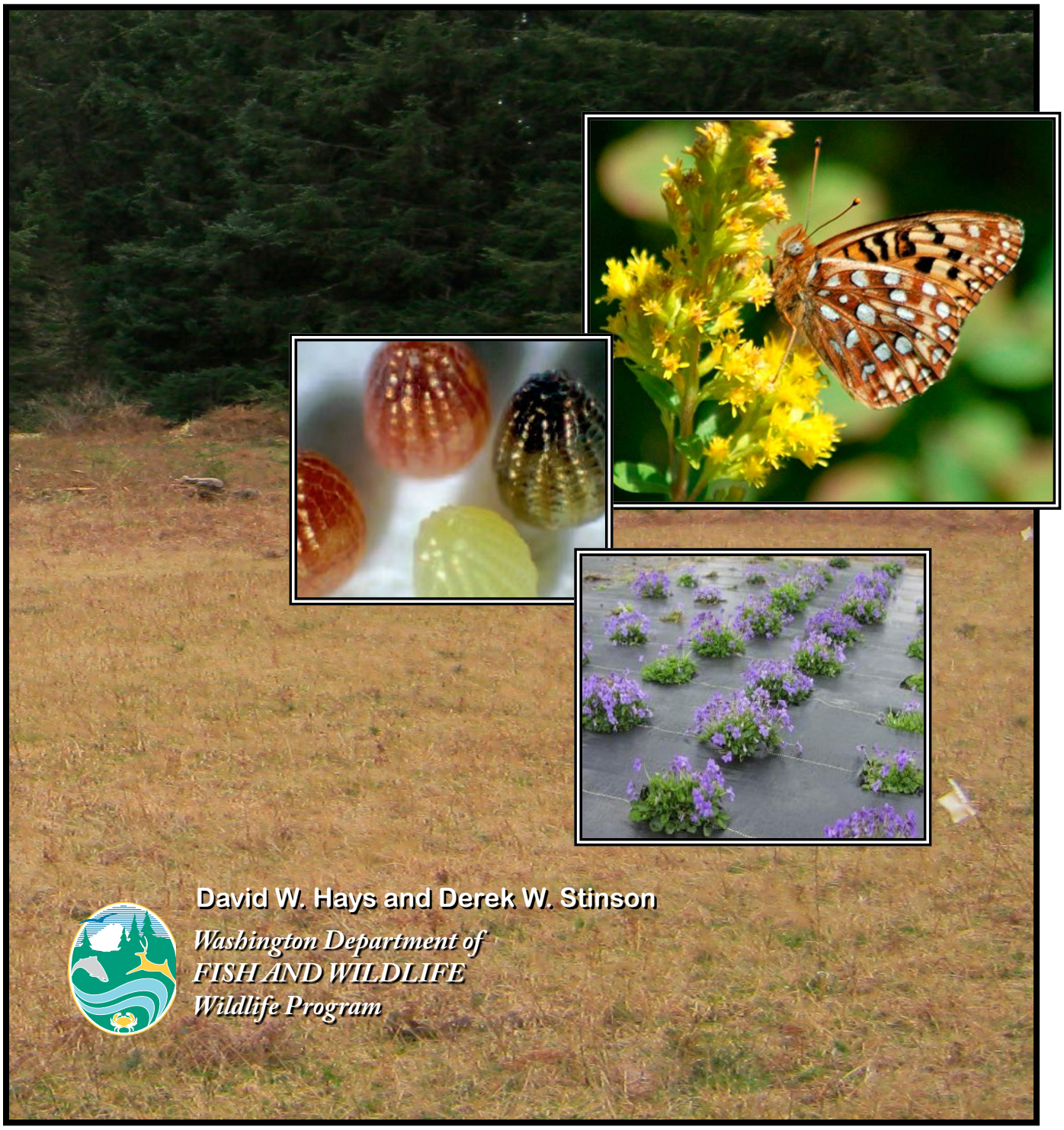
STATE OF WASHINGTON **DRAFT** February 2019

Periodic Status Review for the Oregon Silverspot



David W. Hays and Derek W. Stinson

Washington Department of FISH AND WILDLIFE Wildlife Program

The Washington Department of Fish and Wildlife maintains a list of endangered, threatened, and sensitive species (Washington Administrative Codes 220-610-010 and 220-200-100). In 1990, the Washington Wildlife Commission adopted listing procedures developed by a group of citizens, interest groups, and state and federal agencies (Washington Administrative Code 220-610-110). These procedures include how species listings will be initiated, criteria for listing and delisting, a requirement for public review, the development of recovery or management plans, and the periodic review of listed species.

The Washington Department of Fish and Wildlife is directed to conduct reviews of each endangered, threatened, or sensitive wildlife species at least every five years after the date of its listing by the Washington Fish and Wildlife Commission. These periodic reviews include an update on the species status to determine whether the species warrants its current listing or deserves reclassification. The agency notifies the general public and specific parties interested in the periodic status review, at least one year prior to the end of the five-year period, so that they may submit new scientific data to be included in the review. The agency notifies the public of its recommendation at least 30 days prior to presenting the findings to the Fish and Wildlife Commission. In addition, if the agency determines that new information suggests that the classification of a species be changed from its present state, the Department prepares documents to determine the environmental consequences of adopting the recommendations pursuant to requirements of the State Environmental Policy Act.

This draft periodic status review for the Oregon Silverspot was reviewed by species experts and will be available for a 90-day public comment period. All comments received will be considered during the preparation of the final periodic status review. The Department intends to present the results of this periodic status review to the Fish and Wildlife Commission for action at the June 14-15, 2019 meeting in Port Angeles.

Submit written comments on this report by e-mail by May 22, 2019 to: TandEpubliccom@dfw.wa.gov

Or by mail to:

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On the cover: photo of Oregon Silverspot by Mike Patterson; inset photo of silverspot egg by Oregon Zoo; background photo by Dave Hays.

This work was supported in part by personalized and endangered species license plates

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ACKNOWLEDGEMENTS

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Oregon Silverspot conservation has involved the cooperation and partnerships with U.S. Fish and Wildlife Service, Oregon Zoo, Woodland Park Zoo, Institute for Applied Ecology, Xerces Society for Invertebrate Conservation, North Coast Land Conservancy, Willapa Bay National Wildlife Refuge, and the Center for Natural Lands Management.

EXECUTIVE SUMMARY

The Oregon silverspot *(Speyeria zerene hippolyta)*, a striking butterfly of the Pacific Northwest coast, was listed as endangered by Washington State in 1993, and threatened under the federal Endangered Species Act in 1980. Oregon silverspots historically occurred in coastal settings from Grays Harbor County in Washington, south through Oregon and into northern California. In Washington, it inhabited sites along the coast from Westport to the Columbia River. Today, all but 5 localities (one in California and 4 in Oregon) have been extirpated. A population persisted in Washington on the Long Beach Peninsula through at least 1985, when intensive searches revealed a few butterflies remaining. The most recent surveys in Washington, in 1991 and 1996 found no Oregon silverspots, and in 1996 no suitable habitat. The butterfly is thought to be extirpated from Washington.

The Oregon silverspot occurs in three types of early successional coastal grasslands and adjacent forest fringes: coastal salt spray meadows, stabilized dunes, and montane meadows. Within these grasslands, silverspots have three primary habitat requirements: 1) larval hostplants; 2) adult nectar sources; and 3) features that provide protection from wind. The butterflies emerge in late-summer and the females lay eggs on or near early blue violet *(Viola adunca),* the sole host plant. Eggs hatch in the fall and larvae seek a secure overwintering site and remain dormant until the following spring, when they commence feeding on the violets. The larvae pass through six growth stages before pupating and emerging as butterflies. Adults feed in meadows on floral nectar from herbaceous plants including aster *(Aster spp.),* goldenrod *(Solidago spp.),* pearly everlasting *(Anaphalis margaritacea*), false dandelion *(Hypochaeris radicata),* and thistle (*Cirsium spp.*), and seek refuge in glades and forest edges for protection from strong coastal winds. Habitat loss and degradation are the primary causes of the decline of the Oregon silverspot in Washington and throughout its range. Seaside meadow sites have been developed for residential and business establishments, public parkland, parking areas or lawns. Trees, shrubs, and exotic grasses have invaded the butterfly's meadow habitat, resulting in the loss of food plants. Washington Department of Fish and Wildlife has been conducting management and recovery efforts aimed at acquiring and restoring suitable habitat since 1990. The U.S. Fish and Wildlife Service has also been working to develop techniques to restore habitat at Willapa National Wildlife Refuge and at sites in Oregon.

The Oregon silverspot is likely extirpated in Washington, and will require reintroduction from captive reared or wild populations in Oregon. There is no classification for extirpated species in Washington. We recommend that the Oregon silverspot remain classified as endangered in the State of Washington.

DESCRIPTION & LEGAL STATUS

The Oregon silverspot (*Speyeria zerene hippolyta;* Edwards), is a coastal subspecies of the Zerene fritillary (*S. zerene*), a more widespread butterfly species in western North America. The Oregon silverspot differs from other *S. zerene* subspecies by its darker color and smaller size (McCorkle and Hammond 1988). In addition, the Oregon silverspot differs from closely 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. The Oregon silverspot was listed as endangered by the State of Washington in 1993, and federally threatened by the U.S. Fish and Wildlife Service (USFWS) in 1980 (USFWS 2001). A federal recovery plan was completed in 1982 and revised in 2001 (Stine 1982, USFWS 2001). The most recent USFWS 5-year review recommended that the species be uplisted from federally threatened to endangered (USFWS 2012).

Figure 1. Oregon Silverspot.

DISTRIBUTION

The historical range of the subspecies extends from Westport, Grays Harbor County, Washington, south to Del Norte County, California (USFWS 2001; Figure 2). In Washington, it occurred in coastal grassland habitat in association with the early blue violet (*Viola adunca*). Within its range, the butterfly has been extirpated from at least 11 colonies (2 in Washington, 8 in Oregon, and

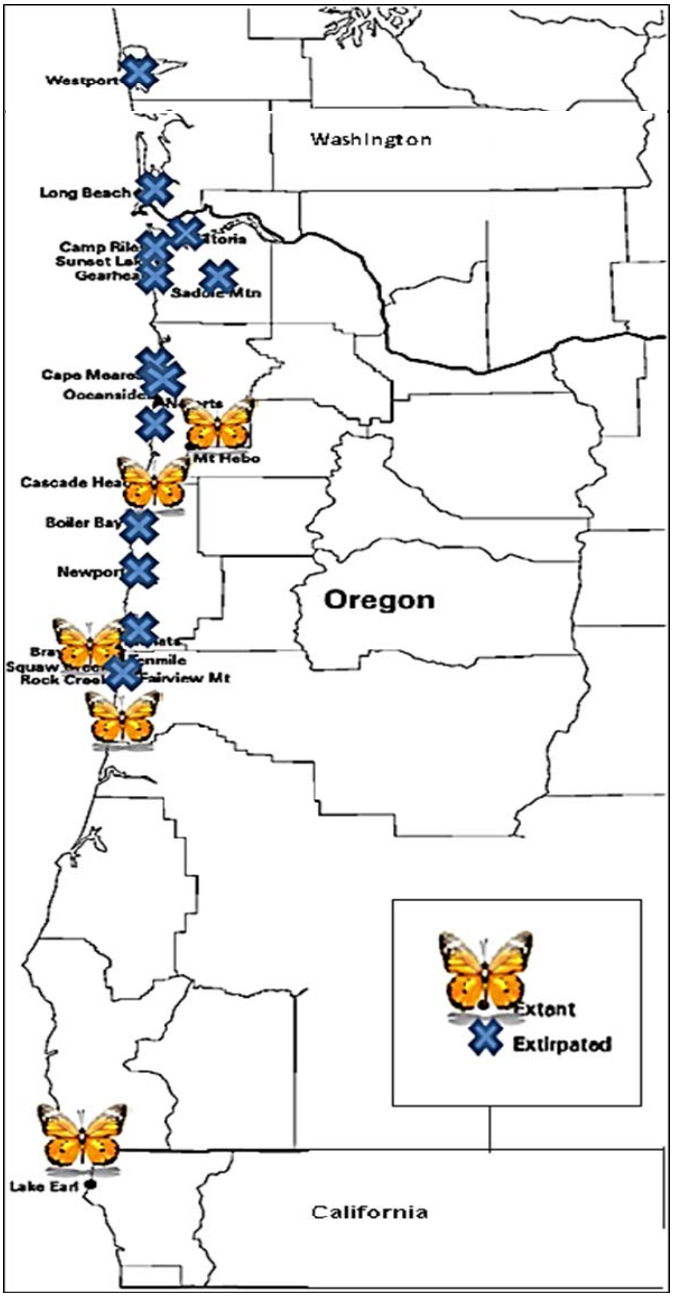


Figure 2. Historic and current distribution of the Oregon silverspot (Walker, unpubl).

1 in California). Currently, Oregon silverspot populations occur at five sites (4 in Oregon, 1 in California). There are three historically documented locations for the Oregon silverspot in Washington: Westport (1950), Loomis Lake on the Long Beach Peninsula (1975), and Nahcotta (1938) (McCorkle et al. 1980). The population at Westport became undetectable sometime prior to 1982; the population on the Long Beach Peninsula (Loomis Lake and Nahcotta) was last documented in 1990 (WDW 1993).

NATURAL HISTORY

The early blue violet is central to the life cycle of the Oregon silverspot (Figure 4). It is the sole food plant for their larvae (caterpillars) and females select areas with high violet densities for egg-laying (USFWS 2001, Damiani 2011). The Oregon silverspot spends most of its annual life cycle in the larval stage (Figure 3). The eggs hatch after approximately 16 to 26 days (McCorkle et al. 1980, Pickering et al. 1992) and resulting larvae then seek a place to overwinter and then spin a thin silk mat on which they will rest until the following spring. With this protection, the larvae are capable of surviving heavy winter rains and sub-freezing temperatures (McCorkle et al. 1980). When they emerge in the spring, the diminutive larvae first begin to feed. Larvae pass through six instars (developmental stages) before pupation and emergence as butterflies. Adults (butterflies) emerge from chrysalises from July to September, depending on their gender (males emerge earlier) and the weather. The timing of larval development results in the adult flight season occurring in the warmest and sunniest coastal weather in late summer. As adults, they fly locally within and between meadows where they mate, lay eggs, and die, thus completing their annual life cycle.

Reproduction. The butterflies mate in late summer after which females lay eggs on or near violet plants. In a laboratory study, one female silverspot laid >214 eggs, and another female laid 385 eggs (McCorkle et al. 1980). Based on studies of closely related butterflies, nectar abundance and quality are key to adult survival and significantly affect the number of eggs produced (Schultz and Dlugosch 1999, Boggs and Ross 1993, Mevi-Schutz and Erhard 2005). Egg hatching rates at one field site (Mount Hebo) varied between 60% (n = 10; The Nature Conservancy 1990), and 78% (n = 23; Pickering et al. 1992).

Habitat requirements. The Oregon silverspot occupies three types of coastal grasslands: coastal salt spray meadows (Oregon and California), stabilized dunes (Washington and Oregon), and coastal montane meadows (Oregon). There have been numerous studies of the habitat requirements and habitat management needs (McCorkle et al. 1980, Hammond 1986, 1990, Hammond and McCorkle 1982, 1984, Pickering et al. 1992, Damiani 2014). The butterfly has adapted to highly specialized grassland habitats that must provide three critical elements: 1) wind protection; 2) dense and abundant larval host plants (i.e. early blue violets); and 3) adult nectar sources.

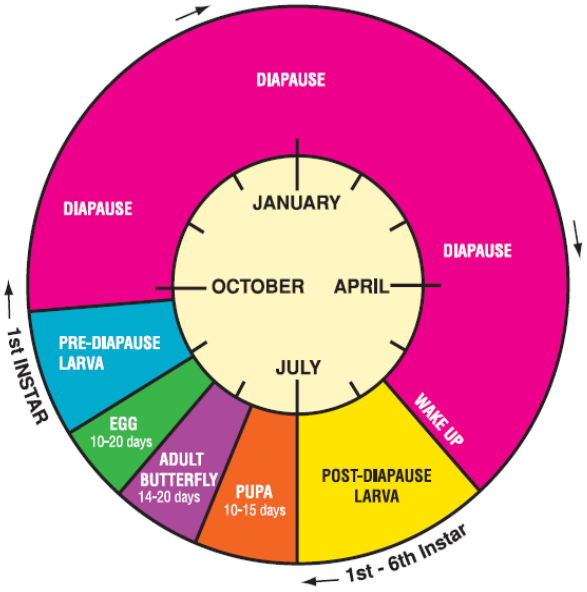


Figure 3. Oregon Silverspot life cycle (from Andersen et al. 2009-Oregon Zoo).

Wind protection. Forest fringes adjacent to grasslands containing early blue violets are an important habitat component (McCorkle et al. 1980; Hammond 1988, 1991; Arnold 1988). Butterflies use the forest fringes for shelter from strong ocean winds, for nectar when flowers are scarce in more exposed meadows, and as male mating territories (Hammond 1991). At three Oregon study sites, Arnold (1988) found ambient air temperatures were 1–3 °C (1.8–6 °F) warmer in the forest fringe areas where the butterflies spent time basking, perching, nectaring, courting, and mating during windy periods.

Arnold (1988) found that males actively patrol grassland meadows in search of females and the majority of successful courtships and copulations occurred in open and sheltered meadows. Butterflies used sheltered forest edge areas for these activities when the exposed meadows were too cold or windy for butterfly activity.

Larval host plant. The early blue violet is the only known native violet species to inhabit the open coastal grasslands and coastal montane meadows and is confined primarily to natural grasslands west of the Cascade Mountain Range. It requires the low open structure of native grassland vegetation. Successful reproduction and seed germination occurs mostly during early succession when there is disturbed, bare mineral soil or short, sparse grass cover. The violet is capable of surviving extended hot, dry periods in mid- and late-summer, conditions that are common in their grassland habitats.

Figure 4. Early blue violet

Other violet species are associated with wetlands and forested habitats, and occasionally have been used by the Oregon silverspot. Butterfly oviposition activity is greatest where early blue violet density is high (plants are clustered), thatch depth is low, and overall vegetation height is low (The Nature Conservancy 1990, Pickering et al. 1992). Silverspot larvae ability to from a distance is limited unilt physical contact, and their ability to find host plants is likely a chance phenomenon (Bierzychudek 2009).

Early blue violets will persist into later successional vegetation, but are eventually crowded and shaded out as succession advances to brushland and forest. Violets can persist for many years under other vegetation, and dormant violets are capable of growing once the shrub, tree species, and grass thatch are removed (Hammond 1986).

Based on laboratory studies, Oregon silverspot larvae feed on 200–300 violet leaves as they develop from early instar caterpillar to pupa (Andersen et. al. 2010). In the wild, a caterpillar would require a group or clump of approximately 16 violet plants for development, assuming each violet could provide about 12 to 20 leaves (USFWS 2012).

Adult nectar sources. Adult silverspots use a variety of floral nectar resources, most of which are members of the Aster family. Frequently used native plants include yarrow *(Achillea millefollium*), pearly everlasting *(Anaphalis margaritacea),* Canada goldenrod *(Solidago canadensis),* dune goldenrod (*Solidago spathulata),* California aster *(Aster chilensis),* and Douglas' aster (*Aster subspicatus*). Hairy cat's ear *(Hypochaeris radicata)* and tansy ragwort *(Senecio jacobaea),* two introduced species, are also primary nectar sources.

The availability of a diversity of nectar sources throughout the flight season may be an important influence on the species' population dynamics (Boggs and Ross 1993). Studies at four silverspot sites in Oregon found pronounced differences in nectar species composition, abundance, and distribution, and differences in nectar species preference among the four sites (Arnold 1988). Oregon silverspot and other *Speyeria* species often seem to prefer nectar of introduced species rather than natives (Hays et al 2000). This may be due to three possible factors: nectar source availability (native sources are often scarce in late summer); the floral morphology of the introduced species facilitated nectar collection by silverspots; and/or the flowers of the introduced species are richer in sugars or amino acids or other chemical components (Arnold 1988).

Survival. There is little quantitative information on survivorship of different life stages of the Oregon silverspot, particularly the immature stages (eggs, larvae, pupae). Adult butterflies are subject to predation by birds and to being killed by collisions with cars on roads (Zielin 2010). Finding early instar larvae in the field is difficult, thereby limiting the measurability of larvae mortality. Little is known of the parasites and predators that may attack small larvae in the wild. McCorkle et al. (1980) suggested that predaceous ground beetles (*Carabidae*) and small spiders are potential predators. As the larvae pass through successive instars and increase in size, they likely become more susceptible to new parasites and predators such as shrews, birds, and possibly mice (McCorkle et al. 1980).

POPULATION AND HABITAT STATUS

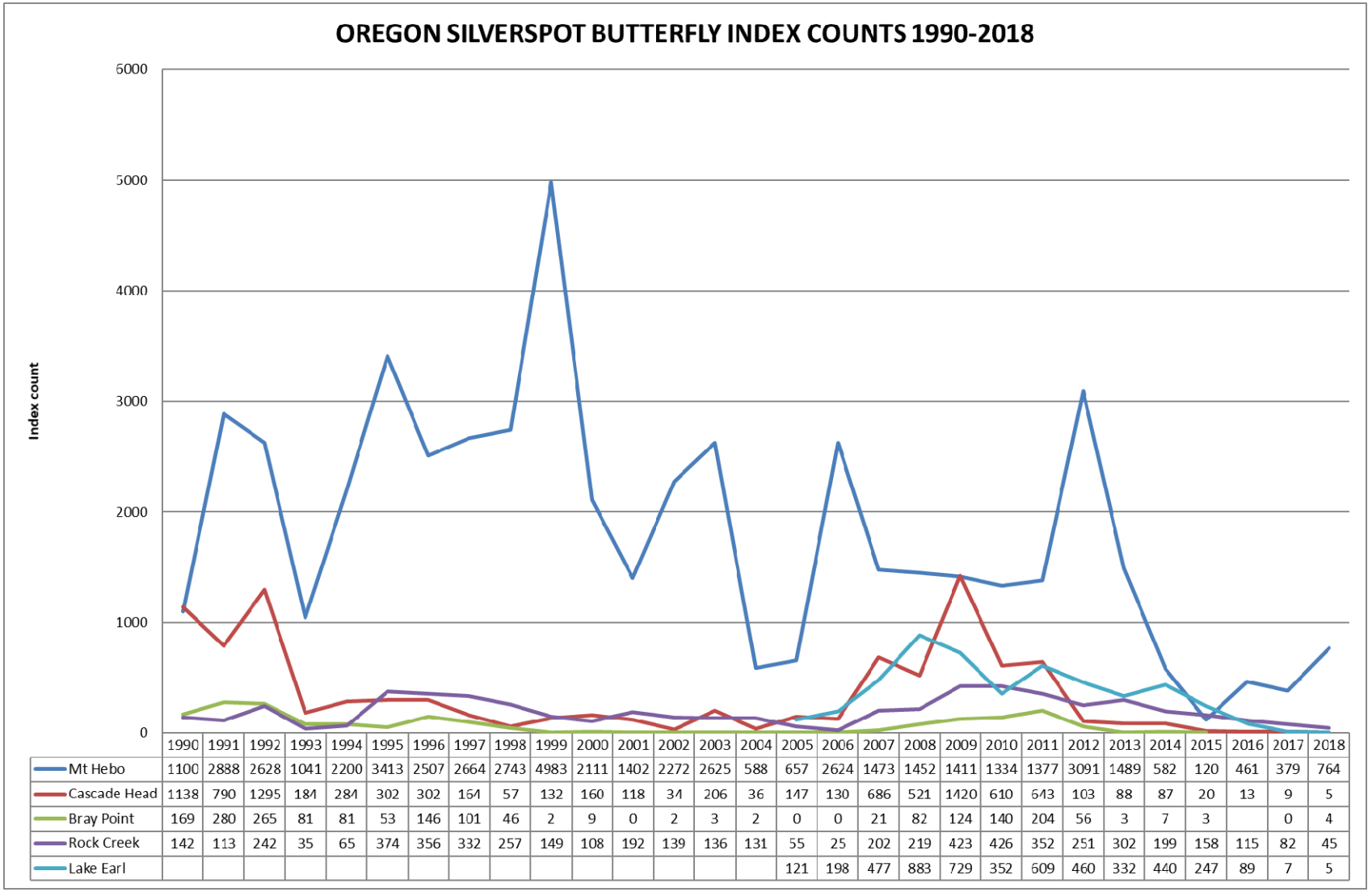
Population Status

Range-wide. Historically, the Oregon silverspot 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 near Lake Earl in Del Norte County, California. At least 20 distinct locations that supported Oregon silverspots were discovered between 1895 and 1975 (McCorkle et al. 1980). One population in Washington and 7 populations in Oregon were mentioned in the 1980 federal listing document, with only 2 of those populations deemed healthy at that time.

Currently just 5 populations are known to be extant: Rock Creek-Big Creek; Bray Pt; Cascade Head; and Mt. Hebo, in Oregon; and Del Norte Conservation Area (Lake Earl) in California. Rang-wide surveys for this species began in the early 1950's, then continued in the late 1960's and the 1970's (McCorkle et al. 1980). At least 6 sites discovered during the late 60's and 70's were considered extirpated by 1980. The population at Clatsop Plains, Oregon, was considered extirpated by 2001 (Lesh 2001). Oregon silverspots were observed at a small site near Bray Pt, Agate Meadows, in 2012 and remained occupied through 2016; no butterflies were found there in 2017 and 2018.

In 2017 and 2018, attempts were made to introduce the butterfly to two new sites in Oregon, Nestucca and Saddle Mountain. The Nestucca site is a restored grassland site, and Saddle Mountain is a known historical site. It may take several years of releases to establish a population and know if the projects have been successful.

Oregon silverspot populations have been surveyed annually in Oregon and California since 1990 to produce an index of butterfly abundance from year to year (Figure 5). These indices are not designed to estimate population size but do provide a standardized measure of butterfly abundance to compare year-to-year variation.



	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
Mt Hebo	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
Cascade Head	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
Bray Point	169	280	265	81	81	53	146	101	46	2	9	0	2	3	2	0	0	21	82	124	140	204	56	3	7	3		0	4
Rock Creek	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
Lake Earl																121	198	477	883	729	352	609	460	332	440	247	89	7	5

Figure 5. Oregon silverspot abundance index at extant sites in Oregon and California (A. Walker, pers. comm).

Butterfly populations can fluctuate dramatically in response to weather. Populations, especially of imperiled species, are most vulnerable when unfavorable weather conditions occur in consecutive years. In 1993, exceptionally cool and wet spring weather was suspected as the reason for population crashes at all four known Oregon butterfly sites (Pickering 1994). Only the larger Mt. Hebo population was able to rebound, while the three smaller sites eventually had to be augmented to prevent extinction. In 2015, the population at Mt. Hebo appeared to crash, and rebounded somewhat in 2016 (Figure 5, A. Walker, pers. comm.).

Washington. Historically, the Oregon silverspot occurred from Westport to the Columbia River in coastal meadows and open-field habitats. Silverspots were collected in the Ocean Park area during the 1910's and in the Loomis Lake area in 1975, 1982, and 1985 (Hammond and McCorkle 1982, Pyle 1985, R. Pyle, pers. comm. *in* Sayce 1990).

Surveys for silverspots continued in 1990 and 1991 at 14 Long Beach Peninsula sites, including all sites previously examined and several additional sites. One possible silverspot butterfly was seen in August 1990, but none were found in 1991. Between 1996 and 2000, sporadic surveys continued in areas where early blue violet was known to occur on the Long Beach Peninsula; no butterflies were found (Hays 1996). Few foodplants (*Viola* spp.) were found at sites surveyed in 1990/1991 (Sayce 1991, Hays 1996). No formal surveys for the Oregon silverspot butterfly have been conducted in Washington since 1996. Given both the lack of detections in surveys, and noticeable decline in foodplants, it is unlikely that a silverspot population exists in the state. Given the distance between the nearest extant silverspot population (Mt. Hebo), including the geographic separation provided by the Columbia River, it is unlikely re-establishment of a population in Washington will occur with natural dispersal, and reintroduction through translocation will be needed.

Federal recovery criteria. According to the recovery criteria from the revised federal recovery plan, delisting requires a viable population in the Long Beach Habitat Conservation Area in Washington, as well as two populations at each of three sites and single populations at the remaining Oregon site and the California site. Managed habitat at each population site must support a minimum viable population of 200–500 butterflies for at least ten years at these sites, and sites must have comprehensive management plans. Currently, federal recovery criteria have not been met in terms of the number and size of populations, the amount and quality of habitat available, and comprehensive management plans have not been completed (USFWS 2012).

Habitat Status

The Long Beach Peninsula is comprised of a series of narrow north/south oriented dunes and swales. With Euro-American settlement, there were two major construction projects that dramatically altered the hydrology and topography of the peninsula. The first, which occurred in the late 1800's to 1930's, was the construction and excavation of a series of dikes, tide gates, and ditches that drained many bogs and freshwater marshes, converting saltmarsh into pastureland, lakes into sloughs, and lowering the subsurface water table on the remainder (Sayce 1990).

The second change was the construction of a series of jetties at the mouth of the Columbia River in the early 1900's. The resulting alteration to the western side of the peninsula was transformative, as enormous amounts of sand accreted along the coastline (Gelfenbaum 1999). By 1990 as much as 915 m (3,000 ft) to 1,220 m (4,000 ft) of sand dunes had accrued to the western edge of the peninsula (Sayce 1990).

Invasive, exotic grasses were brought to the region by Euro-American settlers for livestock grazing. These introduced exotics eliminated many grasses and forbs of native grasslands by crowding out low-growing plants including early blue violet and producing deep layers of thatch that overwhelmed and killed other native meadow plants. Portions of the coastal dune meadow habitat of the Washington coast were also eliminated and altered from development, off-road vehicle damage, grazing, fire suppression, and natural succession to native and non-native shrubs and trees. For example, between 1963 and 1993 in an 8-mile-long portion of the Long Beach Peninsula inhabited by the Oregon silverspot, open meadows declined by 65% while forested area increased by 66% and developed area increased by 53% (Hays 1999).

By the early-1990s, there were no parcels of land on the Long Beach Peninsula that had sufficient abundance of violets to support the Oregon silverspot (Sayce 1991; Hays 1996). Nectar species remained well distributed, but woody shrubs and trees had transformed historical meadows to coastal forest (Sayce 1991). In 1992, WDFW purchased 20 acres of degraded meadow habitat the Oregon silverspot had occupied in the 1980's. Since that time, WDFW, with U.S. Fish and Wildlife Service and Washington Recreation and Conservation Office funding has enlarged and enhanced the meadow for the Oregon silverspot through mowing, weed control, plantings, and tree removal (Hays 1999).

The WDFW property, in conjunction with two properties on the bay side of the Peninsula (a Willapa National Wildlife Refuge property of approximately 12 ha (30 acres) and a private property easement on approximately 24 ha (60 acres) held by the Natural Resources Conservation Service), may eventually provide a suitable area for a reintroduction. Together these properties offer the greatest opportunity for restoring suitable habitat to allow for reintroduction of the butterfly on the Long Beach peninsula. Additional state, federal, and private properties that are scattered throughout the Long Beach Peninsula may provide suitable habitat for the butterfly in the future.

Given current conditions, the creation of Oregon silverspot habitat requires intensive action. Maintaining habitat in the future will depend on the success of current efforts by the WDFW and the U.S. Fish and Wildlife Service to restore degraded meadows. Native seed development is underway, and is essential for future restoration actions. Additional properties owned or managed by Willapa National Wildlife Refuge, Columbia Land Trust, Washington State Parks, and Washington Department of Natural Resources have potential to be restored to suitable condition.

FACTORS AFFECTING CONTINUED EXISTENCE

Federal listing. The Oregon silverspot was federally listed as threatened and protected under the Endangered Species Act in 1980. A recent 5-year status review by the USFWS recommended a status change from threatened to endangered (USFWS 2012). An updated 5-year status review by USFWS is currently underway (A. Walker, pers. comm.).

State, county, and city protections. Oregon silverspots that occur or would be reintroduced into Washington would be protected from 'take' as an endangered species in state law (RCW 77.12.020, RCW 77.15.130). Their habitat also receives protection through DNR forest practice rules, and county and/or municipal critical area ordinances. Critical area ordinances require environmental review and habitat management plans for development proposals that affect state-listed species. Counties generally consult with WDFW, and the county permit issued may impose conditions on the development to avoid, minimize, and mitigate impacts to the population.

Habitat loss. Historically, soil condition, wind, salt spray, and fire regimes maintained low-stature, open grasslands within the species' range by suppressing encroaching trees and shrubs (USFWS 2001). Invasion by exotic plants, natural succession, fire suppression, and land development has resulted in loss and modification of the species' habitat (Zald 2009). Coastal sites are also under intense pressure from development and recreation. Much of the historical habitat and potential habitat has been converted to residential and commercial development.

Illegal collecting. Illegal trade in listed, protected, and rare butterflies sometimes occurs. Collection of butterfly species that exist in small colonies 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. Although collectors generally do not adversely affect healthy, well-dispersed populations of butterfly species, rare species are highly valued by collectors and can be vulnerable to extirpation or extinction from collecting. Unscrupulous collectors who take every specimen they can find on successive days could easily eliminate populations of some species in just a few years. The USFWS has listed several butterfly species due to imperilment by collectors, and incidents of unauthorized take of the Oregon silverspot by collectors have been discovered in past years and indictments were obtained (U.S. Dept. of Justice 1993).

Population size. The small size of several remaining Oregon silverspot populations places them at risk of extinction due to a range of factors. Specifically, small populations generally have lower genetic diversity than larger populations, which can result in less resilience to changing environmental conditions. In addition, small populations are highly vulnerable to random and irregular genetic, demographic, and environmental changes (stochasticity) (Saccheri *et al*. 1998, Harper et al. 2003, Frankham et al. 2017). The combined threats to small isolated populations, including degrading habitats, and climate extremes, continue to endanger the species throughout its range

Pesticides. Hammond and McCorkle (1991) found that *Speyeria* larvae were extremely vulnerable to a wide variety of diseases and pesticides, including Btk *(Bacillus thuringiensis* var. *kurstaki)* and organophosphate pesticides. Laboratory experiments resulted in mortality of all larvae fed violet leaves grown in areas sprayed with these pesticides. Herbicides are used in habitat restoration, however, and can be an important tool in habitat recovery (USFWS 2011). The use of herbicides requires careful consideration when applied in or near extant butterfly populations (Russell and Schultz 2009).

Road kill. Road kill from vehicle traffic is a concern for Oregon silverspots. U.S. highway 101 bisects the coastal Rock Creek-Big Creek critical habitat area in Oregon. Summer traffic along this stretch of highway is very high during the butterfly flight period. Zielin (2010) observed one confirmed collision mortality, and nine apparent collisions. Littlejohn (2012) reported that silverspots typically crossed the highway where vegetation near the road edge was low and between areas with higher density of early blue violets.

Climate change. As climate change continues, expected changes in the Pacific Northwest include warmer, wetter winters and hotter, drier summers, with an increased frequency of extreme precipitation events (Karl et al. 2009, WDFW 2015). Global mean sea level rise of 0.6–1.2 meters, (2–4 feet), by 2100 is "nearly certain," (Shafer et al. 2010). On the Washington and Oregon coasts, 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 vertical land movement (Shafer et al. 2010). Sea level rise may render current Oregon silverspot habitat in low-lying areas unsuitable, which could include the low elevation habitat at Willapa National Wildlife Refuge in Washington and possibly portions of the Del

Norte Habitat Conservation Area in California. Butterflies such as the Oregon silverspot butterfly may be able to shift their range northward and upward into areas that become climactically suitable, but can only do this if suitable habitat is available (Hill et al. 2002). Due to the isolated nature of both extant populations and habitat, any response to a changing climate will likely require human assistance to first create or enhance new habitat, and secondly to move animals to new locations.

MANAGEMENT ACTIVITIES

Habitat restoration. In Washington, WDFW and partners (primarily the USFWS, including Willapa National Wildlife Refuge) have been working to build a successful habitat restoration program through designation of areas to be managed for the butterfly and other coastal species, development of habitat restoration practices, and development of native seed sources. Restoration and active management to establish and maintain suitable Oregon silverspot habitat is ongoing at two sites, one on the ocean side of the Long Beach Peninsula and one on the Willapa National Wildlife Refuge (NWR). The Oregon silverspot recovery unit of Johns River Wildlife Area, near the west side of Loomis Lake in Pacific County, provides some of the last remaining natural meadows with early blue violets present (Hays 1996). Approximately 3 acres were cleared of trees at this site in 2010–2011 to expand existing meadows. In addition, meadows are annually mowed to reduce encroachment by shrubs and small trees. About 3 acres of the Willapa NWR Tarlatt Slough property have been managed to provide feeding and nectaring plants essential to Oregon silverspot (Ritchie 2011). The long-term goal at Willapa NWR is to restore and maintain over 30 acres of native dune/grassland habitat for Oregon silverspot butterfly reintroduction.

Restoration and management challenges include reestablishing coastal meadows in areas dominated by non-native grasses and forbs, shore pine, and shrubs. The cool wet climate of the coastal environment hinders the use of prescribed fire and herbicides, which have proved to be effective tools for restoring native grasslands elsewhere. Effective site preparation methodologies that factor in local climatic conditions still need to be developed for coastal meadow habitats.

A habitat restoration and management partnership was begun in 2009 with the NRCS, Plant Materials Center in Corvallis, Oregon, WDFW, The North Coast Land Conservancy, and the USFWS to develop regionally-sourced plant materials for Oregon silverspot including native violets, nectar plants, and native grasses necessary for the butterfly. Seed and plant materials will be available for use throughout the Long Beach and Clatsop Plains restoration areas. The U.S. Fish and Wildlife Service is currently funding the production of native seed for habitat restoration efforts in southwest Washington and northeast Oregon. In 2017, an expansion of seed production, targeted for Washington and the northwest Oregon coast, was initiated with an additional partner, the Center for Natural Lands Management, based in Olympia, Washington.

Augmentation, reintroduction and captive breeding. Butterfly augmentation and reintroduction is essential for the recovery of this species. A captive-rearing program designed to maintain genetic variability in the population and increase the likelihood of its recovery was initiated in 1999 by the USFWS, The Nature Conservancy, Oregon Zoo, and Woodland Park Zoo. Oregon silverspot larvae are reared at the zoos and returned to sites on the Oregon Coast as pupae, where they emerge as adult butterflies.

The captive-rearing program involves the collection of a small number of wild-mated female butterflies which are taken to the Oregon Zoo, in Portland, Oregon, and the Woodland Park Zoo, in Seattle,

Washington. The purpose of the releases is to stabilize and maintain the small populations at Cascade Head, Bray Point, and Rock Creek, and reduce the likelihood of their extirpation. The Mt. Hebo population is the largest wild population and has not been augmented with captive-reared butterflies. An analysis of the 1990–2005 count and captive-release data from Mt. Hebo and Cascade Head concluded that the removal of 25 females from Mt. Hebo population had a negligible effect on the Mt. Hebo population and a net positive effect on the smaller Cascade Head population (Crone et al. 2007). Approximately 25 female butterflies per year, or less than 3% of estimated index count in any given year, are collected from at Mt. Hebo to use in augmentations of the smaller populations. The females lay eggs in the zoo laboratories, where the eggs soon hatch, and the small caterpillars are cared for until the following summer when they are released into habitat areas. The captive-reared offspring are released into the wild each year, and a new set of females captured for the next year's releases. Survivorship of caterpillars in the 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). The augmentation efforts from 2000 to 2010 have the released thousands of captive-reared larvae, pupae, or adults at the Cascade Head and/or Bray Point and Rock Creek.

In 2010, both zoos collaborated to complete the Oregon Silverspot Husbandry Manual (Andersen *et al.* 2010). The goals for developing the manual were to ensure methods developed through multiple years of captive-rearing would be implemented consistently each year, and to provide methods for others involved in captive-rearing efforts of different butterfly species. A Propagation and Reintroduction Plan for the species was also completed in 2010 to determine appropriate release numbers at each augmentation or future reintroduction site and maximize genetic diversity (Van Buskirk 2010). A population viability analysis was used to estimate extinction probabilities from the Rock Creek, Cascade Head and Mt. Hebo count data. The estimated extinction risk for both the Cascade Head and Rock Creek populations was less when the analysis includes data from 2007–2009, when large augmentations were implemented and successive years of large-scale augmentations have increased the predicted persistence of these populations (Van Buskirk 2010). It is not known if an increasing trend will persist without ongoing augmentation, and monitoring will be needed to determine the long-term success of the augmentations. This analysis also found the Mt. Hebo population to have a negative growth rate during 1999–2009, and a relatively high chance of extinction within less than 50 years if the current trend continues, but the estimates have wide confidence intervals and a high level of uncertainty and are not intended to be used as accurate estimates of extinction risk (Van Buskirk 2010).

Research. In 2016, scientists at the U.S. Geological Survey published "Genetic Diversity and Population Structure in the Threatened Oregon Silverspot Butterfly (*Speyeria zerene hippolyta*) in Western Oregon and Northwestern California – implications for Future Translocations and the Establishment of New Populations" (Miller et al. 2016). Results tracked the introgression of translocated genes and indicated that there was still significant genetic diversity at several Oregon silverspot populations.

There are ongoing research efforts into effective habitat management and restoration techniques for coastal prairie habitat in northwestern Oregon and southwestern Washington (Bahm 2016). One of the Washington sites is Tarlatt Slough on the USFWS Willapa National Wildlife Refuge. The primary focus is site preparation and initial establishment of native species. Zielin (2010) and Littlejohn (2012) investigated the Highway 101 road kill issue in Oregon; Littlejohn (2012) tested the potential of using roadside hedges to elevate flight paths above vehicles, but an experiment using nets suggested hedges would not be effective.

Working groups and conservation planning. An Oregon silverspot working group, led by the U.S. Fish and Wildlife Service, meets annually to discuss progress in captive breeding and other management

actions. In February 2017, the Oregon Zoo hosted a 3 day Oregon Silverspot Butterfly Conservation Planning Workshop that brought together land managers, researchers, zoo specialists, and agency staff to develop detailed action plans to move conservation of the butterfly forward.

CONCLUSION AND RECOMMENDATION

The Oregon silverspot historically occurred along the Washington coast from Westport to the Columbia River. There are currently no known silverspot populations remaining in Washington, and little suitable habitat. The silverspot has continued to decline in Oregon and California. The federal recovery objective for Washington is to re-establish and maintain a population of 200–500 individuals. The Oregon silverspot is likely extirpated in Washington, and will require reintroduction from captive rearing or from wild populations in Oregon. Habitat restoration has been ongoing in Washington in preparation for a reintroduction, although restoration continues to depend upon the development of suitable seed sources and additional restoration methods. There is no state classification for extirpated species, and it is hoped that the Oregon Silverspot can be reintroduced in the future. It is recommended that the Oregon silverspot butterfly remain listed as endangered in Washington.

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WASHINGTON STATE STATUS REPORTS, PERIODIC STATUS REVIEWS, RECOVERY PLANS, AND CONSERVATION PLANS

Periodic Status Reviews

2018 Sea Otter
2018 Pygmy Rabbit
2017 Sharp-tailed Grouse
2017 Fisher
2017 Blue, Fin, Sei, North Pacific Right, and Sperm Whales
2017 Woodland Caribou
2017 Sandhill Crane
2017 Western Pond Turtle
2017 Green and Loggerhead Sea Turtles
2017 Leatherback Sea Turtle
2016 American White Pelican
2016 Canada Lynx
2016 Marbled Murrelet
2016 Peregrine Falcon
2016 Bald Eagle
2016 Taylor's Checkerspot
2016 Columbian White-tailed Deer
2016 Streaked Horned Lark
2016 Killer Whale
2016 Western Gray Squirrel
2016 Northern Spotted Owl
2016 Greater Sage-grouse
2016 Snowy Plover
2015 Steller Sea Lion
2015 Brown Pelican

Conservation Plans

2013 Bats

Recent Status Reports

2017 Yellow-billed Cuckoo
2015 Tufted Puffin
2007 Bald Eagle
2005 Mazama Pocket Gopher, Streaked Horned Lark, and Taylor's Checkerspot
2005 Aleutian Canada Goose
1999 Northern Leopard Frog
1999 Mardon Skipper
1999 Olympic Mudminnow
1998 Margined Sculpin
1998 Pygmy Whitefish

Recovery Plans

2012 Columbian Sharp-tailed Grouse
2011 Gray Wolf
2011 Pygmy Rabbit: Addendum
2007 Western Gray Squirrel
2006 Fisher
2004 Sea Otter
2004 Greater Sage-Grouse
2003 Pygmy Rabbit: Addendum
2002 Sandhill Crane
2001 Pygmy Rabbit: Addendum
2001 Lynx
1999 Western Pond Turtle
1996 Ferruginous Hawk
1995 Upland Sandpiper

Status reports and plans are available on the WDFW website at:
http://wdfw.wa.gov/publications/search.php