silverspot habitat. To monitor the effects of the restoration, CSP conducted a multi-year survey of violet density in the restored areas.

Other recovery activities in recent years include population monitoring, vegetation studies along the butterfly survey transects, and an ongoing habitat management experiment to determine the efficacy of burning, mowing, tilling, and grazing. Additional work is being done to remove invasive species, such as Scotch broom, from the Pacific Shores area, which outcompetes coastal prairie species used by the Oregon silverspot butterfly. Manual removal of Scotch broom by the Tolowa Land Stewards, Sequoia Park Zoo, and other volunteers has occurred annually since 2014, with plans to continue these efforts into the foreseeable future. Unfortunately, the Pacific Shores subdivision has become a popular site for people to dump trash, furniture, vehicles, and other unwanted items. In response, the County of Del Norte established a watchman station at the entrance to the subdivision to curb illicit dumping. The Service monitors groundwater levels and climate variables to better understand factors affecting vegetation changes and other factors affecting butterfly distribution. Finally, a study completed in 2010 analyzed oviposition site selection. Results indicate that Oregon silverspot butterflies preferred to lay their eggs at sites with greater than 16 violets per m^2 (1.5 violets per ft^2) (Damiani 2011, p. 7). This study also evaluated the risk of oviposition sites and areas of high violet density being flooded when Lake Earl is being managed for high water levels. For the 2007 to 2010 study period, the risk of flooding habitat near the lagoon appeared to be low. In addition, females at Lake Early normally avoid laying eggs in areas that are likely to be subsequently inundated under normal conditions, but there is some evidence that the big population crash in 2018 and 2019 may have been attributable to heavy spring rains and subsequent flooding, resulting in inundation and drowning of eggs or larvae. A comprehensive management plan for the site has not been developed or implemented.

There is the potential for this site to be affected by tsunamis due to its low elevation, and over the long term, by sea-level rise associated with climate change (National Research Council 2012, pp. 117, 121-130). Based on a limited study using mtDNA, this population may have particular significance because genetic studies suggest this population was the most genetically diverse and was potentially a source population for other populations (Van Buskirk 2000, p. 22). Further work by Miller *et al*. (2016, p. 10) found some evidence of genetic similarity between the Lake Earl and Rock Creek populations. Given the sharp decline of the Del Norte population, its genetic uniqueness is at risk of being lost.

Historically, Oregon silverspot butterflies were reported from a small coastal site approximately 5 m (8 km) north of the Del Norte population, near Kamph County Park (USFWS 2001, p. 38). However, there are no recent records from this site and little coastal grassland remains. The

recovery plan reported an extirpated population from the Del Norte County site (USFWS 2001, p. 37,) and it is likely that the Kamph County Park is this extirpated population. Point Saint George, about 5 m (8 km) south of Lake Earl, is largely in county ownership and supports violets, but would require a feasibility analysis to determine its ability to support an Oregon silverspot butterfly population. The site is exposed to strong winds, which could affect the viability of an introduced population, and it would need grassland restoration and maintenance prior to consideration as a potential reintroduction site.

2.3.1.7 Other: Establishment of Oregon silverspot butterfly nonessential experimental population areas

In 2017, the Service established a Nonessential Experimental Population (NEP) area for the Oregon silverspot butterfly at Saddle Mountain SNA and Nestucca Bay NWR in Oregon (USFWS 2017, entire). These sites were proposed as possible Oregon silverspot butterfly reintroduction sites in the *Controlled Propagation and Reintroduction Plan for the Oregon Silverspot Butterfly* (*Speyeria zerene hippolyta*) (Van Buskirk 2010, p. 26). The establishment of the NEP designation was to encourage the reintroduction of the species into historical habitat areas while reducing regulatory requirements and public concerns associated with the presence of a listed species. When NEPs are located outside a National Wildlife Refuge or National Park, the population is treated as a species proposed for listing, minimizing Endangered Species Act [(ESA) of 1973, as amended (16 U.S.C. 1531 *et seq*.)] requirements and regulatory oversight.

Nestucca Bay National Wildlife Refuge

The Cannery Hill Unit of the Nestucca Bay NWR is located 7 mi (11 km) north of the Oregon silverspot butterfly population at Cascade Head, and 10 mi (16 km) to the west of the Mount Hebo population in Tillamook County, Oregon. Although the butterfly was never documented at this site, it is within the subspecies' historical range along the coast, and a small area of remnant coastal prairie persisted on the site prior to habitat restoration.

The Nestucca Bay NWR Comprehensive Conservation Plan included a goal to promote the recovery of the Oregon silverspot butterfly by establishing an NEP on the refuge (USFWS 2013, pp. 4-15). The approximately 1,203 ac (487 ha) refuge has 25 to 30 ac (10 to 12 ha) of coastal prairie habitat in varying stages of restoration. In 2011, the Service, in conjunction with the Institute for Applied Ecology, received funding through a Cooperative Recovery Initiative to expand habitat restoration activities to create 12 to 17 acres of suitable habitat for the Oregon silverspot butterfly. The conversion of degraded grasslands from nonnative pasture grasses to native coastal grasses is underway with an

emphasis on establishing the plant species and habitat structure required to support the Oregon silverspot butterfly.

In 2017, an NEP was established on the Nestucca Bay NWR with the release of 927 caterpillars on 6 ac (2.4 ha) of restored coastal prairie habitat. Additional, smaller scale releases occurred in 2018 and 2019 and are expected to continue until a self-sustaining population is achieved.

Within the boundaries of the refuge, the species is managed as a threatened species. A Habitat Management Plan for the site is being prepared to guide future restoration and maintenance actions to benefit the butterfly. In the fall of 2019, an additional 10 ac (4 ha) were planted with native coastal prairie species, increasing the amount of suitable habitat for the Oregon silverspot butterfly.

Saddle Mountain State Natural Area

Saddle Mountain SNA, managed by OPRD, is located in central Clatsop County in northwestern Oregon. This 3,225 ac (1,305 ha) park is known for its unique botanical community, which thrives on the thin rocky soils, and has few invasive weeds. Saddle Mountain historically supported the Oregon silverspot butterfly, which was last documented in 1973 (McCorkle *et al*. 1980, p. 8). Butterfly surveys in 1980 and more recent surveys during the butterfly flight period (2003, 2006, and 2010) did not document the species at Saddle Mountain (Mike Patterson, pers. comm. 2016), and the population was presumed to be extirpated (Van Buskirk 2010, p. 26).

Available suitable habitat for the Oregon silverspot butterfly consists of approximately 60 ac (24 ha) of meadows on the slopes of Saddle Mountain near its upper peaks at 3,288 ft (1,002 m) above sea-level. Based on plant surveys (OPRD 2012, p. 1), the upper meadows contain high-quality butterfly habitat with sufficient densities of violets and native nectar plants. Habitat quality is maintained by the site's vertical drainage patterns associated with steep ridges, thin rocky soils, elevation, and winter snow cover within the forb rich Roemer fescue (*Festuca roemeri*) montane grassland community (ONHIC 2004, p. 4).

In 2018, an NEP was established with the release of 545 caterpillars. Another caterpillar release occurred in 2019 and it is anticipated that multiple releases of captive-reared caterpillars will be needed to establish a viable, genetically diverse Oregon silverspot butterfly population at Saddle Mountain SNA.

Captive Rearing Program

The release of captive-reared Oregon silverspot butterflies began in 2000 to address the decline of the Cascade Head population. The captive-rearing program collects a small number of wild, mated female butterflies,

primarily from Mount Hebo, which are taken to the Oregon Zoo, in Portland, Oregon, and the Woodland Park Zoo, in Seattle, Washington. The wild female butterflies lay eggs in the zoo laboratories. After hatching the small caterpillars are cared for at the zoos until the following summer, when they are released into habitat areas. Each year, captive-reared offspring are released, and a new set of female butterflies are captured to provide caterpillars for the next year's releases. The augmentation efforts from 2000 to 2019 have released thousands of captive-reared caterpillars, pupae, or adults at all Oregon sites. The new NEP populations at Saddle Mountain SNA and Nestucca Bay NWR were established through the release of captive-reared individuals (see above). The purpose of the releases is to establish new populations, stabilize small vulnerable populations, and reduce the likelihood of extirpation of at-risk populations.

Survivorship of caterpillars in zoo facilities has increased dramatically with the average number of surviving offspring per female increasing from 7 in 2000 to 41 in 2009 (Van Buskirk 2010, p. 12) to 132 offspring in 2019 (Throckmorton 2019, p. 3). In 2010, both zoos collaborated to complete the Oregon Silverspot Butterfly Husbandry Manual (Andersen *et al.* 2010, entire), which was revised in 2018 (McEuen *et al*. 2018, entire), to ensure the methods developed over multiple years of captive-rearing were updated, shared, and implemented consistently each year.

All Oregon silverspot butterfly released in 2019 originated from the eggs of 14 females collected in the fall of 2018. In the summer of 2019, 285 pupae were released at Mount Hebo, and 1,573 caterpillars combined were released on Saddle Mountain SNA, Nestucca Bay NWR, Cascade Head, Bray Point and Rock Creek-Big Creek (Table 2). Twelve adults, which eclosed (emerged from pupa) while in captivity at the Oregon Zoo, were released at Nestucca Bay NWR. All populations except for the Lake Earl population in Del Norte County, California, were augmented with captive-reared butterflies in 2019.

Following steep population declines at Lake Earl between 2015 and 2019, efforts to include this population in captive rearing and release efforts are underway. The Sequoia Park Zoo in Eureka, California, is prepared to conduct captive-rearing efforts for the California population. In 2019, the Sequoia Park Zoo successfully reared an unlisted surrogate butterfly species, the Hydaspe fritillary (*Speyeria hydaspe*), using the methodology described in the current Oregon Silverspot Butterfly Husbandry Manual.

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms):

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

In the last 5-year review (USFWS 2012, p. 24), the most significant threat to the Oregon silverspot butterfly was insufficient quality habitat. Sufficient violet and/or native nectar plant abundance and/or density is lacking at most sites. The invasion and dominance of nonnative plants and the disruption of natural disturbance regimes, which historically maintained coastal prairie ecosystems, continues to threaten the survival of the species by degrading habitat quality. Controlling invasive plants and a depleted native seed bank continues to be the most challenging aspect of restoring habitat for this species.

Recovery efforts since the last review have included conducting research to determine effective management treatments and strategies to increase habitat quality for the Oregon silverspot butterfly (Bahm and Petix 2017, entire). The Institute for Applied Ecology in Corvallis, Oregon, has provided invaluable strategies to restore prairie habitat using a combination of effective treatments to control invasive plants. These include the use of herbicides, mowing, prescribed burning, and topsoil removal, followed by plantings of key native plants. Large-scale native plant propagation efforts initiated in 2005 by the Natural Resource Conservation Service, Plant Materials Center in Corvallis, Oregon, and more recently by the Center for Natural Lands Management in Olympia, Washington, have provided the native seeds needed for ongoing butterfly restoration necessary for future butterfly reintroductions. A coastal native seed partner exchange network has recently been formed to address future seed availability for restoration projects.

Since 2006, tens of thousands of the caterpillar host plant, the early blue violet, have been strategically planted in dense patches to support more wild caterpillars. These efforts also provide release sites for population augmentations and reintroductions efforts as caterpillars are placed directly on the violets. Large numbers of native nectar plants and seeds have also been planted to enhance habitat quality at some sites, such as the Nestucca Bay NWR.

To support the recent establishment of new populations at Saddle Mountain SNA and Nestucca Bay NWR, the quantity of suitable butterfly habitat has increased since the last 5-year review. Improved restoration techniques and increases in native seed availability has facilitated a significant increase in the quality of existing habitat and has the potential to expand restoration of degraded habitat areas.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:
At the time of listing, overutilization for commercial purposes was not identified as a threat to the Oregon silverspot butterfly. It is not uncommon, however, for rare butterflies to be highly prized by collectors, and an international trade exists in specimens for both live and decorative markets, as well as the specialist trade that supplies researchers (Collins and Morris 1985, pp. 155–179; Morris *et al*. 1991, pp. 332–334). Illegal collection of Oregon silverspot butterflies was included as a threat in the revised recovery plan based on documented incidents of unauthorized take and subsequent indictments (U.S. Dept. of Justice 1993). In 2016, the unauthorized collection of Oregon silverspot butterflies resulted in a conviction (Kathy Spangler, pers. comm. 2020).

2.3.2.3 Disease or predation:
In the last 5-year review, bacteria of the genus *Wolbachia* was identified as a potential disease threat to the butterfly. *Wolbachia* parasitizes its host mtDNA, potentially affecting the reproductive biology of the host. Preliminary research suggested some butterflies from Mount Hebo and Rock Creek-Big Creek carried various strains of *Wolbachia*; however, up to 65 percent of invertebrate species also carry this bacteria. Research to date has not documented any deleterious effects to Oregon silverspot butterfly populations from *Wolbachia*. No other disease issues have been identified which affect the species at a population level.

Predation of different life stages of the Oregon silverspot butterfly by spiders, wasps, ants, and birds has been observed (Bierzychudek *et al*. 2009, p. 636; Anne Walker, pers. obs., 2008). In addition, the European gazelle beetle (*Nebria brevicollis*), a new invasive species to the northwest and a voracious predator of native invertebrates, has recently been found at Mount Hebo and Nestucca Bay NWR. Research by the Oregon Department of Agriculture is underway to determine whether this beetle is preying on the Oregon silverspot butterfly (James La Bonte, pers. comm. 2020). Predation is a natural occurrence, and there is no evidence that it may be affecting the Oregon silverspot butterfly at the population level, although the effects of predation may be exacerbated when population numbers are reduced.

A small mammal trapping study on Mount Hebo and Nestucca NWR documented an abundance of small mammals in the meadows occupied by the Oregon silverspot butterfly including vagrant shrews (*Sorex vagrans*), deer mice (*Peromyscus maniculatus*), Oregon creeping vole (*Microtus oregoni*), Pacific jumping mouse (*Zapus trinotatus*), and Townsend's chipmunk (*Tamias townsendii*). Species infrequently documented included long-tailed vole (*Microtus longicaudus*), Townsend's vole (*Microtus townsendii*), California ground squirrel, (*Otospermophilus*

beecheyi), black rat (*Rattus rattus*), coast mole (*Scapanus orarius*), Pacific shrew (*Sorex pacificus*), Trowbridge shrew (*Sorex trowbridgii*), and long-tailed weasel (*Mustela frenata*), some of which are potential predators of the butterfly caterpillars or pupae, particularly in degraded butterfly habitat where thatch build-up provides small mammal habitat. The study also found that in meadow areas that are in the process of converting to forest, forest-dwelling mammals such as the Townsend's chipmunk, move into the degraded meadows, increasing the abundance of small mammals (Wilson 2018, p. 3).

2.3.2.4 Inadequacy of existing regulatory mechanisms:
State-level listing protection for the Oregon silverspot butterfly is limited to Washington State, where the butterfly is listed as endangered by WDFW (Washington Administrative Codes 232-12-014). A recent species status assessment recommended maintaining the species' status as State endangered (Hays and Stinson 2019, entire).

Oregon's State Endangered Species Act does not protect invertebrates. However, on Oregon State lands such as Saddle Mountain SNA and Washburne State Park, which support butterfly populations, Oregon State regulations prohibit collection of animals (Oregon Administrative Rule (OAR) 736-010-0055(2)(d)). The U.S. Forest Service defers to State regulations regarding collection of wildlife species on their lands (36 CFR 261.8, p. 424), unless a Special Regulation is enacted for additional species protections (Kathy Spangler, pers. comm. 2020).

The Oregon silverspot butterfly does not have State protected status in California. However, as of October 1, 2018, new rules regulate permits issued for take of wildlife, including invertebrates for scientific, educational, and propagation purposes (California Code of Regulations, Section 650, Title 14).

2.3.2.5 Other natural or manmade factors affecting its continued existence:
Small populations are much more likely to become extirpated than larger populations (*e.g.*, Gilpin and Soulé 1986, pp. 19-34). For the Oregon silverspot butterfly, the greatest predictor of population size in any given year is the population size in the previous year (USFWS 2011, p. 1); thus if populations are small, they are likely to remain small or further decline in size. In 2019, 4 of the 7 populations of Oregon silverspot butterfly had index counts of fewer than 20 individuals, rendering these populations highly susceptible to extirpation which would contribute to the species' overall extinction risk. Isolation of these populations from one another further contributes to their risk of extirpation as opportunities for dispersing individuals to augment small populations or recolonize extirpated populations are reduced.

Collisions with vehicles has been a concern since the listing of the species over 30 years ago. Highway 101 bisects the coastal Rock Creek-Big Creek critical habitat area and heavy traffic occurs during the butterfly flight period when individuals fly back and forth over the road between meadow areas. A road mortality study reported that of 95 butterflies observed crossing the roadway in this area, 1 was confirmed killed by a vehicle strike, and another 9 were believed to have been struck but the bodies were not recoverable for confirmation (Zielin *et al.* 2010, p. 43). Thus, of butterflies known to attempt crossing the road, an estimated 1 to roughly 10 percent were likely killed by vehicle collisions. Summer traffic volume in this area (216 to 402 vehicles per hour) is highest when the butterflies are most active (Bennett 2010, p. 28).

Climate change may also affect the persistence of the Oregon silverspot butterfly. In the Pacific Northwest, temperatures increased 1.5 degrees Fahrenheit (°F) (2.7 degrees Celsius [°C]) in the twentieth century and are expected to increase an additional 3 to 10 °F (5.4 to 18 °C) in the next century (Shafer *et al*. 2010, p. 175). Experiments and historical records show that increased temperature is linked to earlier budding, leafing, and flowering in a variety of plants (Liu *et al*. 2011, p. 1201). Each butterfly species has its own genetically-based, temperature-dependent, biological clock that dictates its development under the temperature regime of the habitat in which it evolved (Hixon *et al*. 2010, p. 288). Changes in the plant community could result in asynchrony in the timing between the butterfly's plant resource needs and the availability of those resources. Complex interactions between weather and resources can affect butterfly populations at any phase of their life cycle. The timing of maximum violet growth and caterpillar development must be synchronized for Oregon silverspot butterfly larvae to develop to the pupal stage. The adult butterfly stage could be affected by changes in flowering time of nectar producing plants, resulting in increased butterfly mortality and reduced reproductive success.

Extreme weather events, such as the drought of 2014 and 2015, have a profound effect on Oregon silverspot butterfly populations and the frequency of extreme weather events is predicted to increase because of climate change (Intergovernmental Panel on Climate Change 2020, p. 17). Climate change affects in the Pacific Northwest are predicted to include warmer, wetter winters and hotter, drier summers and an increased frequency of extreme precipitation events (Adelsman and Ekrem 2012, p. 37).

Global mean sea-level rise of from 0.95 ft (0.29 m) to 3.6 ft (1.1 m) is predicted by 2100 (Oppenheimer *et.al*. 2019, p. 352). On the Oregon coast, tectonic plate uplift currently compensates for some sea-level rise, but by the middle of the next century, the rate of sea-level rise is expected

to supersede that of uplift. Sea-level rise may render current Oregon silverspot butterfly habitat in low-lying areas unsuitable, including the low elevation habitat at Willapa NWR in Washington and possibly portions of the Del Norte Habitat Conservation Area in California.

A regression analysis of the Del Norte Conservation Area butterfly population index counts between 2005 and 2010 and spring precipitation suggests that within a given year the Del Norte Oregon silverspot butterfly population is influenced by the previous year's population size and spring precipitation of the current year. More rain in March to June, was associated with fewer butterflies observed during the summer butterfly flight season at this site (USFWS 2011).

2.4 Synthesis

The 2012 Oregon Silverspot Butterfly 5-Year Review concluded that the combined threats of small, isolated populations, habitat degradation, and climate change continued to endanger the species throughout its range and concluded that without augmentations, three coastal Oregon populations — Cascade Head, Bray Point, and Rock Creek-Big Creek populations — would likely become extirpated. Since the last review, actions taken to minimize the threats to the subspecies include:

- an increase in the number of populations, from five to seven, through the reintroduction of two new NEPs;
- a range expansion of 50 mi (80 km) to the north achieved through reintroduction;
- an increase in the quality and quantity of suitable habitat through restoration and new partnerships;
- population augmentations at all Oregon sites and preparations to include the California site in the future;
- research into habitat restoration techniques;
- monitoring populations and their habitat; and
- progress toward development of habitat management plans for all sites.

Despite the progress in recent years to recover the subspecies, the following factors continue to threaten the species:

- the size and number of remaining populations, with most being populations being extremely small;
- the isolation of the remaining populations from one another;
- the lack of population stability and recent significant declines;
- limited availability of suitable habitat, especially the lack of requisite high density concentrations of the larval host plant, the early blue violet;
- degradation or loss of habitat due to succession and invasive species; and
- vulnerability to extreme weather events such as drought, sea-level rise, and other climate change related effects.

These combined threats endanger the species throughout its range. Oregon silverspot butterfly populations are so small and isolated from one another that they have little capacity to withstand natural variation in the environment, demographic stochasticity, or to rebound from disturbances. All extant populations, with the possible exception of the relatively larger Mount Hebo population, thus have relatively poor resiliency. With only five remaining wild populations, the species has insufficient redundancy to allow it to withstand a catastrophic disturbance. If such a disturbance were to affect the one large remaining population at Mount Hebo, the entire subspecies would be highly vulnerable to extinction in the near term. Finally, representation, the ability of the subspecies to respond to novel changes in the physical or biological environment, is limited. Genetic diversity that may previously have resided within various populations of the subspecies has likely been reduced by significant population declines as well as the necessity of augmenting populations throughout the range with individuals captured at the one large population at Mount Hebo. The Rock Creek and Lake Earl populations may still contain a limited reservoir of genetic variability, but these populations are extremely small, thus the likelihood that they may still preserve unique genes is greatly reduced. Based on our assessment of the resiliency, redundancy, and representation of Oregon silverspot butterfly populations, the long-term viability of the subspecies is tenuous. Without continued augmentations and increased habitat management efforts, all populations of the Oregon silverspot butterfly are highly vulnerable to extirpation within the foreseeable future.

Therefore, we conclude the Oregon silverspot butterfly is in danger of extinction throughout all of its range.

3.0 RESULTS

3.1 Recommended Classification:

____ **Downlist to Threatened**
__X__ **Uplist to Endangered**
____ **Delist**
____ *Extinction*
____ *Recovery*
____ *Original data for classification in error*
____ **No change is needed**

3.2 New Recovery Priority Number: 3

Brief Rationale:

When listed, the subspecies faced a high degree of threat, had a high potential for recovery, and the potential for economic conflict (*i.e.*, construction or other development projects or other forms of economic activity) associated with recovery efforts and thus was afforded an Recovery Priority Number of 3C. However, in the 40 years since the species' listing, the potential for economic conflict has not been realized, nor do we have any information to suggest that it is likely to arise in the future. Therefore, we are changing the listing and recovery priority number to 3, representing a subspecies with a high degree of threat and high recovery potential.

3.3 Listing and Reclassification Priority Number:

Reclassification (from Threatened to Endangered) Priority Number: __3__
Reclassification (from Endangered to Threatened) Priority Number: ____
Delisting (regardless of current classification) Priority Number: ____

Brief Rationale:

At least two populations have been extirpated since listing. Extensive threats to all extant populations including extremely small populations, isolation of all populations, loss of genetic diversity, habitat loss and degradation, as well as potential effects due to climate change continue to make this subspecies vulnerable to extinction.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Design and implement research to identify causes of continued population declines, despite ongoing population augmentations.
- Support efforts to increase habitat quality and quantity in existing occupied habitat and at sites with good potential for future reintroductions.
- Continue to augment all populations to ensure no populations become extirpated while habitat restoration is in progress and research on underlying cause of ongoing declines is completed.
- Complete site-specific management plans for all sites.
- Continue annual index counts to monitor population levels and direct augmentation or reintroduction efforts.
- Reintroduce additional populations into restored habitat in the Clatsop Plains in northwestern Oregon and on the Long Beach Peninsula in southwestern Washington.
- Consider adding restoration and reintroduction locations with willing partners, such as the Bureau of Land Management site at Yaquina Head Lighthouse in Newport, Oregon.
- Augment all populations until stabilized, to meet recovery criteria of 200 to 500 butterflies for 10 years, once sufficient habitat is restored.
- Reclassify the Oregon silverspot butterfly from threatened to endangered status.

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U.S. FISH AND WILDLIFE SERVICE
Signature Page for 5-YEAR STATUS REVIEW

Oregon Silverspot Butterfly (*Speyeria zerene hippolyta*)

Current Classification: Threatened

Recommendation resulting from this 5-Year Status Review:

____ Downlist to Threatened
__X_ Uplist to Endangered
____ Delist
____ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable:___3__

Review Conducted By: Anne Walker, Newport Field Office

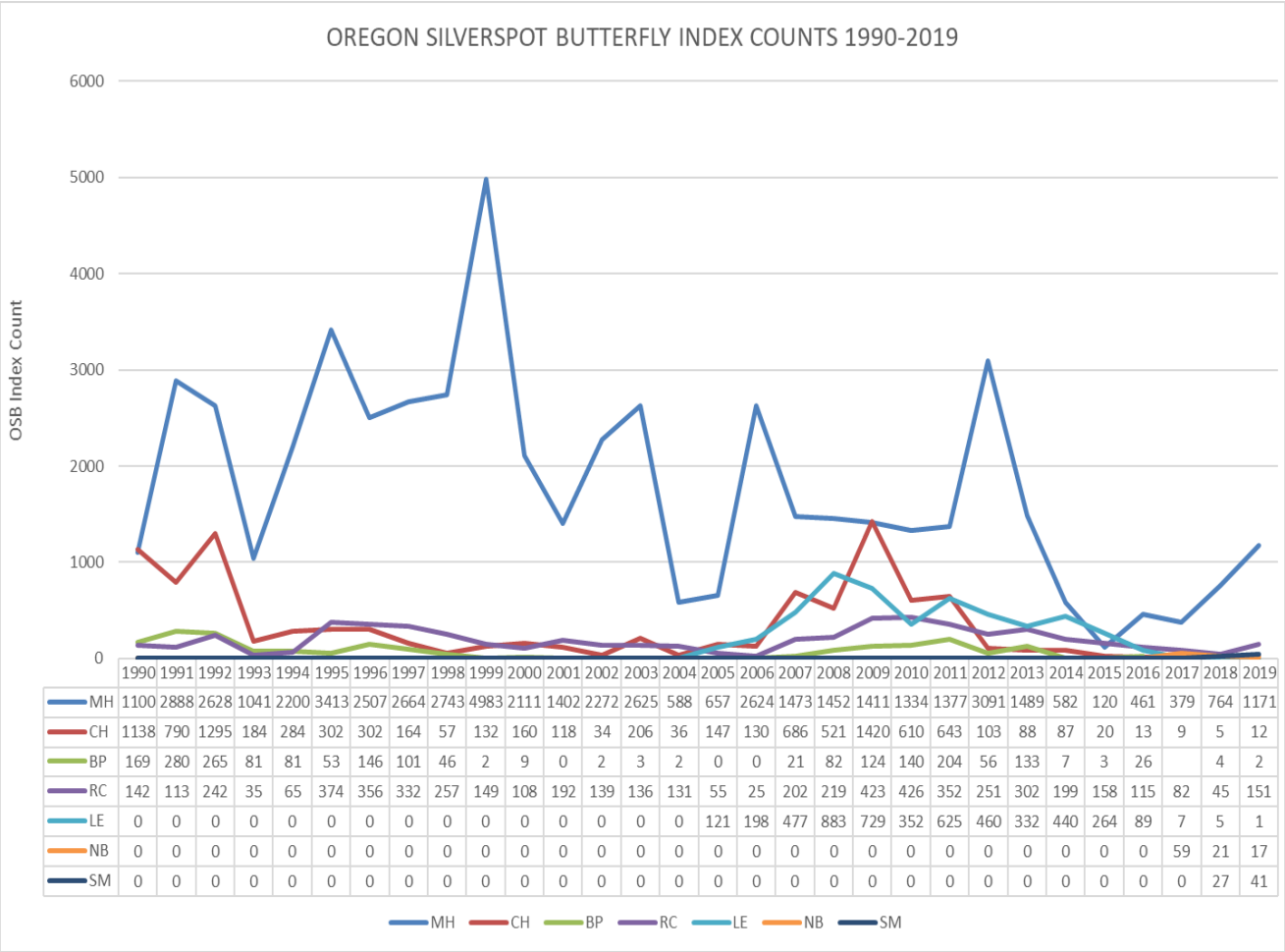
Field Office Approval:

PAUL HENSON Digitally signed by PAUL HENSON Date: 2020.11.23 09:34:20 -08'00' _____ Date November 23,
Lead Field Supervisor, Oregon Fish and Wildlife Office

Regional Office Approval:

Digitally signed by MARJORIE NELSON Date: 2020.11.23 11:31:25 -07'00' _____ Date _____
Assistant Regional Director, Ecological Services,
Interior Regions 09&12

Appendix I. Oregon Silverspot Butterfly Index Counts 1990-2019.



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
MH	1100	2888	2628	1041	2200	3413	2507	2664	2743	4983	2111	1402	2272	2625	588	657	2624	1473	1452	1411	1334	1377	3091	1489	582	120	461	379	764	1171
CH	1138	790	1295	184	284	302	302	164	57	132	160	118	34	206	36	147	130	686	521	1420	610	643	103	88	87	20	13	9	5	12
BP	169	280	265	81	81	53	146	101	46	2	9	0	2	3	2	0	0	21	82	124	140	204	56	133	7	3	26		4	2
RC	142	113	242	35	65	374	356	332	257	149	108	192	139	136	131	55	25	202	219	423	426	352	251	302	199	158	115	82	45	151
LE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	121	198	477	883	729	352	625	460	332	440	264	89	7	5	1
NB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	59	21	17
SM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	41

MH = Mount Hebo
CH = Cascade Head
BP = Bray Point
RC = Rock Creek/Big Creek
LE = Lake Earl (California)
NB = Nestucca Bay NWR
SM = Saddle Mountain