Endangered Species Act - Section 7 Consultation

INTRA-SERVICE BIOLOGICAL OPINION

U.S. Fish and Wildlife Service Reference:
01EWFW00-2016-F-0427

Kaufman Habitat Conservation Plan

Thurston County, Washington

Federal Action Agency:

U.S. Fish and Wildlife Service

Consultation Conducted By:

U.S. Fish and Wildlife Service
Washington Fish and Wildlife Office
Lacey, Washington

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Date

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ACRONYMS AND ABBREVIATIONS

Applicants	The legal entities jointly applying for an Incidental Take Permit. The Applicants include Kaufman Holdings, Inc., Kaufman Real Estate, LLC, and Liberty Leasing.
ATV	All-Terrain Vehicle
CFR	Code of Federal Regulations
cm	centimeters
CNLM	Center for Natural Lands Management
EA	Environmental Assessment
ESA	Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*)
FR	Federal Register
HCP	Habitat Conservation Plan
Permit	Incidental Take Permit
JBLM	Joint Base Lewis McChord
Opinion	Biological Opinion
Service	United States Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
IPCC	Intergovernmental Panel on Climate Change

INTRODUCTION

This document is the U. S. Fish and Wildlife Service's (Service) Biological Opinion (Opinion) based on our review of the proposed issuance of an Incidental Take Permit (Permit) for the Kaufman Habitat Conservation Plan (HCP) located in Thurston County, Washington. This Opinion evaluates the effect of the Permit issuance on the federally threatened streaked horned lark (*Eremophila alpestris strigata*), endangered Taylor's checkerspot butterfly (*Euphydryas editha taylori*), threatened Olympia pocket gopher (*Thomomys mazama pugetensis*), and threatened Yelm pocket gopher (*T. mazama yelmensis*). This Opinion is prepared in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et. seq.*) (ESA).

The Service has determined that issuing the proposed Permit "may affect, and is likely to adversely affect" the streaked horned lark, Taylor's checkerspot butterfly, Olympia pocket gopher, and Yelm pocket gopher. The effects to these species and their habitats are described in this Opinion.

This Opinion is based on the information provided in the HCP (Krippner Consulting 2016), other information provided by Krippner Consulting, the final Environmental Assessment (EA) (Carr 2015), conversations with the project proponent, the Washington Department of Fish and Wildlife (WDFW), Service staff, and site visits. A complete record of this HCP and Opinion is on file at the Service's Washington Fish and Wildlife Office in Lacey, Washington.

CONSULTATION HISTORY

From 2014 to 2015, the Service provided technical assistance to the Applicants in developing a HCP for their proposed development projects. The Service supported the publication of an EA in the Federal Register on October 21, 2015 (80 FR 65796) along with the draft HCP. Following a comment period ending December 21, 2015, the Service received a final HCP and conducted the Section 7 consultation.

Scope of our Analysis

The focus of our analysis is the effect of the proposed development and conservation actions on the covered species and their habitats. The Service worked with the Applicants to design the HCP (Krippner 2016) and reviewed the draft EA (Carr 2015). Based on internal discussions and review of the draft HCP and EA, the Service agreed that the proposed Permit issuance was ready for consultation upon receipt and review of the final HCP proposal on January 26, 2016. With regard to the proposed Permit issuance, the Service made the following effect determinations:

- **"may affect, likely to adversely affect"** Taylor's checkerspot butterfly, streaked horned lark, and two subspecies of Mazama pocket gopher: Olympia pocket gopher and Yelm pocket gopher, and likely to result in benefits to all of the species above;

- **"no effect"** for the following species: golden paintbrush (*Castilleja levisecta*), western yellow-billed cuckoo (*Coccyzus americanus*), and Oregon spotted frog (*Rana pretiosa*).

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The Service proposes to issue a Permit in accordance with our authority and responsibility under section 10(a)(1)(B) of the ESA for implementation of the Kaufman HCP (Krippner Consultants, 2016). Kaufman prepared and submitted a Permit application based on their proposed plan to conserve habitat for covered species on designated mitigation sites and to develop other sites ("development sites") as described in the HCP. The proposed HCP includes measures the Applicant will implement measures to minimize and mitigate the effects of incidental take in the near-term (on development sites) and over the long-term (on mitigation sites).

Project Design and Components

The proposed HCP entails the following: (1) developing or redeveloping 13 sites for commercial purposes; and (2) implementing minimization and mitigation actions on development sites (before construction) and on mitigation sites. The ultimate uses of the development sites are not yet determined, so the exact type of commercial activities that will occur on them are undetermined. Based on the Applicants' recent development patterns, we expect that commercial infrastructure will occupy the entirety of each site, except in the existing permanent habitat set-asides. We also assume that construction activities and operations will comply with all local, state, and federal regulations. Construction activities will include, but are not limited to: 1) excavating; 2) scraping; 3) filling; 4) grading; 5) paving; 6) building structures; and 7) installing infrastructure, landscaping, and stormwater ponds.

The Applicant proposes to clear, grade, and build on 13 development sites in Thurston County. Development sites range from degraded grasslands to sites already used for commercial or industrial purposes; none are functional grassland prairies dominated by natural ecosystem processes. Some development sites include existing permanent habitat set-asides. However, we assume that the set-asides will not sustain individuals of the covered species because they are small, degraded, and isolated from other suitable habitat by anthropogenic infrastructure, development, and human activity. Construction will start upon Permit issuance and will occur throughout the 20-year Permit duration.

The Applicants also propose to mitigate for the impacts associated with development on additional sites, within the range of the Olympia pocket gopher and the Yelm pocket gopher. Because those other development sites are not yet identified, they are not considered as part of this HCP. The mitigation actions described in the HCP will enhance habitat in excess of the mitigation for impacts on the covered lands. This Opinion does not address effects related to unidentified development sites. However, this Opinion addresses habitat management across the full extent of the mitigation sites because that activity will begin with the proposed Permit issuance. The lands proposed for coverage are depicted in Appendix A of the HCP.

The proposed Permit issuance will cover HCP implementation with the following covered activities as described in the HCP: 1) pre-construction vegetation management of the 13 development sites; 2) construction of new buildings, pavement, and infrastructure; and 3) mitigation actions on the on-site set-asides and the mitigation sites.

1. Pre-construction vegetation management of the development sites may include:
    a. Mowing.
    b. Mechanical removal and control of nonnative, invasive, and/or undesirable plant species.
    c. Preparing sites for planting.
    d. Planting of native seeding.
    e. Surveys for covered species.

2. Construction may include:
    a. Construction surveys.
    b. Grading and earthmoving activities associated with construction.
    c. Installation and construction of infrastructure associated with new construction projects, including roadways, sidewalks, parking lots, sewer lines, utilities, and lighting.
    d. Installation of new facilities, including foundations, commercial building, associated structures, parking lots, and access routes.
    e. Landscaping.

3. Ongoing vegetation management on the on-site set asides and on the mitigation sites may include:
    a. Mowing.
    b. Mechanical removal and control of nonnative, invasive and/or undesirable plant species.
    c. Preparing sites for planting.
    d. Planting.
    e. Prescribed burns.
    f. Monitoring.

A total of 204 acres (13 development sites comprised of 46 parcels) will be developed or redeveloped for commercial/industrial use. Of the 204 acres on development sites, construction activities will impact approximately 170 acres of potential prairie ecosystems (Table 1). Construction will not occur on the remaining 34 acres because they are already designated as permanent habitat set-asides. Baseline conditions prevent the set-aside areas from being restored to higher function. On the two proposed mitigation sites, permanent management of 87.5 acres will maintain preferred vegetation for the covered species. If prescribed burning occurs on the mitigation sites, it will be conducted by an appropriately experienced land manager operating under their own Section 10(a)(1)(A) recovery permit, so effects of burning are not further addressed in this opinion.

The construction timing for individual sites and specific details (e.g., size, number, and locations of buildings or required infrastructure) may change over time, through modifications of building permits or other approvals from Thurston County. Construction and/or development of individual sites could occur at any time within the 20-year term of the Permit.

Figure 1. Kaufman HCP Development and Mitigation Sites

Site Purpose	Mazama pocket gopher subspecies	Site Name	Site Area (Acres)	Suitable MPG Habitat (Acres)
Development	Yelm	Sargent Rd	10.7	7.7
		Grand Mound	18.9	16.7
		Wichman/ McCellan	5.2	3.2
		Subtotal	**34.9**	**27.7**
	Olympia	Lathrop	7.7	0.2
		I-5 Commerce	40.3	5.5
		Tumwater C.	36.5	16.0
		Tilley Road	27.9	1.3
		88th Ave	3.1	0.1
		Kaufman Ind. Park	11.8	0.8
		79th Ave	5.2	0.8
		Liberty/Trails End	4.4	2.7
		Deschutes	19.3	9.9
		Union Mills	12.8	3.1
		Subtotal	**169.0**	**40.3**
	-	**Total**	**203.8**	**68.0**
Mitigation	Yelm	Leitner Prairie	36.2	36.2
	Olympia	Deschutes Corridor	51.3	51.3
	-	**Total**	**87.5**	**87.5**

Conservation Measures

HCP implementation includes measures designed to avoid and minimize effects of construction on covered species. The conservation measures are fully described in the HCP (Krippner Consulting 2016), and are summarized here:

1. Pre-Construction Habitat Management: Vegetation management before construction on development sites will maintain habitat quality for covered species.

2. Biological Monitoring: Monitoring by trained biologists, or others qualified to serve in this role, will be used primarily to detect presence of covered species and to inform vegetation management.

3. Construction Timing: Whenever practicable, construction will occur outside the sensitive times for the applicable species (e.g., after breeding and until young Mazama pocket gophers are mobile). Construction on sites occupied by streaked-horned lark, if any, will be delayed by one breeding cycle.

4. Endangered Species Surveys & Relocation: a qualified biologist will survey for occupancy, and attempt to trap and relocate, any species when deemed necessary and advisable by the Service.

Monitoring and Reporting Requirements

The ongoing monitoring of covered activities, species presence/persistence, and incidental take of the covered species will provide measures of the success of the various management actions. Monitoring activities are described in Section 5 of the draft HCP. Annual reports will summarize implementation of covered activities on development and mitigation sites and will summarize incidental take either by the number of individuals of covered species (when that can be determined) or by the area of habitat impacted. Monitoring is intended to ensure that suitable habitat is maintained for the covered species.

Mitigation

Mitigation is designed to offset anticipated effects on the covered species and their habitats. To compensate for unavoidable impacts, the Applicants will ensure the persistence of 87.5 acres of suitable habitat for covered species in perpetuity through enhancement or protection of dedicated mitigation sites. (See Appendix A of the draft HCP for Conservation Site Management Plans).

The HCP (Section 4) describes the mitigation plan as a combination of short-term habitat maintenance for covered species on the development sites and long-term habitat enhancement or maintenance on mitigation sites. Management of two large mitigation sites (36.2 and 51.3 acres) will offset the effects of development on 13 individual sites with fragmented patches of suitable Mazama pocket gopher habitat (68 acres in total). By extinguishing development rights and enhancing prairie characteristics on the larger mitigation sites, the HCP will provide larger areas of higher quality and less fragmented habitat than is provided on the development sites. More detail about the spatial allocation of impacts and mitigation are available in the HCP.

Interrelated and Interdependent Actions

Interrelated actions are those "…that are part of the larger action and dependent on the larger action for their justification"; interdependent actions are those "…that have no independent utility apart from the action under consideration" (50 CFR section 402.02). The Service does not foresee any adverse effects that are attributable to interrelated or interdependent actions associated with the proposed action.

Action Area

The action area is defined as all areas to be affected directly or indirectly by the action and not merely the immediate area involved in the action (50 CFR 402.02). In delineating the action area, we evaluated the farthest reaching physical, chemical, and biotic effects of the action on the environment. This includes effects that may happen later in time, but are a result of the action.

The action area for this Opinion ("Plan Area" in the HCP) encompasses the entire area affected by the development and mitigation actions. The action area overlaps with portions of the ranges of each covered species (see Appendix A of the HCP).

The farthest-reaching effects will be physical disturbance from construction and habitat management activities on covered lands, beyond which the movement and operation of heavy equipment will be indistinguishable from background levels. Therefore, the action area includes only the covered lands which are contained within Thurston County.

Analytical Framework for the Jeopardy and Adverse Modification Determinations

The following analysis relies on the following four components: (1) the Status of the Species, which evaluates the rangewide condition of the listed species addressed, the factors responsible for that condition, and the species' survival and recovery needs; (2) the Environmental Baseline, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and (4) Cumulative Effects, which evaluates the effects of future, non-federal activities in the action area on the species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed federal action in the context of the species' current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of listed species in the wild.

The jeopardy analysis in this Opinion considers the rangewide survival and recovery needs of the listed species and the role of the action area in providing for those needs. It is within this context that we evaluate the significance of the proposed action, taken together with cumulative effects, for purposes of making the jeopardy determination.

STATUS OF THE SPECIES

Streaked Horned Lark

The streaked horned lark was listed as a threatened species on October 3, 2013 (78 FR 61452), under the ESA. The streaked horned lark is a subspecies of horned lark that is genetically differentiated from all other sampled localities (Drovetski et al 2005, p. 875). Genetic information suggests the subspecies is suffering from a population bottleneck (Drovetski et al 2005, p. 881). The streaked horned lark's breeding range historically extended from southern British Columbia, Canada, south through the Puget lowlands and outer coast of Washington, along the lower Columbia River, through the Willamette Valley, the Oregon coast and into the Umpqua and Rogue River Valleys of southwestern Oregon (Altman 2011, pp. 200-202).

The subspecies is extirpated as a breeding species throughout much of its range, including all of its former range in British Columbia, the San Juan Islands, the northern Puget Trough, the Washington coast north of Grays Harbor County, the Oregon coast, and the Rogue and Umpqua Valleys in southwestern Oregon (Pearson and Altman 2005, pp. 4–5). Streaked horned larks currently breed on seven sites in the south Puget Sound. The largest population of streaked horned larks currently breeds at the Olympia Airport (Pearson and Altman 2005, p. 23; Pearson et al. 2008, p. 3). In the winter, most of the streaked horned larks that breed in the south Puget Sound migrate south to the Willamette Valley or west to the Washington coast. Streaked horned lark has experienced a substantial contraction of its range; the streaked horned lark's current range appears to have been reduced to less than half the size of its historical range in the last 100 years. In the south Puget Sound, approximately 150 to 170 streaked horned larks breed at six sites (Altman 2011, p. 213). Recent studies have found that larks have very low nest success in Washington (Pearson et al. 2008, p. 8)

The streaked horned lark population decline in the south Puget Sound of Washington indicates that the observed range contraction for this subspecies may be continuing, and the subspecies may disappear from that region in the near future. There are many other ongoing threats to the streaked horned lark's habitat throughout its range, including: (1) converting land use to agriculture and industry; (2) loss of natural disturbance processes such as fire and flooding; (3) encroachment of woody vegetation; (4) invasion of coastal areas by nonnative beachgrasses; and (5) incompatible management practices. The continued loss and degradation of streaked horned lark habitat may result in smaller, more isolated habitats available to the subspecies, which could further depress the rangewide population or reduce the geographic distribution of the streaked horned lark.

For a detailed account of streaked horned lark biology, life history, threats, demography, and conservation needs, refer to Appendix A: Status of the Species Streaked Horned Lark.

Taylor's Checkerspot Butterfly

The Taylor's checkerspot butterfly (*Euphydyas editha taylori*) was listed as an endangered species on October 3, 2013, throughout the subspecies range in Washington, Oregon, and British Columbia (78 FR 61452 [October 3, 2013]). Taylor's checkerspot butterfly requires open grassland habitat dominated by short-statured grasses, with abundant forbs to serve as larval host plants and nectar sources. These habitats occur on prairies, shallow-soil balds (Chappell 2006, p. 1), grassland bluffs, and grassy openings within a forested matrix on south Vancouver Island, British Columbia; the north Olympic Peninsula; south Puget Sound, Washington; and the Willamette Valley, Oregon. In Washington, Taylor's checkerspot butterflies inhabit glacial outwash prairies in the south Puget Sound region. Northwest prairies were formerly more common, larger, and interconnected, and supported a greater distribution and abundance of Taylor's checkerspot butterflies than prairie habitat does today.

The distribution of the Taylor's checkerspot butterfly has been reduced from more than 80 populations to the 14 occupied locations with small populations that are known rangewide today. Some of the populations that have been extirpated have disappeared in the past decade, and some declined from robust population sizes of 1,000s of individual butterflies to zero within a 3-year interval and have not returned (Stinson 2005, p. 94). In the south Puget prairies, only one native local population remains, others are the result of recent reintroduction efforts. Most remaining populations of Taylor's checkerspot butterflies are very small; 5 of the 14 known populations are estimated to have fewer than 100 individuals.

The threats of land development and loss of habitat from conversion to other uses (agriculture); the impacts of military training and recreation; existing and likely future habitat fragmentation, habitat disturbance; long-term fire suppression; and ongoing loss and degradation of habitat associated with native and nonnative invasive species continues. These factors have resulted in the present isolation and limited distribution of the subspecies, and are currently ongoing and will continue into the foreseeable future. The combination of ongoing threats coupled with small population sizes and highly variable population dynamics leads us to conclude that the Taylor's checkerspot butterfly is currently in danger of extinction throughout its range.

For a detailed account of Taylor's checkerspot butterfly biology, life history, threats, demography, and conservation needs, refer to Appendix B: Status of the Species Taylor's Checkerspot Butterfly.

Olympia Pocket Gopher

On April 9, 2014, the Service listed the Olympia pocket gopher as a threatened species under the ESA. The subspecies is associated with glacial outwash prairies in western Washington, an ecosystem of conservation concern (Hartway and Steinberg 1997, p. 1). Steinberg and Heller (1997, p. 46) found that pocket gophers are even more patchily distributed than are prairies, as there are some seemingly high quality prairies within the species' range that lack pocket gophers; e.g., Mima Mounds Natural Area Preserve (NAP), and 13th Division Prairie on Joint Base Lewis-McChord (JBLM).

There are few data on historical or current population sizes of Mazama pocket gopher populations in Washington. Knowledge of the past status of the pocket gopher is limited to distributional information.

The Olympia pocket gopher faces significant threats that contribute to a risk of extinction. Best available scientific and commercial information identifies the following significant threats to the subspecies: (1) destruction, modification, or curtailment of habitat and range including the on-going, cumulative effects of development, military training, and loss or curtailment of natural disturbance processes; (2) poor connectivity between small and isolated populations; and, (3) predation and pest control, including that which is attributable to domesticated pets.

For a detailed account of Olympia pocket gopher biology, life history, threats, demography, and conservation needs, refer to Appendix C: Status of the Species Mazama Pocket Gopher.

Yelm Pocket Gopher

On April 9, 2014, the Service listed the Yelm pocket gopher as a threatened species under the ESA. The subspecies is associated with glacial outwash prairies in western Washington, an ecosystem of conservation concern (Hartway and Steinberg 1997, p. 1). Steinberg and Heller (1997, p. 46) found that pocket gophers are even more patchily distributed than are prairies, as there are some seemingly high quality prairies within the species' range that lack pocket gophers; e.g., Mima Mounds Natural Area Preserve (NAP), and 13th Division Prairie on JBLM.

There are few data on historical or current population sizes of Mazama pocket gopher populations in Washington. Knowledge of the past status of the pocket gopher is limited to distributional information.

The Yelm pocket gopher faces significant threats that contribute to a risk of extinction. Best available scientific and commercial information identifies the following significant threats to the subspecies: (1) destruction, modification, or curtailment of habitat and range including the on-going, cumulative effects of development, military training, and loss or curtailment of natural disturbance processes; (2) poor connectivity between small and isolated populations; and, (3) predation and pest control, including that which is attributable to domesticated pets.

For a detailed account of Yelm pocket gopher biology, life history, threats, demography, and conservation needs, refer to Appendix C: Status of the Species Mazama Pocket Gopher.

ENVIRONMENTAL BASELINE

Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the action area that have undergone section 7 consultation, and the impacts of State and private actions which are contemporaneous with the consultation in progress. The Environmental Baseline evaluates 1) the condition of covered species in the action area, 2) the factors responsible for their condition, and 3) the relationship of the action area to the survival and recovery of the covered species.

ENVIRONMENTAL BASELINE: STREAKED HORNED LARK

Suitable habitat for streaked horned larks is comprised of expansive areas of flat, open ground. These areas were historically provided in native prairies and scoured river-banks. With the decline of native prairies and scoured riverbanks in the Pacific Northwest, airports provide attractive breeding sites for streaked horned larks because they must be maintained as large, flat, and treeless areas. Breeding habitat used by streaked horned larks is generally flat with substantial areas of bare ground and sparse, low-stature vegetation (Pearson and Hopey 2005, p. 27). A key attribute of nesting habitat is the open landscape context—generally a flat, treeless landscape of 300 acres or more (Converse et al. 2010, p. 21). While there are no parcels of this size in the action area, there are smaller parcels that are contiguous with open landscapes on adjacent parcels. Along the lower Columbia River, streaked horned larks regularly breed on sites that are 10 to 20 acres and adjacent to large open river landscape. By contrast, in the south Puget Sound, they breed on much larger sites. For example, the area used for breeding at the Olympia Airport site is approximately 375 acres and the Artillery Impact Area nest site at JBLM is 8,000 acres. Despite its smaller size compared to other breeding sites in south Puget Sound, the Olympia Airport has more streaked horned larks (22-23 breeding pairs from 2010 to 2014 (Linders 2011, p.3; WDFW 2013, p.70)) than the others (WDFW 2013, p.70).

Foraging habitat availability is not a significant limiting factor. Streaked horned larks in the action area require an open landscape context typical of flat low-stature grasslands for both foraging and nesting, however more flexibility in selection of foraging areas is observed.

The primary long-term term threat to streaked horned lark are the conversion and degradation of habitat including successional changes to grassland habitat and the spread of invasive plants, or the conversion of habitat to residential, commercial, and industrial developments. The south Puget Sound prairies are one of the rarest ecosystems in the United States (Dunn and Ewing 1997, p. v).

The action area contains suitable habitat for nesting and foraging. Streaked horned larks are likely to use habitat in the action area for foraging and, to a minor degree, breeding during the breeding season. The majority of individuals winter away from the action area.

Throughout the action area, the largest open areas are found on the Deschutes Corridor and Leitner Prairie mitigation sites. The development sites are each smaller, and generally have more limited contiguity or no contiguity with suitable habitat.

Baseline, by definition, is a “snapshot” of a species’ health at a specified point in time. It does not include the effects of the action under review in this consultation. Therefore, the baseline for streaked horned lark reflects our best understanding of the status of the species and its habitat at the time of this writing and the effects of this proposed action will alter that baseline for all future analyses. Impacts of the taking resulting from this proposed action on this species are analyzed relative to the current environmental baseline.

Current Condition of the Streaked Horned Lark in the Action Area

Research of streaked horned larks at the specific scale of Thurston County and/or the action area is lacking, so we assess their status at the scale of southern Puget Sound, and expect that it applies at a finer scale.

Streaked horned larks in the South Puget Sound are declining rapidly in number (Camfield et al. 2011, p. 8). There are seven known breeding sites in south Puget Sound, including three sites at regional airports and four sites on military installations (Altman 2011, p. 213). The Olympia Airport is the documented breeding site closest to the action area. An estimated 150 to 170 streaked horned larks breed at these seven, south Puget Sound sites. The number of streaked horned lark territories within these seven breeding sites declined by 45 percent over three years (2004 to 2007); from 77 to 42 territories (Pearson, as cited in Camfield et al. 2011, p. 8).

Studies from Washington sites found "extremely high breeding site fidelity" (Anderson et al. 2013, p. 3); "...most streaked horned larks return each year to the place where they were born" (Wolf pers. comm. 2013d; and see Anderson et al. 2013, p. 3; Pearson et al. 2008, p. 11). While there are reports of banded individuals leaving Washington to breed in Oregon, (Pearson et al. 2008, p. 12), immigration into south Puget Sound from the Willamette Valley and the Washington Coast/lower Columbia River system is not known to occur (Anderson et al. 2013, p. 23).

Given their high site fidelity, we presume most of the individuals that nested, or were hatched, in south Puget Sound sites will return to the same sites to breed. Thus, we refer to an assemblage of individuals returning year-after-year to nest at the same site as a local population. As such, any additional individuals breeding in or near the action area are from the migratory portion of a rangewide population.

Streaked horned larks may occupy additional areas of suitable habitat in the coming decades. Habitat maintenance at sites near the Olympia Airport could provide demographic support for that local population. All areas that currently support breeding and foraging are considered essential in maintaining the current population and distribution of streaked horned larks until new local populations become established and/or the overall population increases. Recently, two banded individuals hatched on JBLM were seen at the Olympia Airport, demonstrating that some first-year breeding birds will use locations other than their natal sites. Young banded birds and banded adults that dispersed to non-natal sites are documented in other geographic areas as well (Pearson 2008 et al., p. 12).

Adults occupy breeding sites prior to the nesting season. Adults and fledglings continue their occupancy after the nesting season. Before the nesting season, they exhibit a variety of breeding behaviors at nesting sites, such as displaying, singing, and establishing and defending territories. Once streaked horned larks have completed nesting, they do not begin their migration immediately; instead, adults and young of the year group together into foraging flocks (Anderson 2007, p. 6). Although most fledglings are capable of sustained flight by early to mid-September, they can occupy breeding areas into October (Anderson, in litt. 2013). The Service considers the nesting season to extend from April 1 through September 15 and we expect adults and juveniles are extremely vulnerable to disturbance and habitat alteration for the entire duration of breeding season (Table 2).

Figure 2. South Puget Sound streaked horned lark life stages and vulnerability

Life Stage	Significant Date (2014)	Stage Duration	Spatial arrangement	Ground Vulnerability
Adult Arrival	First detection 14 Feb	~ 2 months	Throughout sites	Low
Nesting (Eggs, Nestlings)	First egg laid ~13 April First hatch date ~26 April	mid-April to early May	Confined to nest location	Moderate - high
Fledgling	First fledge date ~4 May	early May to late Aug	0-2807 m from natal nest	High
Independence	Last date of independence ~ 28 August	After 1 Sept	Throughout sites	Low

(Wolf and Anderson 2014, p. 41)

Daily survival of streaked horned larks increases later in the breeding season in July, August, and September (Moore 2013, p. 48); streaked horned larks fledging later in the season had higher survival rates than those fledging earlier in the season (Moore 2013, p. 24). Threats include injury or death from mowing and other general maintenance or equipment operation in their habitat. Young fledglings are particularly vulnerable to crushing by equipment (Moore 2013, p. 27). Young streaked horned larks appear more vulnerable to mowing-related mortality within approximately 2.5 weeks of fledgling than as nestlings (Moore 2013, p. 26). Their reliance on early-successional habitats and susceptibility to injury or death from common land management activities, are aspects of low streaked horned lark productivity (78 FR 61474). Overall nest success in or near the action area is low (9 successful nests out of 23 nests discovered) (Pearson and Hopey 2004, p. 15).

Current Habitat Conditions for Streaked Horned Larks in the Action Area

In the action area, most of the open space (i.e., not built upon or forested) is dominated by Scot's broom (*Cystisus scoparius*) or mowed, non-native, perennial grasses. Vegetation conditions, land use, and the relative isolation of development sites suggest that the only portion of the action area streaked horned larks are likely to use in the current condition are open areas of the Deschutes Corridor mitigation site adjacent to the Olympia Airport.

None of the development or mitigation sites were surveyed for streaked horned lark presence. The development sites and immediately surrounding developed lands are extremely unlikely to contain suitable lark nesting habitat due to the relatively small size of each parcel in an urbanized landscape context. None of these sites provide the large open areas, sparsely vegetated with short annual grasses, and high percent cover of rocks, typical of the breeding habitat used by streaked horned larks in the south Puget Sound (Pearson and Hopey 2005, pp.19-20). The mitigation sites also have low potential as suitable lark habitat, but due to their larger sizes, and the contiguity of Deschutes Corridor with the Olympia Airport, this portion of the action area has potential foraging or nesting habitat. The current shrub cover on much of the Deschutes corridor site makes it extremely unlikely that streaked horned larks currently use the site for any life history stage.

Elevated noise and human activity is extremely common at each breeding site in the south Puget Sound. The adjacent Olympia Airport had almost 40,000 operations (take offs or landings) between April and September in 2013 (1,500 aircraft operations per week) (Rudolph, in litt. 2014).

Streaked horned larks will sometimes nest in the grassy medians and gravel shoulders along the edge of the runways, taxiways, and roads. Paved surfaces contribute to the open-landscape context of the environment, and the birds use the paved areas to display and sing. These areas present risks to nesting birds because they are regularly mowed, which can result in mortality of young birds. Although mowing in nesting areas results in the mortality of some eggs and chicks, it also creates and maintains suitable nesting habitat for this species. Larks that use the action area require active management to maintain suitable nesting habitat.

Factors Responsible for the Condition of the Streaked Horned Lark in the Action Area

Ongoing management activities create habitat features attractive to nesting streaked horned larks. These activities include mowing during the spring and summer to maintain low vegetation heights, accidental fires, construction of temporary roads, use of herbicides and planting native prairie grasses and forbs that reduce the need for mowing. The streaked horned larks prefer these bare-ground or sparse-grass habitat features in large-open landscapes that were historically created by natural and anthropogenic fires. When historical prairie burning stopped, ingrowth of woody plants and urbanization fragmented the prairies, and suitable habitat almost disappeared in south Puget Sound.

Conservation Role of the Action Area for Streaked Horned Larks

The conservation role of the action area is to provide a secure habitat for eventual demographic support at a scale that supplements the rangewide population. All undeveloped areas that provide sources of food and suitable nesting opportunities are important for recovery because additional secure habitat areas are needed for the streaked horned lark population in or near the action area.

Protecting habitat that supports the local population nesting at the Olympia Airport is essential to the recovery of the streaked horned lark. Until other suitable nesting habitat provides streaked horned larks the opportunity to successfully reproduce, habitat management at and near the Olympia Airport is essential in maintaining the conservation role of the action area for streaked horned larks. Likewise, managing activities on occupied sites so that streaked horned larks can persist in a breeding territory is critical to increasing the number of streaked horned larks in the action area. The abundance and distribution of streaked horned larks in Washington has declined to the point where suitable habitat is not currently limiting at the existing occupied sites. Because ongoing active management is needed to maintain suitable nesting habitat, the airfields serve as risky but essential conservation areas for this species. Long-term protection of additional sites will bolster the role of existing airport habitats while providing for breeding sites without some of the risks common to airports.

Primary long-term threats to the streaked horned larks in the action area include the 1) loss and conversion of suitable nesting and foraging habitat due to a) development and b) succession of plant communities, 2) incompatible habitat management practices during the nesting season, 3) predation, 4) aircraft strikes, 5) spread of invasive plants, 6) recreation, and 7) low genetic diversity (78 FR 61452). Sites used by streaked horned larks in the action area require some level of ongoing management. Often, mowing is necessary to maintain habitat structure because historical natural disturbance events are now suppressed in urbanized areas. Mowing maintains the low-stature vegetation and bare ground that characterize suitable habitat; however, mowing is also a threat when conducted during the nesting season because eggs and chicks are not mobile and adults are not always able to escape mowers.

In the action area, predation and emigration are significantly lowering numbers of streaked horned larks (78 FR 61452-61496). In most studies of streaked horned lark nesting ecology, predation was the primary documented source of nest failure (Pearson and Hopey 2004, p. 15; Pearson and Hopey 2005, p. 16; Pearson and Hopey 2008, p. 1; and Moore and Kotaich 2010, p. 23 as cited in 78 FR 61482). Concurrently, a net movement of birds out of the south Puget Sound and low fecundity and adult survival, led Pearson et al (2008, p. 14) to conclude "there is a high probability the remaining local populations in this region could be lost in the near future unless immediate actions are taken to reverse this trend."

Streaked horned larks likely suffer from inbreeding depression (Drovetski et al 2005, p. 881). With severely low population numbers rangewide (Altman 2011, entire), mortality of remaining individuals further constrains the population's genetic capacity, yet all streaked horned larks nesting in south Puget Sound are subjected to routine sources of mortality and disturbance from mowing and aircraft taking off and landing (Stinson 2005, p. 74).

The Olympia Airport, adjacent to the action area, is working with the WDFW, developed measures to schedule mowing and to manage vegetation on the airfield to minimize impacts on streaked horned larks while also meeting airport safety regulations. While these activities continue to pose threats to streaked horned , the measures maintain a likelihood of continued streaked horned lark survival on the airport. Even with positive habitat management for streaked horned larks immediately adjacent to the action area, threats associated with ongoing habitat management, habitat loss, and human-caused disturbance continue to occur.

Climate Change

Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying (Field et al. 1999, pp. 1-3; Hayhoe et al. 2004, p. 12422; IPCC 2007, p. 1181). The potential impacts of a changing global climate to the streaked horned lark are presently unclear;

however, projections localized to the Georgia Basin – Puget Trough – Willamette Valley Ecoregion suggest that temperatures are likely to increase approximately 5 degrees Fahrenheit at the north end of the region by the year 2080 (78 FR 61452:61490 [October 3, 2013]).

Worldwide, the Intergovernmental Panel on Climate Change (IPCC) states it is very likely that extreme high temperatures, heat waves, and heavy precipitation events will increase in frequency (IPCC 2007, p. 783). Climate change may lead to increased frequency and duration of severe storms and droughts (Golladay et al. 2004, p. 504; McLaughlin et al. 2002, p. 6074; Cook et al. 2004, p. 1015), as well as sea level rise.

The effects of climate change on habitat suitability are primarily associated with changes in plant community succession from a sparsely vegetated herbaceous cover to a shrubby or forested state, which would make existing habitat unsuitable for nesting streaked horned larks. Because the occupied site adjacent to the action area, and potential habitat in the action area, are actively managed for commercial purposes in ways that attract streaked horned larks, this climate-driven conversion to unsuitable habitat is not anticipated in the action area. As a result, habitat changes associated with climate change are not currently considered a threat to streaked horned larks in the action area.

Climate change does increase risks to streaked horned larks from stochastic weather events. The occurrence of extreme weather events is expected to increase and may negatively impact the ability of streaked horned larks to survive by increasing exposure or sensitivity to extreme weather, or requiring increased adaptive capacity (78 FR 61452:61491). Stochastic events such as ice storms or flooding that could kill individuals. There are estimated to be fewer than 1,600 streaked horned larks rangewide (Altman 2011, p. 213). During the breeding season, small populations of streaked horned larks are distributed across the range; in the winter, however, streaked horned larks concentrate mainly on the lower Columbia River sites and in the Willamette Valley. Concentrating a majority of the population in this manner may expose significant numbers to severe weather events, which has the potential to kill a substantial percentage of the entire subspecies (Pearson and Altman 2005, p. 13). The streaked horned lark's small population sizes also increases the subspecies' vulnerability to stochastic natural events (78 FR 61452:61491). Because the risk described here is rooted in the random occurrence of extreme conditions, we cannot quantify the risk.

Effects of the Action: Streaked Horned Lark

Effects of HCP implementation on streaked horned larks will result from temporary maintenance of foraging habitat on two development sites, long-term creation and maintenance of foraging habitat on one mitigation site, and construction on the development sites.

Foraging habitat for streaked horned larks is not a significant limiting factor. Streaked horned larks in the action area require an open landscape of flat, low-stature grasslands, for both foraging and nesting, although they exhibit more flexibility in selecting foraging areas.

Suitable nesting habitat is limited in the action area. None of the covered lands currently contain suitable nesting habitat. As such, we do not expect that the proposed construction will alter existing nesting habitat, and implementation of the HCP will not reduce the area available for nesting, nor the quality of existing nesting habitat.

Streaked horned larks forage on, and near, nesting sites, and prefer sites with a large percentage of bare ground and low vegetation (Rogers 2000, p. 110). For example, streaked horned larks that breed and rear at an airfield in Pierce County, also regularly forage at smaller, nearby recreational fields. As this example illustrates, an open-context landscape is important to the selection of foraging habitat, but foraging sites can be smaller than breeding sites. It appears that individual streaked horned larks using the action area have adequate access to foraging habitat.

Because none of the covered lands have an open-landscape context as extensive as any documented breeding sites (e.g., Olympia Airport), the likelihood that new breeding territories will occur on covered lands is low, though it is possible on the mitigation sites. The same factors also limit the quantity and quality of forage on these sites; however, we do expect that streaked horned larks will forage on covered lands. None of the covered lands were surveyed for streaked horned lark occupancy and none are considered active breeding or nesting territories prior to HCP initiation.

The HCP describes all portions of development sites with low-stature vegetation as potential foraging habitat for streaked horned larks. However, only two development sites are in moderately large and open areas, adjacent to the known source population of streaked horned larks at the Olympia Airport: Tumwater Commerce Place (39 acres) and the portion of Deschutes Industrial Park west of the existing stormwater pond (5.5 acres). Though very unlikely, it is still possible that streaked horned larks could use smaller areas with potentially suitable habitat at the development and mitigation sites. Under the HCP, vegetation management on development sites will maintain foraging habitat for streaked horned larks, regardless of the size of the site, until development begins. Schedules for mowing and other vegetation management will minimize impacts to streaked horned larks through pre-management visual surveys for activities during the nesting season (see HCP minimization measures). If surveys determine that project sites are occupied by streaked horned lark, managers will suspend vegetation management and other disturbing activities. Detection probability on development sites will be high because there is excellent visibility and the sites are small.

Over the long-term, implementation of the HCP will not maintain habitat for streaked horned larks on the development sites. The proposed construction and related activities will destroy all foraging habitat for streaked horned larks on the development sites. This will occur concurrent with, or after, establishing suitable habitat on the mitigation site (described below). Nesting is extremely unlikely on the development sites, so we do not expect impacts to nests in the near- or long-term at those locations. The removal of habitat by development will be partially offset by creation of foraging habitat in the mitigation sites, and will result in changes to foraging locations. However, we do not expect these alterations to measurably change the quantity of foraging opportunities for streaked horned larks in the action area. Foraging habitat on the mitigation sites will be of higher quality than on the development sites.

We do not expect that the designated set-asides maintained on development sites will provide suitable habitat for streaked horned larks. At the Deschutes Industrial Park, the set-aside will not be suitable for streaked horned larks because it is an excavated stormwater pond at a lower grade than the surrounding lands. At the Tumwater Commerce Place, the set-aside will not be suitable for streaked horned larks because the development on the rest of the site will isolate the set-aside from the larger open landscape context.

The Deschutes Corridor mitigation site currently contains too much woody vegetation to serve as suitable habitat for streaked horned larks. Streaked horned larks are not currently known to occur near the Leitner Prairie mitigation site, but there are records of historical occurrences (Stinson 2005, pp 50-52). Conservation measures in the HCP commit to removing woody vegetation and maintaining 20 percent (17.4 acres) of each mitigation site in a bare or low-vegetation condition suitable for streaked horned larks to use for foraging and breeding by year four of HCP implementation. The HCP will double this area to 40 percent (34.8 acres) by year 10. Because these management targets are consistent with management objectives for other covered species, the acreage-based targets are likely to be exceeded in most years of the permit term.

By year four of HCP implementation, suitable habitat for streaked horned larks will occur on the mitigation sites because of the habitat-based targets directing management actions under the HCP. We expect that streaked horned larks will use the mitigation sites, particularly at the Deschutes Corridor site, because it is in close proximity to a relatively large breeding population. When streaked horned larks are present, management actions on the mitigation sites will have the potential to impact individual streaked horned larks. The likelihood of impact depends on the ability of operators to detect and avoid the streaked horned larks. As described above, streaked horned larks are vulnerable to habitat management, particularly during the nesting season. Routine vegetation management will occur during the nesting season if the streaked horned larks are not first detected.

Streaked horned larks are expected to begin foraging on the mitigation sites after the initial restoration of suitable habitat (by year four of HCP implementation). With continued expansion of suitable habitat on the mitigation sites by year 10, we expect that streaked horned larks may begin nesting on covered lands during the second decade of HCP implementation. Similar to the foraging habitat above, the habitat-based targets directing management actions under the HCP informed this conclusion.

Streaked horned larks can remain undetected when they occur in low numbers. The HCP includes conservation measures to detect streaked horned larks prior to vegetation management activities, such as mowing. However, the mitigation sites may also be used as foraging habitat by individuals from nearby nesting sites. As such, it is possible that, if those individuals are using the mitigation sites outside of the survey periods, they might not be detected and will be impacted by mowing and other vegetation management practices. We also expect that nesting will occur on the mitigation sites after year 10. We anticipate that any nesting will be at very low densities (low numbers of nests per unit area) due to the relatively small size of the sites. In either of these scenarios (foraging, or low-density nesting), streaked horned larks on covered lands could remain undetected prior to mowing even with pre-management occupancy surveys.

In that event, mowing may kill streaked horned larks on the mitigation sites. Therefore, it is reasonably certain that vegetation management on the mitigation sites will injure or kill individual streaked horned larks.

The number of streaked horned larks that will be killed or injured by mowing is expected to be very low because both scenarios depend on streaked horned larks not being detected. With proper survey techniques, false negatives (non-detection of existing nests) will occur in up to 16 percent of surveys conducted in habitat with a low density of streaked horned larks (Pearson et al. 2015, p. 10). Non-detection of streaked horned larks is extremely unlikely with a higher density of streaked horned larks or extremely good conditions for visibility. Based on observed detection rates, and the survey conditions on covered lands (excellent visibility and relatively small parcel size), we expect that a maximum of one nest will be disturbed or destroyed by mowing or other vegetation management activities on the mitigation sites as a result of non-detection after habitat restoration. Each nest is associated with a pair of adults and approximately three eggs or chicks (Pearson and Hopey 2004, p. 12), all five of which will be killed or permanently injured. There is a moderate likelihood that a disturbed nest will be replaced by a subsequent nest with different individuals during HCP implementation. Because the site is currently unsuitable for nesting, any nesting that occurs on the site will represent increased reproductive potential of the local population. The mitigation site will serve as a very small expansion of the suitable habitat on the adjacent airport property. Likewise any individual streaked horned larks using habitat on the mitigation site will represent a small expansion of the existing population, so the loss of this one nest will not reduce the productivity of the local population.

If there are significant numbers of streaked horned larks foraging on the mitigation sites, surveyors will readily detect them, and mowing will temporarily cease. However, as described above, non-detection can occur when numbers are low. During foraging, adult streaked horned larks are capable of avoiding injury from mowers by moving away from equipment, a strategy that is often successful but is not failsafe. The risk of mowing-related injury or death to foraging individuals exists when streaked horned larks forage independently or at a very low density and a streaked horned lark fails to flee from the path of a mower. If streaked horned larks regularly use the same sites, avoidance measures are expected to be successful because detection probabilities are high. Mowing-related injury or death is expected to occur on mitigation sites where low numbers of individual streaked horned larks will forage. Based on the above-described error rate for detecting streaked horned lark presence (16 percent error), and the HCP prescriptions that will develop habitat for the species by year four (16 years during which habitat exists and management may occur), there is potential for individual streaked horned larks to be injured or killed by mowing. Under this scenario, a maximum of three foraging larks will remain undetected between years four and 20 of HCP implementation. For that scenario to occur, site occupancy by streaked horned larks must be inconsistent. If larks are detected in most years, adaptive management will assume lark presence when developing mowing schedules. It is when larks are not detected for an extended period—leading to the false conclusion that the species is absent—that an individual will be exposed to the risks described above. Therefore, we expect that a maximum of one individual will be injured or killed by mowing every sixth year, for a total of three streaked horned larks during the 20-year permit term.

In conclusion, HCP implementation will destroy foraging habitat on development sites and create foraging and nesting habitat on mitigation sites. Implementation of the HCP will marginally expand the amount of suitable breeding habitat for streaked horned larks. Streaked horned larks foraging, and/or nesting in the mitigation sites could be injured or killed by mowing or other vegetation management activities. Although it is unlikely that nesting will occur on any covered lands, the mitigation sites will be managed to enable nesting, and foraging behaviors are likely to occur on the mitigation sites, so HCP implementation is expected to result in:

- a maximum of one nest, including associated individuals, being disturbed or destroyed by mowing on the mitigation sites during the 20-year permit.

- a maximum of three streaked horned larks foraging on the mitigation sites being injured or killed by mowing on the mitigation sites, at a rate of up to one individual every sixth year.

Cumulative Effects: Streaked Horned Lark

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

The Service is not aware of any non-federal, future actions that are reasonably certain to occur in the action area. Many, if not all, of the foreseeable actions that could have significance for streaked horned lark are expected to have an independent federal nexus, and would therefore be subject to the requirements of a separate section 7 consultation process.

Integration and Synthesis of Effects: Streaked Horned Lark

The proposed permit issuance for HCP implementation will result in commercial development of 13 sites with degraded habitat conditions for streaked horned larks and permanent enhancement of two larger mitigation sites. Adverse effects to streaked horned larks from issuance of an Permit for the proposed HCP will result from vegetation management on mitigation sites.

Proposed vegetation management will maintain any existing habitat on development sites until development begins. Development will occur incrementally across the 13 sites over 20 years. Vegetation management on both mitigation sites will restore habitat for streaked horned larks during the first three years of the permit term. Ongoing management will maintain suitable habitat for streaked horned larks from years four through 20 of the permit (and beyond), so the sites will accommodate streaked horned larks foraging or nesting on covered lands, representing a significant enhancement for streaked horned larks over the baseline condition of covered lands.

Conservation measures are incorporated into the HCP to provide suitable habitat and to minimize the risk of mowing over streaked horned larks. However, streaked horned larks foraging or nesting at very low densities may remain undetected and will thereby be impacted by mowing.

We expect that streaked horned larks exposed to mowing or other vegetation management are likely to be injured or killed. During the 20-year permit term, vegetation management on the covered lands will:

1. Disturb or destroy a maximum of one streaked horned lark nest between years 10 and 20 (not annually), including associated individuals: one adult pair and three eggs or chicks.

2. Injure or kill a maximum of three adult streaked horned larks foraging on the covered lands at approximately one adult every six years from years four through 20.

The loss of five adult streaked horned larks and three eggs or chicks on covered lands over 20 years is not expected to result in a population-level effect to the species. The conservation role of the action area is to eventually contribute demographic support to the most significant breeding population of streaked horned larks in the south Puget Sound prairie ecosystem. The covered lands will support occasional foraging and occasional nesting for streaked horned larks and the proposed management will maintain the open-landscape context of adjacent breeding areas. Use of the mitigation site by streaked horned larks will represent a small expansion of the existing population, so the loss of the above-described individuals will occur when the population at the Olympia Airport is growing and expanding. The loss of individuals will represent a small and immediate reduction in productivity of the local population, but this will be offset by the permanent protection of suitable habitat connected to the Olympia Airport. Habitat maintenance activities on the mitigation site will ensure the long-term suitability of the site for streaked horned larks, providing for a long-term productivity improvement for the species in the action area that will exceed any minor reduction in numbers resulting from vegetation management. Therefore, the above-described effects will not appreciably reduce the likelihood of survival and recovery of the species in the wild.

In conclusion, the HCP will injure or kill three adult streaked horned larks engaged in foraging behaviors and disturb or destroy a maximum of one nest, injuring or killing two adults and three eggs or chicks. These effects will not negatively affect the long-term productivity or the likelihood of survival and recovery of the species in the wild. Short-term effects on productivity will be temporary as they are associated with the expansion of streaked horned lark into additional habitat area.

Conclusion: Streaked Horned Lark

After reviewing the current status of the streaked horned lark, the environmental baseline for the action area, the effects of the proposed Permit issuance and the cumulative effects, it is the Service’s Opinion that the HCP, as proposed, is not likely to jeopardize the continued existence of the streaked horned lark. Critical habitat for this species has been designated at occupied locations outside of the action area (78 FR 61506-61588). However, this action does not affect that area and no destruction or adverse modification of that critical habitat is anticipated.

ENVIRONMENTAL BASELINE: TAYLOR'S CHECKERSPOT BUTTERFLY

This section describes the environmental baseline for Taylor's checkerspot butterfly by analyzing the condition of the species, the factors responsible for the condition of the species—including the condition of habitat for the species—and the conservation role of the action area.

Baseline, by definition, is a "snapshot" of a species' health at a specified point in time. It does not include the effects of the action under review in this consultation. Therefore, the baseline for Taylor's checkerspot butterfly reflects our best understanding of the status of the species and its habitat at the time of this writing and the effects of this proposed action will alter that baseline for all future analyses. Impacts of the taking resulting from this proposed action on this species are analyzed relative to the current environmental baseline.

Current Condition of the Taylor's Checkerspot Butterfly in the Action Area

The entire Permit area is in the historical range of Taylor's checkerspot butterfly. Modern land-use patterns reduced the occurrence of suitable larval host plants and nectar plants compared to the historical landscape. Fire suppression promoted invasion of prairies by woodlands, Scot's broom, and nonnative grasses (Dunn and Ewing 1997, p. v; Tveten and Fonda 1999, p. 146). Taylor's checkerspot butterfly requires open grassland habitat dominated by short-statured grasses, with abundant forbs to serve as larval host plants and nectar sources. These habitats are found on prairies, shallow-soil balds (Chappell and Kagan 2001, p. 41), grassland bluffs, and grassy openings within a forested matrix on south Vancouver Island, British Columbia; the north Olympic Peninsula; south Puget Sound, Washington; and the Willamette Valley, Oregon. In Washington, Taylor's checkerspot butterflies inhabit glacial outwash prairies in the south Puget Sound region. Northwest prairies were more common, larger, and interconnected, and supported a greater distribution and abundance of Taylor's checkerspot butterflies than prairie habitat does today.

Taylor's checkerspot butterfly are currently known to occupy two sites near the action area. The fragmented habitat in the action area challenges natural population expansion, so current populations in the south Puget Sound prairies exist only where they were actively reintroduced at Scatter Creek Wildlife Area – South, and Glacial Heritage Preserve. The reintroduced populations are approximately one mile and three miles from the nearest lands proposed for coverage, respectively. Taylor's checkerspot butterfly have not been observed at any of the lands proposed for HCP coverage and are unlikely to occur there given the current degraded quality of the grasslands. Larval host plants and nectar plants required for Taylor's checkerspot butterflies are present, so these development and mitigation sites could provide marginal habitat for Taylor's checkerspot butterfly. Therefore, the lack of verified Taylor's checkerspot butterfly occupancy does not rule out the potential presence of the species during the permit term. Natural population expansion onto covered lands would likely rely on restoration of prairie quality and quantity both inside the action area and on adjacent lands to restore landscape-scale habitat connectivity. Alternately, enhanced population expansion through active reintroductions on or near covered lands is the more likely mechanism for Taylor's checkerspot butterflies to reach the covered lands within the next 20 years.

Existing habitat conditions on the development sites are impacted by commercial site preparation, initial construction, and encroachment by woody vegetation. Construction of development infrastructure, such as roads and sewers, began prior to the Federal listing of Taylor's checkerspot butterfly as endangered in October of 2013. Without vegetation management or the historically-regular fires, Scot's broom and other woody vegetation established on some development sites and woody plants shade or out-compete the larval host and nectar plants required by Taylor's checkerspot butterfly. Development sites with any suitable habitat are grasslands that are moderately to severely degraded by the above-described conditions. Though some larval host and nectaring plant species are present, these essential habitat components are not common on any of the development sites.

In July 2014, Center for Natural Lands Management (CNLM) surveyed seven of the development sites for the presence of larval host and nectar plants to test a Prairie Habitat Assessment Model for Thurston County (Table 3). The sites proposed for coverage that were not surveyed had existing conditions that made the presence of these plants extremely unlikely. The estimated area of suitable habitat is based on the number of 625 square meter quadrats that contained at least four square meters of larval host plants. Since accessible nectar sources can be as far away as 200 meters from the host plants, and all known occupied sites with larval host plants also had at least one nectar source (e.g., Severns and Grosboll 2011, entire), the presence of nearby nectar sources was assumed for all quadrats with host plants. The habitat potential on a small development site in an urbanized setting is inherently limited by isolation and fragmentation.

Figure 3. Estimated Area of Current Potential Habitat for Taylor's Checkerspot Butterfly

Appendix A Map #	Development Site	Estimated area of larval host plants (acres)	Site Size (acres)
1A	Kaufman Industrial Park	Not surveyed, mostly developed	11.79
1B	79th Ave Business Park	0	5.19
2	Liberty Leasing/Trails End Industrial Park	1.70	4.42
3	Deschutes Industrial Park	2.47	19.29
4	Tumwater Commerce Place	Not surveyed, dense grasses with few forbs	36.47
5A	Tilley Road Industrial Park	Not surveyed, mostly forested	27.87
5B	88th Avenue Subdivision	Not surveyed, mostly forested	3.08
6	I-5 Commerce	0.31	40.34
7	Lathrop Industrial Park	0	7.68
8	Grand Mound Distribution Center	0	18.89

Appendix A Map #	Development Site	Estimated area of larval host plants (acres)	Site Size (acres)
9	Sargent Road	1.85	10.74
10	Union Mills Road	Not surveyed, developed and dense shrubs	12.84
11	Wichman/McCellan Properties	Not surveyed, dense grasses and fill soils	5.23
	Total acreage	6.33	106.55 surveyed 203.83 total

In all cases, the larval host plant observed on covered lands was narrowleaf plaintain (*Plantago lanceolata*), and in most cases, the nectar source observed was hairy cat's ear (*Hypochaeris radicata*). Both are non-native plants. Likewise, few nectar species were present at the development sites during spring when Service biologists visited but did not formally survey the project development sites. Habitat conditions on the project development sites are poor.

Using the CNLM survey data with the conservative assumptions described above, up to 6.4 acres, or 3.1 percent, of the total area of the development sites currently consists of suitable habitat for Taylor's checkerspot butterflies. This is likely an overestimate because only four square meters of potential habitat within each 625-square meter quadrat qualified the entire quadrat as "habitat."

On the mitigation sites, existing conditions are moderately functional grasslands that currently have very low habitat value for Taylor's checkerspot butterfly. Shrub encroachment and non-native vegetation are significant at the Deschutes Corridor mitigation site. Dense Scot's broom thickets and patches of other invasive plants cover approximately 25 acres (57 percent of the site). Red alder (*Alnus rubra*) colonized disturbed soil areas along the east boundary and gravel quarry areas. The total tree cover is estimated to be 14 acres, or 32 percent of the site. Sparsely vegetated, gravelly soils cover the rest of the site (five acres, 11 percent). The Leitner Prairie mitigation site was in a similar condition until prairie restoration efforts began in 2013. Prior to 2013, much of the site was covered with Scot's broom thickets, other shrubs, and scattered conifer trees. Grass cover is currently dominant, including native and non-native species. Native prairie wildflowers are found in portions of this site. Larval host and nectaring plants were confirmed in low density on Leitner Prairie, and are likely absent from the Deschutes Corridor.

It is extremely unlikely that Taylor's checkerspot butterflies would occur on any of the covered lands prior to HCP implementation. In the South Puget Sound prairies, the species is currently found only on and very near sites where they were actively reintroduced. The species was not observed on any lands proposed for HCP coverage.

Factors Responsible for the Condition of the Taylor's Checkerspot Butterfly in the Action Area

Taylor's checkerspot butterfly is rare in the south Puget Sound and likely to be currently absent from action area. Habitat for Taylor's checkerspot butterfly in the South Puget Sound is severely fragmented and degraded. Potential habitat for Taylor's checkerspot butterfly on the development sites is also small and fragmented, and their location between neighboring developments constrains future habitat potential. Ongoing development would isolate, fragment, and degrade the sites more over time, eventually resulting in a permanent loss of functional habitat. The proposed development sites are characterized by invasive non-native vegetation or forests that established after natural prairie-maintaining disturbances were eliminated. Most of the development sites were cleared and prepared for commercial sale and/or development. Regular mowing at some of the development sites maintained low-statured grasses, preventing encroachment by woody vegetation. Dense Scot's broom or conifers cover other development sites.

Large open areas with low-statured grasses and forbs were historically maintained by anthropogenic and natural fires in South Puget Sound prairies. Fire suppression became the dominant paradigm in the region over the 19th and 20th centuries, allowing for a successional shift away from native prairie plant composition to forest while commercial, residential, and transportation infrastructure developed (Boyd 1986, entire; Christy and Alverson 2011, p. 93). The result was a reduction in and fragmentation of the prairie ecosystem (Crawford and Hall 1997, pp. 13-14; Watts et al. 2007, p. 736). These factors interact to form the primary threat to the species in the action area: fragmentation and reduced abundance of suitable habitat and the loss of habitat-maintaining processes.

Additional threats to the species in the action area historically resulted from vegetation management in suitable habitat. Vegetation management typical of local land uses promoted a shift away from native prairie species toward non-native grasses, significantly reducing the quality of habitat for the species (Rogers 2000, p. 41). The combination of habitat loss, habitat fragmentation, and land uses resulted in the endangered status of the species in the action area.

Conservation Role of the Action Area for Taylor's Checkerspot Butterfly

The conservation role of the action area is to provide open grassland habitats that may serve as dispersal corridors should Taylor's checkerspot butterfly populations establish on high-quality prairies within dispersal distance of the action area. In the action area, and throughout the Pacific Northwest, prairies were formerly more common, larger, and interconnected. The historical prairie network supported a greater distribution and abundance of Taylor's checkerspot butterflies than prairie habitat does today. In and near the action area, occupied sites are rare. Two prairies near the action area, and not on covered lands, are occupied and currently provide Taylor's checkerspot butterfly with protected habitat for all life history phases. All other suitable habitat in the action area is likely to be currently unoccupied, so the conservation role of the covered lands and other unoccupied habitat in the action area is to provide dispersal corridors should Taylor's checkerspot butterfly populations become established on high-quality prairies within dispersal distance.

Undeveloped areas that provide Taylor's checkerspot butterfly with food and reproductive opportunities are important because restoration of developed sites is usually unfeasible. The remaining areas of suitable habitat are increasingly isolated. Other patches of suitable habitat in the action area are severely degraded by changes in vegetation or incompatible land-use. The result is that opportunities for natural expansion of the butterfly population are extremely limited. Therefore, the primary conservation role of the action area is to contribute to prairie ecosystem contiguity for the existing population of Taylor's checkerspot butterfly on two prairies in the southern portion of the action area. The proposed HCP is the first in a series of anticipated conservation plans from local land managers that, together, may support the natural expansion of the existing populations of Taylor's checkerspot butterfly.

Climate Change

Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying (Field et al. 1999, pp. 1-3; Hayhoe et al. 2004, p. 12422; IPCC 2007, p. 1181). The potential impacts of a changing global climate to the Taylor's checkerspot butterfly are presently unclear; however, projections localized to the Georgia Basin – Puget Trough – Willamette Valley Ecoregion suggest that temperatures are likely to increase approximately 5°F at the north end of the region by the year 2080 (78 FR 61452:61490 [October 3, 2013]).

Worldwide, the IPCC states it is very likely that extreme high temperatures, heat waves, and heavy precipitation events will increase in frequency (IPCC 2007, p. 783). Climate change may lead to increased frequency and duration of severe storms and droughts (Golladay et al. 2004, p. 504; McLaughlin et al. 2002, p. 6074; Cook et al. 2004, p. 1015), as well as sea level rise.

The effects of climate change on habitat suitability are primarily associated with changes in plant community succession from a sparsely vegetated herbaceous cover to a shrubby or forested state, which would make existing habitat unsuitable for Taylor's checkerspot butterfly. Because the occupied sites near the action area are actively managed for habitat maintenance for Taylor's checkerspot butterfly, this climate-driven conversion to unsuitable habitat is not anticipated. As a result, habitat changes associated with climate change are not currently considered a threat to Taylor's checkerspot butterfly at the scale of the action area.

Climate change does increase risks to Taylor's checkerspot butterfly from stochastic weather events. The occurrence of extreme weather events is expected to increase and may negatively impact the ability of Taylor's checkerspot butterfly to survive by increasing exposure or sensitivity to extreme weather, or requiring increased adaptive capacity (78 FR 61452:61491 [October 3, 2013]). Only two sites near the action area are currently occupied. Concentrating a significant population in this manner exposes the species to risks from stochastic events such as ice storms or flooding that could kill individuals. A severe weather event could kill a substantial percentage of the species in the action area. The small populations of Taylor's checkerspot butterfly increases the subspecies' vulnerability to stochastic natural events (78 FR 61452:61491 [October 3, 2013]). Because the risk described here is rooted in the random occurrence of extreme conditions, we cannot currently quantify the risk.

Effects of the Action: Taylor's Checkerspot Butterfly

Effects to Taylor's checkerspot butterfly resulting from issuance of the Permit for HCP implementation are associated with loss of potential habitat on development sites and activities associated with the restoration and maintenance of potential habitat on mitigation sites. Due to difficulties quantifying the numbers of individuals of this species that may be affected, this analysis describes effects in terms of habitat area, rather than numbers of affected individuals.

<u>Changes in Habitat Area</u>

Lands proposed for HCP coverage include 13 development sites (203.8 acres) and two mitigation sites (87.5 acres). Both mitigation sites and seven development sites contain host plants for Taylor's checkerspot butterflies at low- to moderate densities. Taylor's checkerspot butterflies are extremely unlikely to occupy any covered lands during the initial implementation of the HCP (years 1-4). Based on the above-described data from CNLM, the development sites contain up to 6.4 acres of suitable habitat (3 percent of the area of development sites) with habitat patches between 0.3 acres and 2.5 acres. Although we do not expect these small, degraded patches of potential habitat to be, or become occupied, the HCP will protect the patches of potential habitat until development begins on each site. Proposed vegetation management will maintain low-stature herbaceous vegetation, emphasizing maintenance of larval host and nectar plants for Taylor's checkerspot butterfly. Habitat maintenance on the development sites will primarily benefit gophers, and it is unlikely that Taylor's checkerspot butterflies will use habitat on the development sites. Even with measures to improve habitat suitability for Taylor's checkerspot butterfly through planting and seeding appropriate native vegetation, the isolated nature of the development sites will permanently limit their functionality for Taylor's checkerspot butterfly. Over the 20-year permit duration, development will destroy or further isolate all 6.4 acres of potential habitat on the development sites.

To mitigate for permanent habitat loss from the development sites, the HCP commits to restore habitat on 8.8 acres of the mitigation sites by the fourth year of HCP implementation. The restoration target will increase to 17 acres by the tenth year of HCP implementation. Successful restoration of south Puget Sound prairies relies on vegetation management to reduce the occurrence of invasive plants, reduce woody plant cover, and reintroduce native prairie forbs (Dunn 1998, entire; Schultz et al 2011, p. 374). Methods for prairie restoration are established and continually refined (Schultz et al 2011, entire), so the HCP has methods to integrate the best available information into management and planning. Through active prairie management, HCP implementation will increase the amount of suitable habitat and reduce habitat fragmentation on the covered lands.

Under the HCP, habitat enhancements will begin immediately and habitat impacts will occur incrementally. The 13-site development plan spans 20 years. Prairie restoration on the mitigation sites will establish 8.8 acres of suitable habitat for the Taylor's checkerspot butterfly by year four, and 17 acres by year 10. The Taylor's checkerspot butterfly is extremely unlikely to occupy the development sites at any time, so the loss of potential habitat from development sites will not result in the loss of individuals. This loss of isolated, degraded, and unoccupied habitat would be insignificant to the current populations of Taylor's checkerspot butterfly adjacent to the action area. The loss of approximately six acres of unoccupied habitat will not result in a loss of any individuals, nor a demographic-level effect on Taylor's checkerspot butterfly in the action area or rangewide.

Management of the mitigation sites under the HCP will promote recovery by addressing the major threat affecting this species: loss of suitable habitat (78 FR 61474). Ongoing prairie management on mitigation sites will prevent ingrowth of trees and shrubs and maintain larval host and nectar sources for Taylor's checkerspot butterfly.

<u>Habitat Restoration and Maintenance</u>

Under the HCP, prairie habitat restoration and maintenance for the benefit of Taylor's checkerspot butterfly will include native seeding or planting as needed to provide oviposition sites, larval food, or nectar sources; mowing to prevent woody plant encroachment; and mechanical treatments on the development sites and both mitigation sites. Although the majority of restoration activities would be performed outside of the flight season and in marginal-quality habitat, individual Taylor's checkerspot butterflies may be present year-round and vulnerable to mowing.

The habitat for Taylor's checkerspot butterflies on seven development sites will be maintained through plantings, mowing and mechanical treatments until development begins at each site. The risk of habitat-management activities injuring individual Taylor's checkerspot butterflies on the development sites is discountable because the likelihood of site occupancy is extremely remote.

As described above (see *Changes in Habitat Area*), the HCP will restore suitable habitat on two mitigation sites by seeding or planting native prairie plants used for oviposition sites, larval food, or nectar sources to improve habitat conditions for the species in the action area. Initial site conditions are degraded in terms of Taylor's checkerspot butterfly habitat.

We expect a net benefit from vegetation treatments on the mitigation sites. Patches of suitable habitat created by planting, seeding, mowing, and mechanical treatments will total 17 acres by year 10. Although these are relatively small habitat patches, the entirety of the mitigation sites will provide the open grassland context that would support Taylor's checkerspot butterfly dispersal. The HCP will contain some Taylor's checkerspot butterfly habitat after year 10; however, larger higher-quality sites outside the action area will likely remain a higher priority for reintroductions of this species.

Between years 10 and 20 of HCP implementation, individual Taylor's checkerspot butterfly from nearby populations are reasonably certain to access and use the covered mitigation sites for dispersal and potentially, reproduction. Because each mitigation site will only have small patches of habitat for Taylor's checkerspot butterfly, it is unlikely that independent populations will establish on the mitigation sites. However, limited occupancy and reproduction are likely to occur on each mitigation site. Therefore, Taylor's checkerspot butterflies occurring at low density on both mitigation sites from years 10 to 20 of HCP implementation will be exposed to vegetation management activities.

The proposed permit will allow maintenance of short-statured grasslands through motorized mowing. Mowing will occur in the late summer, outside of the Taylor's checkerspot butterfly flight season (April 15 to June 15). Mowing is necessary to maintain habitat for other covered species. Habitat maintenance activities will occur where needed to maintain the open grassland condition that all covered species require. Therefore, mowing and mechanical vegetation treatments will be concentrated in areas where woody plants are establishing and where dense non-native grasses dominate, which are habitat conditions that Taylor's checkerspot butterfly does not use. In areas suitable for the species, vegetation stature will already be quite low and dominated by herbaceous plants, reducing the need for mowing. For these reasons, the Applicants are planning to concentrate mowing and mechanical treatments in areas not likely to be occupied by Taylor's checkerspot butterfly, so areas with proper vegetation for Taylor's checkerspot butterfly will not be directly managed in every year. However, we anticipate that mowing may occasionally occur in potentially occupied areas of the mitigation sites because of the difficulty in implementing a mowing regime entirely within thicker vegetation that in patches amid shorter vegetation.

When vegetation management for habitat restoration, including mowing, planting, and seeding occurs in suitable habitat occupied by dispersing individuals, equipment and the associated foot traffic can crush and kill Taylor's checkerspot butterflies. Foot traffic associated with vegetation management other than mowing is likely to adversely affect Taylor's checkerspot butterflies in all life stages because it may occur year-round. Mowing is likely to adversely affect juvenile life stages because it will not occur during the adult flight season. The risk of crushing Taylor's checkerspot butterflies is an unavoidable result of implementing active habitat restoration. From years 10 to 20 of HCP implementation, up to half of the habitat occupied or potentially occupied by Taylor's checkerspot butterfly habitats (8.5 out of 17 acres) will be mowed each year and crushing will occur in occur in a small fraction of the mowed area. An unknown number of Taylor's checkerspot butterfly will be crushed by equipment and foot traffic in a portion of the 8.5 acres of suitable habitat managed annually at the mitigation sites from years 10 to 20 of HCP implementation. The likelihood of injury or death to Taylor's checkerspot butterfly across 8.5 annually is a maximum potential impact because vegetation treatments will primarily occur in areas where habitat quality is already degraded, and it is unlikely that all 8.5 acres would be occupied.

In conclusion, the HCP will promote recovery by addressing a major threat affecting this species: loss of suitable habitat. As Taylor's checkerspot butterfly disperse from nearby occupied sites to, or through, the mitigation sites, habitat maintenance will kill an unknown but small number of Taylor's checkerspot butterflies in all life stages across 8.5 acres of suitable habitat on mitigation sites annually from years 10 to 20 of the proposed action.

Cumulative Effects: Taylor's Checkerspot Butterfly

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

The Service is not aware of any specific future actions that are reasonably certain to occur in the action area. The Service is not aware of any specific future actions that are likely to contribute cumulative effects Taylor's checkerspot butterfly.

Integration and Synthesis of Effects: Taylor's Checkerspot Butterfly

The proposed permit issuance for HCP implementation will result in commercial development of 13 sites and permanent enhancement of two mitigation sites. Seven of the development sites have potential habitat for Taylor's checkerspot butterfly totaling 6.4 acres, though it is all severely degraded in terms of habitat quality and connectivity. The other six development sites have no habitat for the species. Together, the two mitigation sites will provide 8.8 acres of suitable habitat by year four of the permit term and 17 acres by year 10. The most significant effects on Taylor's checkerspot butterfly from HCP implementation will result from vegetation management on mitigation sites. Negative effects of replacing habitat for Taylor's checkerspot butterfly on development sites with habitat on mitigation sites are insignificant, primarily because it is extremely unlikely that any individuals will occupy the development sites now or in the future. Habitat created on the mitigation sites will provide greater benefits to Taylor's checkerspot butterfly productivity compared to the degraded and isolated habitat on the development sites.

Proposed vegetation management will maintain any existing habitat on development sites until development begins on each site. Development will occur incrementally across the 13 sites over 20 years. Vegetation management on the mitigation sites represents a slight enhancement for Taylor's checkerspot butterfly over the baseline condition of covered lands by maintaining a permanent potential dispersal corridor.

Taylor's checkerspot butterfly requires early-seral grasslands with appropriate plant species to support each life history phase. To maintain low-stature grasslands suitable for the species, HCP implementation will manage vegetation on the mitigation sites by planting, seeding, mowing, or other mechanical treatments. However, because the host and nectar plants will occur in relatively small patches on the mitigation sites, we expect only a transitory presence of Taylor's checkerspot butterfly at the mitigation sites as the species occasionally disperses from nearby established populations. The overall effects of vegetation management under the HCP will benefit Taylor's checkerspot butterfly by providing permanent dispersal habitat with some nectaring and reproductive opportunities. The incidental effects of habitat maintenance are reasonably certain to kill an unknown number of Taylor's checkerspot butterflies across a maximum of 8.5 acres of the 17 acres of suitable habitat on mitigation lands annually from years 10 to 20 of HCP implementation.

The above-described effects on Taylor's checkerspot butterfly will result in the loss of some individuals. However, HCP implementation will also result in enhanced Taylor's checkerspot butterfly numbers, distribution, and reproduction. As described above, the adverse effects of mowing will kill individuals in a portion of the suitable habitat created by HCP implementation. However, a significant portion of the individuals present will remain unharmed, including all individuals occupying the 8.5 acres of suitable habitat not directly managed in a given year and the majority of individuals in the habitat that is actively managed in a given year. Habitat management will not directly affect the majority of individuals present in a given year, so those individuals will benefit from the maintenance of suitable habitat. Overall, the HCP will benefit Taylor's checkerspot butterfly by expanding distribution through creation and maintenance of suitable habitat, and contributing habitat for reproduction of the species. Even with the above-described losses of individuals, the HCP will result in small increases in the numbers, distribution, and reproduction of the species.

In conclusion, issuance of a permit for HCP implementation will kill an unknown but likely very small number of Taylor's checkerspot butterfly across 8.5 acres of the 17 acres of suitable habitat on mitigation lands annually from years 10 to 20 of the permit term. These effects are incidental to the enhancement of habitat and will not negatively affect the productivity or the likelihood of persistence of the species in the action area, or at any broader scale of measure for the species. Permit issuance for the HCP will not jeopardize Taylor's checkerspot butterfly. Therefore, Permit issuance for the HCP will not appreciably reduce the likelihood of survival and recovery of Taylor's checkerspot butterfly in the wild.

Conclusion: Taylor's Checkerspot Butterfly

After reviewing the current status of the Taylor's checkerspot butterfly, the environmental baseline for the action area, the effects of the proposed Permit issuance and the cumulative effects, it is the Service's Opinion that the HCP, as proposed, is not likely to jeopardize the continued existence of the Taylor's checkerspot butterfly.

ENVIRONMENTAL BASELINE: OLYMPIA POCKET GOPHER

Current Condition of the Olympia Pocket Gopher in the Action Area

The northern portion of the action area is within the range of the Olympia pocket gopher, including 10 of the 13 development sites and the Deschutes Corridor mitigation site. The largest known population of Olympia pocket gophers is located on and surrounding the Olympia Airport in Bush Prairie (WDFW 2013, p. 30). The action area includes some of the larger unbuilt sites adjacent to the Olympia Airport.

The total population abundance of Olympia pocket gopher is unknown. One of the few available data points is from Witmer et al. (1996, p. 96), who estimated Olympia pocket gopher density at approximately 25 Olympia pocket gophers per acre by live trapping, radiocollaring, and monitoring in the early spring on a site near the Olympia Airport. We expect that the greatest number of individuals is located on, and near, the Olympia Airport because the airport represents the largest intact patch of habitat in the subspecies' range. The species' fossorial habits make population counts extremely difficult on a site-specific or rangewide basis. Olympia pocket gophers located on the airport are a source population for nearby lands.

Other than studies of population density and distribution of Olympia pocket gophers at the Olympia Airport performed in 2005 (McAlister and Schmidt 2005), there is very limited information on pocket gopher density in the action area. Based on the above information, we could estimate that the 2005 density of pocket gophers at the Olympia Airport was approximately 25 individuals per acre. However, this may not be a suitable estimate for 2016, or for other sites near the Olympia Airport. Site conditions (i.e., habitat quality) are relevant to maintaining a density of individuals, but we lack the information to quantify this relationship. Qualitatively, sites where suitable soils remain uncompacted, and herbaceous cover dominates, are where the highest densities of mounds are observed. Throughout the action area, numbers and density likely vary, depending on where the site is located relative to other occupied sites, and how the soil and vegetation are managed. We currently lack a reliable population estimate for the Olympia pocket gopher. However, the Service has determined that large-scale changes in population and habitat status, including local extirpations and range contraction, threaten the Olympia pocket gopher (79 FR 19775).

Olympia pocket gophers remain in their home ranges year round. The average home range size likely varies based on factors such as soil type, climate, and density and type of vegetative cover (Cox and Hunt 1992, p. 133; Case and Jasch 1994, p. B–21; Hafner et al. 1998, p. 279). The best available information describes home ranges for individuals averaging about 1,076 square feet (100 square meters, or 0.02 acre) (Witmer et al. 1996, p. 96), and varying widely in shape, size, and orientation. Home ranges are likely smaller in better quality habitat (Chase et al. 1982; Marsh and Steele 1992), due to better foraging efficiency. Across sites, there is very limited information available on the size and configurations of Olympia pocket gopher home ranges, and there is currently no method to estimate these parameters based on observations of mounds. Therefore, we make no assumptions about home range size or population abundance based on mound presence and density. This further challenges population estimates because mounds are generally the only visible or detectable evidence of activity and/or occupancy.

Olympia pocket gophers are capable of recolonizing sites with suitable soils, adequate forage, and reasonable connectivity to a source population. Juvenile dispersal occurs each year and in each direction from natal sites (unless there are barriers). Dispersal occurs across varied cover types. This dispersal pattern allows for colonization of unoccupied sites, increasing density on occupied sites, and a constantly shifting mosaic of occupied sites. Therefore, we assume that unoccupied sites in the action area will become occupied at some point in time.

Olympia pocket gophers may be particularly sensitive during their reproductive season. Olympia pocket gophers breed from March through July, and young are reared with adults until September (Stinson 2013, p. 14). Most young do not survive to breeding age due to high predation rates. Most depredation of subterranean rodents occurs when they are surface feeding, pushing soil out of burrows, or dispersing (Baker et al. 2003); especially young of the year that are inexperienced at avoiding predators. Throughout the action area, construction activities such as grading, excavation, filling, and paving commonly occur between June and September, when juveniles may be particularly sensitive and/or vulnerable to injury. These activities destroy burrows and feeding tunnels, and they remove, damage, or degrade foraging resources, and have the potential to crush individual gophers. These activities may cause individuals to abandon burrow systems and home ranges, possibly exposing them to predators (e.g., coyotes, raptors, dogs, corvids). When habitat disturbance destroys feeding tunnels and food caches, there is an associated increase in the energetic cost to individuals, and possibly measurable effects to survival and reproduction.

Throughout the action area, threats to Olympia pocket gopher result from habitat loss and fragmentation (development, succession to unsuitable habitat conditions), loss or curtailment of natural disturbance processes that maintain habitat (e.g., fire), operation of heavy equipment, predation, and low genetic diversity (79 FR 19776-19782). The threats combine to result in the loss of a majority of historical habitat, and the loss of access to suitable habitat. Therefore, the status of the Olympia pocket gopher in the action area is consistent with the Federal listing of the subspecies as threatened.

Baseline, by definition, is a "snapshot" of a species' health at a specified point in time. It does not include the effects of the action under review in this consultation. Therefore, the baseline for Olympia pocket gopher reflects our best understanding of the status of the species and its habitat at the time of this writing and the effects of this proposed action will alter that baseline for all future analyses. Impacts of the taking resulting from this proposed action on this species are analyzed relative to the current environmental baseline.

Current Habitat Conditions for the Olympia Pocket Gopher in the Action Area

Sites in the range of the Olympia pocket gopher can provide high quality habitat if they have suitable soils, herbaceous vegetation, undeveloped areas, and a lack of excessive exposure to predators. The action area, particularly in the range of the Olympia pocket gopher, is undergoing rapid urbanization. Ingrowth of industrial, light industrial, and residential land uses have steadily increased and this trend is expected to continue. The result is intensive habitat fragmentation throughout the action area and ongoing habitat loss.

Ten of the 13 development sites are in the range of the Olympia pocket gopher. The sites exhibit varying habitat suitability, mostly varying based on the amount or extent of soil compaction (or other damage), the density and areal extent of woody cover (such as Scot's broom), and the presence of partial or complete barriers to dispersal and migration (e.g., surrounding urban/suburban infrastructure). Scot's broom and other tall vegetation frequently creates a dense overstory that shades understory vegetation, resulting in poor forage conditions (i.e., reduced density and availability of preferred forbs).

Based on Appendix B of the HCP, we expect that the soils on the development sites near the airport are Nisqually Complex soils, and are deep (at least five feet deep), loamy, fertile, friable, and well-drained. They are likely to have a small component of rocks, and to be capable of supporting a diversity of grasses and forbs that provide food for the Olympia pocket gopher (based on McAllister and Schmidt 2005, p. 7).

We expect the population of Olympia pocket gophers at the Olympia Airport serves as a source population. However, habitat conditions around the airport likely limit the success of dispersing juveniles. Immediately off the airport's property, habitat fragmentation is severe. Roadways surrounding the airport present risks from predators and vehicles. Available habitat adjacent to the airport is predominantly in isolated parcels surrounded by an urban context. Paved areas, compacted soils, excavations, and encroaching shrubs and trees degrade the habitat value on most of the remaining unbuilt parcels.

Pocket gophers in the action area use grasslands that largely lack native vegetation, so the urbanized setting is capable of supporting the entire life cycle of individuals. However, with decreasing connectivity between degraded habitats, the condition of habitat in the action area is a significant factor in the threatened status of the subspecies.

Factors Responsible for the Condition of the Olympia Pocket Gopher in the Action Area

As described above, habitat quality, quantity, and connectivity are degraded in the action area. Urban development is a rangewide stressor on the Olympia pocket gopher. Development is particularly concentrated around the airport. Development within the range of the Olympia pocket gopher occurred slowly and in low density since the area was originally settled in the mid 1800's. More recent development trends include rapid infill of remaining open-spaces. Habitat loss threatens the Olympia pocket gopher.

Management at the Olympia Airport maintains conditions that are generally protective of Olympia pocket gophers. The presence of the airport has precluded development over a large portion of Bush Prairie. Regular airport mowing maintains low-statured vegetation to ensure aviation safety, which also provides suitable forage conditions for Olympia pocket gophers. Fencing and active predator control benefits Olympia pocket gophers on the airport and contributes to its function as a source population.

Conservation Role of the Action Area for the Olympia Pocket Gopher

The conservation role of the action area is to provide a sufficient quantity and quality of secure breeding, rearing, and foraging habitat. None of the development or mitigation sites are within designated critical habitat; however, they can contribute to the recovery of the Olympia pocket gopher because they all contain suitable habitat and soils, which are limiting factors for the Olympia pocket gopher. All of the development sites in the range of the Olympia pocket gopher are either currently occupied, or within the dispersal range of occupied sites.

The Olympia Airport likely supports the largest population of Olympia pocket gophers in Washington (Stinson, in litt. 2007; Port of Olympia and WDFW 2008, p.1; Port of Olympia 2012). The areas surrounding the airport provide demographic support to the population at and around the airport. The proposed development sites contribute to the conservation of Olympia pocket gopher because they are currently occupied, or contain suitable soils. All lands proposed for HCP coverage in the range of the Olympia pocket gophers can provide breeding, rearing, and dispersal habitats, and provide demographic support to the rangewide population of the subspecies. The Olympia Airport likely supports more individuals than any other breeding site in the range of this subspecies and we expect that the development sites adjacent to the airport would support similar abundance of gophers if managed similarly.

Protecting and supporting the local population at and around the Olympia Airport is essential to the recovery of the Olympia pocket gopher. Across the range of the Olympia subspecies, most of their suitable habitat has been permanently lost to development, degraded by encroaching woody plants, or become severely fragmented. Therefore, habitat availability is now the primary limiting factor for the subspecies. Numbers of Olympia pocket gophers, though seemingly abundant at the Olympia Airport, are depressed throughout the rest of their range. Because the action area includes the core area of a subspecies with a localized range, the action area includes lands that are important to the survival and recovery of the Olympia pocket gopher. Recovery can be achieved through long-term enhancement and protection of suitable habitat, provided this occurs in a connected matrix allowing for dispersal between patches of suitable habitat. Habitat on the lands proposed for coverage can contribute to this objective, but recovery cannot be achieved on the covered lands alone, nor will the action area contain all lands important to recovery. Therefore, the action area contributes to the lands required for recovery. Covered lands are near and adjacent to the largest intact patch of habitat for the subspecies, but habitat quality varies from marginally suitable to completely degraded. Habitat protection and enhancement in the action area is essential to survival and recovery of the Olympia pocket gopher.

Threats to be Addressed in the Action Area to Ensure Recovery of the Olympia Pocket Gopher

Olympia pocket gophers are currently threatened by habitat loss, primarily caused by development and woody plant encroachment, throughout the range of the subspecies. Fragmentation reduces their ability to disperse to the decreasing and shrinking patches of suitable habitat. Additionally, most sites used by Olympia pocket gophers require some level of management to maintain suitable habitat conditions. The natural disturbance processes that historically maintained grasslands (principally fire) are now suppressed under modern land management practices.

Predation is also a significant ongoing threat, especially from domestic animals associated with residential development and recreation. Predation has a population-level impact on Olympia pocket gophers (79 FR 19781). Urbanization in the action area has increased exposure to feral and domestic cats and dogs, which are known and effective predators.

Domestic cats and dogs are known predators of pocket gophers (Case and Jasch 1994, p. B-21; Henderson 1981, p. 233; Wight 1918, p. 21). At least two pocket gopher locations were located because house cats brought home pocket gopher carcasses (WDFW 2001). Informal interviews with area biologists document multiple incidents of domestic pet predation on pocket gophers (Chan, *in litt.* 2013; Clouse, *in litt.* 2013; Skriletz, *in litt.* 2013; Wood, *in litt.* 2013). There is also one recorded instance of a WDFW biologist being presented with a dead Mazama pocket gopher by a dog during an east Olympia site visit in 2006 (Burke Museum 2012; McAllister, *in litt.* 2013). In the action area, some pocket gophers occur in areas where people recreate with dogs, bringing these potential predators into environments that may otherwise be relatively free of them, consequently increasing the risks to individual pocket gophers and populations that may be small and isolated.

In conclusion, the primary threats to address in the action area to ensure recovery are the loss of habitat and the loss of habitat connectivity. Habitat losses are driven by development but may be reversed by restoring degraded habitat. Once protected from development, suitable habitat in the action area requires management to prevent encroachment by woody plants and to minimize unauthorized land uses.

Climate Change

The Service has assessed climate change as a potential threat to the Olympia pocket gopher along with six other extant Mazama pocket gopher subspecies in Washington State, and has concluded that the threat is not imminent. The Olympia pocket gopher's fossorial lifestyle, and propensity to use well-drained soils, should serve to buffer the subspecies from the most predictable aspects of a changing climate. However, this should not be misconstrued to mean that the Service believes climate change is not a threat in the long term (79 FR 19769). For Mazama pocket gophers, the effects of climate change are likely to be restricted to indirect effects, prompted by changes in vegetative structure, the occurrence of plant invasions, and encroachment. Despite this potential for future environmental change, the Service has not identified any data on an appropriate scale that allows for an evaluation of habitat or population trends, or predictions about whether and how the subspecies will be significantly impacted by climate change (79 FR 19787).

Effects of the Action: Olympia Pocket Gopher

Effects on Olympia pocket gopher resulting from issuance of the Permit for HCP implementation are associated with (1) changes in the amount and quality of suitable habitat, and (2) habitat management activities that cause severe damage or collapse of burrows or nests used by gophers. Due to difficulties quantifying individuals of this species, this analysis describes effects in terms of habitat area (habitat surrogates), rather than numbers of affected individuals.

Effects to the amount, quality, and connectivity of suitable habitat can serve as effective surrogates for effects on Olympia pocket gophers. The dispersal patterns of pocket gophers support natural colonization and re-colonization of suitable habitats where short-distance connectivity to a source population is available (Stinson 2005, pp 26-27). A primary threat to the subspecies is loss of habitat (Stinson 2005, pp 46-48), so analyzing effects of the action on habitat area, quality, and connectivity addresses the species recovery needs.

Changes in the Amount and Quality of Suitable Habitat

Lands proposed for HCP coverage include 10 development sites and one mitigation site in the range of the Olympia pocket gopher. The HCP proposes a building schedule for all development sites dependent on economic and logistic considerations within 20 years. Under the HCP, management of the development sites will maintain the baseline level of suitable habitat for Olympia pocket gopher until commercial development activities begin on each site. Therefore, we assume HCP implementation will result in incremental habitat losses on development sites over 20 years.

The development sites in the range of the Olympia pocket gopher total 169 acres, (reported in the HCP as 168.97 acres). The development sites provide degraded habitat for Olympia pocket gophers. The currently undeveloped areas on these sites appear to have been previously cleared and graded, reducing habitat suitability for Olympia pocket gophers compared to an undisturbed prairie or grassland. The sites include areas with dense woody shrubs or stands of trees, which are less suitable or unsuitable for Olympia pocket gophers (Steinberg 1996, Olson 2011b, Stinson 2013). We assume that habitat degradation or isolation results in lower pocket gopher productivity. The sites also include areas that are currently suitable for pocket gophers and areas that are currently occupied by Olympia pocket gophers. A detailed description of the habitat conditions on each site is provided in the HCP (pp. 48-50). Of the 169 acres on the development sites, 40.3 acres are suitable habitat for Olympia pocket gophers in the environmental baseline. Olympia pocket gophers were confirmed to occupy six development sites and a total of approximately 30.8 acres of suitable habitat, though patterns of occupancy during the 20-year permit term are likely to change on the 10 development sites, and as much as 40.3 acres could become occupied before development begins.

During HCP implementation, we assume that all of the suitable Olympia pocket gopher habitat on the development sites will be degraded, converted to other uses, and lost. When construction is initiated on development sites, all individuals present are likely to be permanently displaced, injured, or killed. The potential to injure or kill individuals will be highest during initial site clearing, grading, and excavation, because these activities involve intensive vehicle traffic and operation of heavy construction equipment, and extend below the ground where burrow systems, nests, and food caches are likely to be severely damaged.

To minimize the effects of habitat loss (i.e., reduced amount and quality of suitable MPG habitat) on productivity of the subspecies, suitable habitat on the development sites will be maintained until development/re-development proceeds, and while restoration of habitat for Olympia pocket gophers proceeds on the Deschutes Corridor mitigation site. This will minimize or avoid any significant temporary decline in suitable and available habitat for Olympia pocket gophers, and minimize short-term negative effects on productivity in the action area.

Habitat enhancement will ensure that the Deschutes Corridor mitigation site is maintained in a grassland condition with less than 10 percent cover of woody vegetation during the first decade of the HCP, and less than five percent woody cover thereafter. The mitigation site includes areas of suitable soils for Olympia pocket gophers with grassland cover, and areas with shrubs or tree cover that the Applicants will restore to a grassland condition. The site is described in detail in the HCP (p. 53 and its appendices A, B, and D). The HCP Conservation Program (beginning on p. 57 of the HCP) provides additional detail about how habitat enhancement on the mitigation site will provide high quality habitat for Olympia pocket gophers. The Service worked closely with the Applicants in developing the information in the HCP, including the site management plans for the mitigation site. The proposed methods for managing and monitoring Olympia pocket gopher habitat should significantly improve quality and function over time.

The mitigation actions on approximately 35.3 acres of Deschutes Corridor, which include management in perpetuity for improved pocket gopher habitat quality, will offset the proposed development impacts in the range of the Olympia pocket gopher. The mitigation actions will provide enhancement and long-term protection on 30.8 acres to offset impacts to an equal area of occupied habitat for Olympia pocket gopher, and on 4.4 acres to offset impacts to suitable habitat that is not currently occupied on the development sites prior to HCP implementation (9.5 acres).

The Applicants may obtain and reserve additional habitat credits for their own future use, or for sale or trade to others with approval from the Service. Approximately 46 acres of Deschutes

Corridor will be managed to the performance standards described in the Deschutes Corridor site management plan (Appendix D of the HCP), leaving 10 acres of available mitigation credit. Management of the mitigation site for these additional credits is considered in this Opinion, but the issuance of an Permit for any impacts to Olympia pocket gophers beyond the 10 identified development sites or Deschutes Corridor is an anticipated future Federal action, so those impacts are not considered here. Therefore, HCP implementation will result in the permanent loss of a maximum of 30.8 acres of currently occupied Olympia pocket gopher habitat and 9.5 acres of additional suitable habitat for the subspecies.

Permit issuance for HCP implementation will result in gradual loss of occupied and unoccupied habitat for Olympia pocket gophers on 40.3 acres of fragmented and degraded habitat concurrent with restoration of a single block of habitat on 46 acres of a 51-acre mitigation site. The mitigation site has greater habitat potential for the Olympia pocket gopher than the smaller development sites because of its larger size and good connectivity to the largest source population in the subspecies range. The mitigation site will provide higher quality forage compared to the development sites. Suitable habitat for the Olympia pocket gopher on the development sites will be capable of supporting individuals for a period (i.e., until development or re-development of the site), but will not support long-term survival and productivity. By contrast, the mitigation site will provide better forage, better connectivity for dispersing juveniles, and a larger contiguous area of high functioning habitat to establish and support a greater number of individuals and territories. For these reasons, Olympia pocket gophers on the restored mitigation site are likely to establish a self-sustaining population, thereby providing a significant long-term and range-wide benefit to the subspecies. By extinguishing the development rights on the mitigation site and managing for persistence of the grassland ecosystem, the HCP will result in long-term protection of habitat with greater potential and productivity for the Olympia pocket gopher than the small, fragmented, and degraded habitats present on the development sites.

Construction activities associated with developing and/or redeveloping sites will significantly disturb, permanently displace, injure, or kill all of the Olympia pocket gophers on the above-described 40.3 acres. We anticipate that most individuals will be displaced when development activities begin. Any individuals that remain on-site will be injured or killed, most likely as the result of severe damage or collapse of burrows and nests by heavy equipment operations. Likewise, displaced individuals will be subject to a significantly increased risk of injury or mortality from predation, vehicles, or an inability to locate suitable habitat nearby. Therefore, habitat loss (i.e., reduced amounts and quality of suitable Mazama pocket gopher habitat) will incrementally injure or kill all Olympia pocket gophers on 40.3 acres of the development sites as each site is developed or re-developed.

Habitat Management

The HCP includes conservation measures to maintain and enhance suitable habitat for Olympia pocket gophers on both the development sites and on one mitigation site. Olympia pocket gophers may occur on the mitigation site at any time during HCP implementation. Increasing numbers of individuals are expected during the first decade of HCP implementation due to improving habitat conditions on the mitigation site and proximity of the site to the source population at the Olympia Airport.

Management activities intended to improve habitat for pocket gophers may injure individual gophers or damage their burrow systems. Damage to burrow systems can represent an increased energetic demand with related decreases in reproductive potential, though we lack specific data to quantify this relationship. Damage to burrows also can force individuals to the surface where predation risks are greater.

While habitat management activities are likely to severely damage and/or collapse some burrows, and thereby injure or kill some individuals, we do not expect that every burrow and every individual will be adversely affected. The pocket gopher's fossorial habit makes it difficult to determine response and outcomes for individuals. In most cases, it will be difficult or impossible to determine whether, and how many, individuals have suffered physical injury or mortality as a result of burrow or nest collapse. Therefore, we instead use a habitat surrogate to describe and quantify the area where Olympia pocket gophers would be present and adversely affected.

Burrows consist of a series of main runways, off which lateral tunnels lead to the surface of the ground (Wight 1918, p. 7). Burrows and tunnel systems are vulnerable to damage. "Feeding tunnels comprise most of the burrow system…most feeding tunnels [are] between 15 and 35 cm [6 and 14 inches] below the surface…[these] shallow tunnels…are easily destroyed by large animals stepping on the surfaces above them" (Vleck 1981, pp. 393-394).

Pocket gophers rely on burrowing, and the maintenance of burrows, as their only means of locating and acquiring seasonal food resources, and locating and interacting with potential mates (Vleck 1979, p. 122; Bandoli 1981, p. 301; Reichman et al 1982, p. 692). Burrowing is energetically "expensive" (Vleck 1979, pp. 122-123, 133). The behavioral traits and characteristics which have been documented in closely related fossorial species (e.g., small home range sizes, repeated use of the same foraging tunnels, aggressive territoriality) demonstrate an adaptive response to resource scarcity and/or the need for rigorous control of energetic demands (Vleck 1979, p. 133; Vleck 1981, p. 391; Kelt and van Vuren 1999, pp. 337, 339). Pocket gopher densities almost certainly reflect a complex set of interactions between habitat quality, resource/food availability, and aspects of social proximity (i.e., mate-searching and territoriality) (Reichman et al. 1982, pp. 687-688, 692; Huntly and Inouye 1988, p. 787; Case and Jasch 1994, p. B-21; Kelt and van Vuren 1999, p. 337, 339).

Mowing and vegetation management for habitat enhancement clearly result in measurable impacts to vegetation and forage resources, and may, in some instances, also result in impacts to soils. However, where effects to pocket gophers and their habitat are concerned, these activities generally result in significant long-term benefits. While these activities do maintain the low-statured, early seral vegetation that pocket gophers rely on, they may, at some locations result in rutting or compaction of soils, damage to shallow foraging tunnels, and/or a measurable temporary reduction of available forage resources.

The Service expects that mowing and vegetation management on the development sites and mitigation site will have significant beneficial effects for Olympia pocket gophers, their habitat, and forage resources. These activities are planned and implemented with site-specific information, and directed at locations where Scot' broom, tall oatgrass, and other noxious and invasive non-native plants dominate. Intact, functioning prairie habitats on the mitigation site will not be subject to frequent management (e.g., woody plant removal). While some individuals may find fewer food resources for a period, pocket gophers store plant material in below-ground food caches and the Service expects that individuals that are temporarily affected will continue to have adequate available food reserves. The Service concludes that mowing and vegetation management, as proposed, will not have measurable adverse effects to forage resources for Olympia pocket gophers.

Damage and destruction of shallow foraging tunnels imposes an energetic cost on affected individuals. Where the occupied habitat is low-quality and supports sparse forage resources, there is a greater potential for measurable effects to individuals. "In less productive environments, a fossorial rodent tunneling a given distance will encounter fewer food resources than it would in more productive areas" (Vleck 1979, p. 133). Several factors are likely to influence the response and outcomes in specific cases, including physical extent (i.e., how much of the individual's home range is affected), site fertility and productivity, and timing and frequency of disturbance. Timing and temporal considerations will be important in most cases, since Mazama pocket gophers store food in caches and exhibit other adaptive responses to natural, seasonal patterns of resource scarcity.

Site-specific soil properties, soil disturbance history, and climatic factors all substantially influence vulnerability to compaction, shrinkage, loss of porosity, and structural destabilization (Rab 2004, p. 337). Fine-grained soils containing substantial clay or silt fractions are particularly vulnerable, especially when wet (Ampoorter et al. 2010, pp. 2, 17). Some findings indicate that relatively coarse-grained gravelly or sandy loams, which are typical of some sites supporting the pocket gophers, are not particularly vulnerable to effects resulting from the operation of mechanized equipment (Wass and Smith 1997, pp. v, 1, 4, 6, 12).

External loads can compress, collapse, and/or destabilize soil profile structure. Studies demonstrate that heavier equipment tends to rut and compact soils (Ampoorter *et al*. 2010, pp. 1-3, 22); more frequently or intensively trafficked areas become more compacted, and/or compacted at greater depth (Ampoorter *et al*. 2010, pp. 1-3, 19); wet soils (in particular, wet, fine-grained soils) are more vulnerable to rutting and compaction than dry soils (Miller et al. 1996, pp. 226-229, 235); and previously disturbed soils are likely more vulnerable to compaction. Available information indicates that Olympia pocket gophers will be affected by damage or destruction of shallow foraging tunnels. Exposure is not discountable ("extremely unlikely") and available information is not sufficient to demonstrate that these exposures will result in insignificant or immeasurable effects.

The Service concludes that mowing and vegetation management will compact, rut, or otherwise physically disturb surface and subsurface soils at some locations. Shallow foraging tunnels will be extensively damaged, imposing a measurable and significant energetic demand on some individuals. However, not all of the mechanized equipment that is likely to be used poses the same risk of extensively damaging soils and foraging tunnels. With consideration for these factors, the Service has reached the following conclusions:

- In most cases, activities conducted with light mowers or ATVs ("three-" or "four-wheelers"; "side-by-sides") will not extensively damage soils or foraging tunnels. If vulnerable soils (e.g., fine-grained Nisqually and Spanaway-Nisqually complex soils) have intensive traffic with light ATVs while soil moisture content is high, this activity may result in damage. When soil moisture content falls within an acceptable range, light ATVs will not cause significant soil rutting, compaction, or other damage regardless of soil type or texture.

- Activities conducted with heavier tractors or tree removal equipment are more likely to extensively damage soils and foraging tunnels:

    - When vulnerable soils (e.g., fine-grained Nisqually and Spanaway-Nisqually complex soils) driven over with heavier tractors or tree removal equipment, extensive damage to foraging tunnels is expected. This damage will significantly disrupt normal behaviors (i.e., the ability to successfully feed, move, and/or shelter) and impose a significant energetic cost on affected individuals. Affected individuals will experience measurable adverse effects to energetics, growth, fitness, or long term survival, creating a likelihood of injury.
    - If vulnerable soils (e.g., fine-grained Nisqually and Spanaway-Nisqually complex soils) are driven over with heavier tractors or tree removal equipment while soil moisture content is high, significant compaction, rutting, and other damage to soil conditions that are important to Olympia pocket gophers (soil properties and suitability) is likely and foreseeable. These impacts will degrade habitat function and may persist for months or years.
    - When less vulnerable and more resilient soils (e.g., coarse-grained Spanaway and Spanaway-Nisqually complex soils) are driven over with heavier tractors or tree removal equipment, extensive damage to foraging tunnels and significant soil compaction and rutting can be avoided. The frequency and intensity of traffic, and soil moisture content, will both influence outcomes.
    - If less vulnerable and more resilient soils (e.g., coarse-grained Spanaway and Spanaway-Nisqually complex soils) are driven over while soil moisture content is high, when soils are saturated, or experiencing freeze-thaw conditions, this activity may result in significant compaction, rutting, and other damage to soil conditions that are important to Olympia pocket gophers (soil properties and suitability).

Soil types and vulnerability to damage vary across the development and mitigation sites.

On development sites, habitat management will likely be limited to mechanical removal and control of nonnative and invasive plant species, generally involving the operation of mowers and other small equipment. The objective on these sites is to maintain existing grassland area until subsequent development or re-development. Less commonly, a heavier tractor or other larger mowing equipment may be used for this purpose.

On the mitigation site, habitat restoration will require heavier tractors and/or tree removal equipment in the first decade of HCP implementation. Restoration activities will result in significant disturbance to soils in areas of degraded habitat that are likely to be occupied in low-density by Olympia pocket gophers. However, despite potential temporary adverse effects, we expect the Olympia pocket gopher numbers will rebound and increase following implementation of restoration activities. Habitat restoration will include heavy equipment operation to clear trees and shrubs from the Deschutes Corridor mitigation site:

- Three times per year on all 46 acres of suitable habitat for Olympia pocket gophers from years one to three of HCP implementation.

- Twice per year on 60 percent of the suitable habitat (27.6 acres) from years four to nine of HCP implementation.

On the mitigation site, habitat maintenance activities will occur after habitat restoration (tree and shrub removal). Most of these activities will employ mowers, ATVs, and other smaller equipment. Equipment capable of rutting, compacting, or damaging soils will be minimized, but may be used based on site-specific conditions over time. This will be rare in “high-quality” habitat that is more likely to be densely occupied by Olympia pocket gophers.

The above-described activities will restore and maintain 46 acres of low-statured vegetation or bare ground will require minimal management in a given year, so that impacts from habitat maintenance activities are not anticipated across every acre in every year. Habitat maintenance will occur on the development and mitigation sites, concentrated in areas where new trees, shrubs, or other non-target vegetation could reduce the localized productivity of Olympia pocket gophers. This means habitat maintenance will occur primarily in areas with low numbers of Olympia pocket gophers. Even with annual maintenance, only a small portion of the individuals present on the mitigation site will be exposed to equipment operation. As described in the foregoing effects analyses, we anticipate that high-functioning grassland habitat will be subject to maintenance activities every other year, while the remainder of the site will be subject to annual mowing or mechanical treatments. Based on HCP performance targets for vegetation conditions, equipment operation for habitat maintenance will injure or kill Olympia pocket gophers on a small portion of the:

- Development sites: 40.3 acres of suitable habitat annually until each site is developed, ranging from one to 20 years per site.

- Deschutes Corridor Mitigation site:

    - 9.2 acres of suitable habitat annually from years one to three of HCP implementation.

- 18.4 acres of suitable habitat annually from years four through nine of HCP implementation.
- 46 acres of suitable habitat annually from years 10 to 20 of HCP implementation.

The net effect of habitat management and maintenance activities will provide significant long-term benefits for Olympia pocket gophers.

Cumulative Effects: Olympia Pocket Gopher

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

The Service is not aware of any specific future actions that are reasonably certain to occur in the action area. The Service is not aware of any specific future actions that are likely to contribute to cumulative effects on Olympia pocket gophers.

Integration and Synthesis of Effects: Olympia Pocket Gopher

In the range of the Olympia pocket gopher, the proposed permit issuance for HCP implementation will result in commercial development or re-development of 169 acres across the proposed development sites, and permanent enhancement of the 51.3-acre Deschutes Corridor mitigation site. The development sites include 40.3 acres of potential habitat for Olympia pocket gophers, all of which may directly support Olympia pocket gophers at any time before development begins. Each development site is degraded in terms of habitat quality and connectivity, and some sites are severely degraded by compaction or woody plant encroachment. Approximately 30 acres of the development sites, with moderately-degraded habitat, are occupied by Olympia pocket gophers prior to HCP implementation.

The mitigation site will provide 46 acres of suitable Mazama pocket gopher habitat by the end of the first decade of the permit term, in the form of a single large patch of high-quality grassland with good connectivity to the largest source population of Olympia pocket gophers. We anticipate that the fragmented and degraded development sites serve, at best, as moderately productive habitat for Olympia pocket gophers. The larger contiguous patch of enhanced habitat on the Deschutes Corridor mitigation site, once restored to “high” and “medium” quality grassland conditions, will serve as a highly productive site for Olympia pocket gophers.

The adverse effects on Olympia pocket gophers from HCP implementation will result from vegetation management on all covered lands, and development of covered lands.

Construction activities on the development sites will fill, grade, and otherwise destroy soil conditions that are important to Olympia pocket gophers on the development sites. When construction begins, all individuals present on the development sites will be permanently displaced, injured, or killed. Over the period of twenty years, habitat losses will occur in 10 increments as each site is developed, ranging from 0.1 to 16 acres of habitat loss at any one time. *Construction activities associated with developing and/or redeveloping sites will significantly disturb, permanently displace, injure, or kill all of the Olympia pocket gophers, including all life history stages, on the 40.3 acres of suitable habitat on development sites incrementally, as each site is built, over 20 years.*

Because we anticipate the Olympia pocket gopher on the development sites has low long-term productivity and resilience, it is extremely unlikely that the habitat losses on these sites will amount to a measurable demographic effect for the subspecies. In fact, we expect that HCP implementation will have a positive demographic effect for the Olympia pocket gopher because of increased productivity and resilience as a result of perpetual management for higher-quality habitat on the mitigation site.

Although the net effect of HCP implementation is positive for Olympia pocket gophers, the Service expects that habitat management on the development sites and the Deschutes Corridor mitigation site will cause moderate to severe damage to soils and/or forage resources in some instances, and will have measurable adverse effects to all life stages of Olympia pocket gopher occupying portions of the site as follows:

- *Habitat restoration on the Deschutes Corridor mitigation site will include heavy equipment operation that will injure or kill a small portion of the Olympia pocket gophers:*
    - *Three times per year on all 46 acres of suitable habitat from years one to three of HCP implementation.*
    - *Twice per year on 60 percent of the suitable habitat (27.6 acres) from years four to nine of HCP implementation.*
- *Habitat maintenance on the Deschutes Corridor mitigation site will include heavy equipment operation that will injure or kill a small portion of the Olympia pocket gophers in:*
    - *9.2 acres of suitable habitat annually from years one to three of HCP implementation.*
    - *18.4 acres of suitable habitat annually from years four through nine of HCP implementation.*
    - *46 acres of suitable habitat annually from years 10 to 20 of HCP implementation.*
- *Habitat maintenance on the Deschutes Corridor mitigation site will include heavy equipment operation that will injure or kill a small portion of the Olympia pocket gophers in 40.3 acres of Olympia pocket gopher habitat on 10 development sites until each site is developed, ranging from one to 20 years.*

The effect of Permit issuance for HCP implementation on Olympia pocket gophers, summarized above, will be to replace degraded habitat threatened by development with high quality habitat protected from development in perpetuity. Some individuals will be permanently displaced, injured, or killed by construction activities associated with development or re-development. Habitat restoration and maintenance activities may also disturb the normal behaviors of some individuals. The HCP will enhance the subspecies' rangewide productivity and resilience, fully mitigating for the anticipated adverse effects on the subspecies. Habitat lost from development sites has inherently low productivity. By contrast, the larger area of intact habitat on the mitigation site and its connectivity to a source population will impart significant short-term and long-term benefits for the subspecies by improving the numbers and distribution of the Olympia pocket gopher. The long-term stability of habitat on the mitigation site will also support ongoing reproduction of Olympia pocket gopher, whereas the fragmented and degraded development sites provide for irregular occupancy and unreliable reproduction. As a result, HCP implementation will enhance productivity of Olympia pocket gophers in the action area. Therefore, HCP implementation will not appreciably reduce the likelihood of survival and recovery of the species in the wild.

Conclusion: Olympia pocket gopher

After reviewing the current status of the Olympia pocket gopher, the environmental baseline for the action area, the effects of the proposed Permit issuance, and the foreseeable cumulative effects, it is the Service's Opinion that the HCP, as proposed, is not likely to jeopardize the continued existence of the Olympia pocket gopher. Critical habitat for this subspecies has been designated outside the action area (79 FR 19712-19757). This action does not affect those areas and no destruction or adverse modification of designated critical habitat is anticipated.

ENVIRONMENTAL BASELINE: YELM POCKET GOPHER

Baseline, by definition, is a "snapshot" of a species' health at a specified point in time. It does not include the effects of the action under review in this consultation. Therefore, the baseline for Yelm pocket gopher reflects our best understanding of the status of the species and its habitat at the time of this writing and the effects of this proposed action will alter that baseline for all future analyses. Impacts of the taking resulting from this proposed action on this species are analyzed relative to the current environmental baseline.

Current Condition of the Yelm Pocket Gopher in the Action Area

The southern portion of the action area is in the range of the Yelm pocket gopher, including three development sites and the Leitner Prairie mitigation site. Yelm pocket gophers are known to occur in a number of locations near the covered lands, including monitored areas at Scatter Creek Wildlife Area (west of Interstate-5), Rock Prairie southwest of Tenino, and Tenalquot Prairie to the northeast.

There are few data on historical or current population sizes of the Yelm pocket gopher. The total abundance of Yelm pocket gophers is not known, but an overall decline in habitat availability was a primary factor in the Service's determination that the subspecies is threatened (79 FR 19775). Throughout the action area, the number and density of Yelm pocket gophers likely varies depending on where the site is located relative to other occupied sites, and how the soil and vegetation are managed. We currently lack a reliable population estimate for the Yelm pocket gophers. However, the Service previously determined that large-scale changes in population and habitat status, including local extirpations and range contraction, threaten the Yelm pocket gophers (79 FR 19775).

Yelm pocket gophers remain in their home ranges year round. Because there is very limited information available on Yelm pocket gopher density and home range, we cannot estimate the number of Yelm pocket gophers per acre. Yelm pocket gophers are capable of recolonizing sites with suitable soils, adequate forage, and reasonable connectivity to a source population. Juvenile dispersal occurs each year and in each direction from natal sites (unless there are barriers). Dispersal occurs across varied cover types. This dispersal pattern allows for colonization of unoccupied sites, increasing density on occupied sites, and a constantly shifting mosaic of occupied sites. Therefore, we assume that unoccupied sites in the action area will become occupied at some point in time.

Yelm pocket gophers may be particularly sensitive during their reproductive season. Yelm pocket gophers breed from March through July, and young are reared with adults until September (Stinson 2013, p. 14). Most young do not survive to breeding age due to high predation rates. Most depredation of subterranean rodents occurs when they are surface feeding, pushing soil out of burrows, or dispersing (Baker et al. 2003); especially young of the year that are inexperienced at avoiding predators. Throughout the action area, construction activities such as grading, excavation, filling, and paving commonly occur between June and September, when juveniles may be particularly sensitive and/or vulnerable to injury. These activities destroy burrows and feeding tunnels, and they remove, damage, or degrade foraging resources, and have the potential to crush individual gophers. These activities may cause individuals to abandon burrow systems and home ranges, possibly exposing them to predators (e.g., coyotes, raptors, dogs, corvids). When habitat disturbance destroys feeding tunnels and food caches, there is an associated increase in the energetic cost to individuals, and possibly measurable effects to survival and reproduction.

Throughout the action area, threats to Yelm pocket gophers result from habitat loss and fragmentation (development; succession to unsuitable habitat conditions), loss or curtailment of natural disturbance processes that maintain habitat (e.g., fire), operation of heavy equipment, predation, and low genetic diversity(79 FR 19776-19782). The threats combine to result in the loss of a majority of historical habitat, and the loss of access to suitable habitat. Therefore, the status of the Yelm pocket gopher in the action area is consistent with the Federal listing of the subspecies as threatened.

Current Habitat Conditions for the Yelm Pocket Gopher in the Action Area

Sites in the range of the Yelm pocket gopher can provide high quality habitat if they have suitable soils, herbaceous vegetation, undeveloped areas, and a lack of excessive exposure to predators. The action area is undergoing rapid urbanization. Industrial, light industrial, and residential land uses have steadily increased and this trend is expected to continue. The result is intensive habitat fragmentation throughout the action area and ongoing habitat loss.

Three of the development sites are in the range of the Yelm pocket gopher. The sites exhibit varying habitat suitability, based on the amount or extent of soil compaction (or other damage), the density and areal extent of woody cover (such as Scot's broom), and the presence of partial or complete barriers to dispersal and migration (e.g., surrounding urban/suburban infrastructure). Scot's broom and other tall vegetation frequently creates a dense overstory that shades out understory vegetation, resulting in poor forage conditions (ie., reduced density and availability of preferred forbs).

Based on Appendix B of the HCP, we expect that the soils on the development sites in the action area are Spanaway-type soils, and are sandy, and well-drained. They are likely to have a gravel component and to be capable of supporting a diversity of grasses and forbs that provide food for the Yelm pocket gopher.

We expect the population of Yelm pocket gophers in the action area is capable of serving as a source population. However, habitat conditions around the covered lands are likely to impose some challenges to dispersing juveniles. Immediately off covered lands, roadways and incompatible land-uses fragment habitat. Habitat adjacent to the covered lands is predominantly in isolated parcels amid mixed commercial, residential, agriculture, and open-space. Paved areas, compacted soils, excavations, and encroaching shrubs and trees degrade the habitat value on most of the remaining unbuilt parcels.

Pocket gophers in the action area use grasslands that largely lack native vegetation, so the increasingly developed setting is capable of supporting the entire life cycle of individuals. However, with decreasing connectivity between degraded habitats, the condition of habitat in the action is a significant factor in the threatened status of the subspecies.

Factors Responsible for the Condition of the Yelm Pocket Gopher in the Action Area

As described above, habitat quality, quantity, and connectivity are degraded in the action area. The Scatter Creek Wildlife Area and Rock Prairie have the highest quality intact patches of habitat for the subspecies near the action area. Increasing commercial and residential development is a rangewide stressor on the Yelm pocket gopher. Development is particularly concentrated around the interstate highway, which bisects the historical prairies in the subspecies' range. Development within the range of the Yelm pocket gopher occurred slowly and in low density since the area was originally settled in the mid 1800's. More recent development trends include rapid infill of remaining open-spaces. Habitat loss threatens the Yelm pocket gopher.

Management of Scatter Creek Wildlife Area and, on large portions of Rock Prairie, maintains conditions that support Yelm pocket gophers. The presence of the state-owned Wildlife Area has precluded development of a single large piece of land important to the subspecies. Vegetation management is implemented on these areas, as funding allows, to reduce the encroachment of woody vegetation. Ranching on Rock Prairie has maintained low-statured grasses and prevented woody encroachment.

Conservation Role of the Action Area for the Yelm Pocket Gopher

The conservation role of the action area is to provide a sufficient quantity and quality of secure breeding, rearing, and foraging habitat. None of the development or mitigation sites are within designated critical habitat; however, they contribute to the recovery of the Yelm pocket gopher because they contain suitable habitat and soils, which are limiting factors for Yelm pocket gophers. Each of the development properties in the range of the Yelm pocket gopher are either occupied by Yelm pocket gophers, or are within the dispersal range of occupied sites.

Some agricultural lands in Rock Prairie and the Scatter Creek Natural Area likely support the largest populations of Yelm pocket gophers near the action area. The areas surrounding Scatter Creek and Rock Prairie provide demographic support to those populations. The proposed development sites contribute to the conservation of Yelm pocket gopher because they are currently occupied, or contain suitable soils. All lands proposed for HCP coverage in the range of the Yelm pocket gopher can provide breeding, rearing, and dispersal habitats, and provide demographic support to the rangewide population of the subspecies.

Protecting and supporting the Yelm pocket gopher, especially near the Scatter Creek Natural Area and Rock Prairie is essential to its recovery. Much of their habitat was lost to development, degraded by encroaching woody plants, or is severely fragmented. Therefore, habitat availability is now the primary limiting factor for the subspecies. The Yelm pocket gopher, though seemingly abundant at a few locations, is depressed throughout the rest of its range. Because the action area includes occupied areas and suitable habitat in the dispersal range of the subspecies, the action area includes lands that are important to the survival and recovery of the Yelm pocket gopher. Recovery can be achieved through long-term enhancement and protection of suitable habitat, provided this occurs in a connected matrix allowing for dispersal between patches of suitable habitat. Habitat on the lands proposed for coverage can contribute to this objective, but recovery cannot be achieved on the covered lands alone, nor will the action area contain all lands important to recovery. Therefore, the action area contributes to the lands required for recovery. Covered lands are near and adjacent to significant intact patches of habitat for the subspecies, but habitat quality varies marginally suitable to completely degraded. Habitat protection and enhancement in the action area is essential to survival and recovery of the Yelm pocket gopher.

Threats to be Addressed in the Action Area to Ensure Recovery of the Yelm Pocket Gopher

Yelm pocket gophers are currently threatened by habitat loss, primarily caused by development and woody plant encroachment, throughout the range of the subspecies. Fragmentation reduces their ability to disperse to the decreasing and shrinking patches of suitable habitat. Additionally, most sites used by Yelm pocket gophers require some level of management to maintain suitable habitat conditions. The natural disturbance processes that historically maintained grasslands (principally fire) are now suppressed under modern land management practices.

Predation is also a significant ongoing threat, especially from domestic animals associated with residential development and recreation. Predation has a population-level impact on Yelm pocket gophers (79 FR 19781). Residential development in the action area has increased exposure of gophers to feral and domestic cats and dogs, which are known and effective predators.

Domestic cats and dogs are known predators of pocket gophers (Case and Jasch 1994, p. B-21; Henderson 1981, p. 233; Wight 1918, p. 21). At least two pocket gopher locations were located because house cats brought home pocket gopher carcasses (WDFW 2001). Informal interviews with area biologists document multiple incidents of domestic pet predation on pocket gophers (Chan, *in litt.* 2013; Clouse, *in litt.* 2013; Skriletz, *in litt.* 2013; Wood, *in litt.* 2013). There is also one recorded instance of a WDFW biologist being presented with a dead Mazama pocket gopher by a dog during an east Olympia site visit in 2006 (Burke Museum 2012; McAllister, *in litt.* 2013). In the action area, some pocket gophers occur in areas where people recreate with dogs, bringing these potential predators into environments that may otherwise be relatively free of them, consequently increasing the risks to individual pocket gophers and populations that may be small and isolated.

In conclusion, the primary threats to address in the action area to ensure recovery are the loss of habitat and the loss of habitat connectivity. Habitat losses are driven by development but may be reversed by restoring degraded habitat. Once protected from development, suitable habitat in the action area requires management to prevent encroachment by woody plants and to minimize unauthorized land uses.

Climate Change

The Service has assessed climate change as a potential threat to the Yelm pocket gopher along with six other extant Mazama pocket gopher subspecies in Washington State, and has concluded that the threat is not imminent. The Yelm pocket gopher's fossorial lifestyle, and propensity to use well-drained soils, should serve to buffer the subspecies from the most predictable aspects of a changing climate. However, this should not be misconstrued to mean that the Service believes climate change is not a threat in the long term (79 FR 19769). For Mazama pocket gophers, the effects of climate change are likely to be restricted to indirect effects, prompted by changes in vegetative structure, the occurrence of plant invasions, and encroachment. Despite this potential for future environmental change, the Service has not identified any data on an appropriate scale that allows for an evaluation of habitat or population trends, or predictions about whether and how the subspecies will be significantly impacted by climate change (79 FR 19787).

Effects of the Action: Yelm Pocket Gopher

Effects to Yelm pocket gopher resulting from issuance of the Permit for HCP implementation are associated with (1) loss of habitat on development sites and restoration of habitat on mitigation sites, and (2) habitat management activities that may cause severe damage or collapse of burrows or nests used by gophers. Due to difficulties quantifying individuals of this species, this analysis describes effects in terms of habitat area, rather than numbers of affected individuals.

Effects to the amount, quality, and connectivity of suitable habitat can serve as effective surrogates for effects on Yelm pocket gophers. The dispersal patterns of pocket gophers support natural colonization of suitable habitat where short-distance connectivity to a source population is available (Stinson 2005, pp 26-27). A primary threat to the subspecies is loss of habitat (Stinson 2005, pp 46-48), so analyzing effects of the action on habitat area, quality, and connectivity addresses the species recovery needs.

Changes in the Amount and Quality of Suitable Habitat

Lands proposed for HCP coverage include three development sites and one mitigation site in the range of the Yelm pocket gopher. The HCP proposes a building schedule for all development sites dependent on economic and logistic considerations within 20 years. Under the HCP, management of the development sites will maintain the baseline level of suitable habitat for Yelm pocket gopher until commercial development activities begin on each site. Therefore, we assume HCP implementation will result in incremental habitat losses on development sites over 20 years.

The development sites in the range of the Yelm pocket gopher total 34.9 acres (reported in the HCP as 34.86 acres). The development sites provided degraded habitat for Yelm pocket gophers. The currently undeveloped areas on these sites appear to have been previously cleared and graded, reducing habitat suitability for Yelm pocket gophers compared to an undisturbed prairie or grassland. The sites include areas that are currently suitable for pocket gophers and areas that are currently occupied by Yelm pocket gophers. A detailed description of the habitat conditions on each site is provided in the HCP (pp. 54-55). Of the 34.9 acres on the development sites, 27.7 acres are suitable habitat for Yelm pocket gophers in the environmental baseline. Yelm pocket gophers were confirmed to occupy one development site and a total of approximately 16.7 acres of suitable habitat, though patterns of occupancy during the 20-year permit term are likely to change on the three development sites, and as much as 27.7 acres could become occupied before development begins.

During HCP implementation, we assume that all of the suitable Yelm pocket gopher habitat on the development sites will be lost (27.7 acres). When construction is initiated on development sites, all individual gophers present will be degraded, converted to other uses, and lost. The potential to injure or kill individuals will be highest during initial site clearing, grading, and excavation, because these activities involve intense vehicle traffic and operation of heavy equipment, and extend below the ground where burrow systems, nests, and food caches are likely to be severely damaged.

To minimize the effects of habitat loss (i.e., reduced amount and quality of suitable Yelm pocket gopher habitat) on productivity of the subspecies, suitable habitat on development sites will be maintained until development/re-development proceeds, and while restoration of habitat for Yelm pocket gophers proceeds on the Leitner Prairie mitigation site (36.2 acres). This will minimize or avoid any significant temporary decline in suitable and available habitat for Yelm pocket gophers, and minimize short-term negative effects on productivity in the action area.

Habitat enhancement will ensure that the Leitner Prairie mitigation site is maintained in a grassland condition with less than 10 percent cover of woody vegetation during the first decade of the HCP, and less than five percent woody cover thereafter. The mitigation site was recently converted back to grassland from a dense shrub cover. The mitigation site requires ongoing management to prevent shrubs and trees from encroaching on the grassland again. The site is described in detail in the HCP (p. 56 and its appendices A, B, and C). The HCP Conservation Program (beginning on p. 57 of the HCP) provides additional detail about how habitat enhancement on the mitigation site will provide high quality habitat for Yelm pocket gophers.

The Service worked closely with the Applicants in developing the information in the HCP, including the site management plan for the mitigation site. The proposed methods for managing and monitoring Yelm pocket gopher habitat will significantly improve quality and function over time.

The mitigation actions on approximately 22.1 acres of Leitner Prairie, which include management in perpetuity for improved pocket gopher habitat quality, will offset the mitigation needs of the development sites in the range of the Yelm pocket gopher. The mitigation actions will provide enhancement and long-term protection on 16.7 acres to offset impacts to an equal area of occupied habitat for Yelm pocket gopher, and on 5.5 acres to offset impacts to suitable habitat that is not currently occupied on the development sites prior to HCP implementation (10.9 acres).

The Applicants may obtain and reserve additional habitat credits for their own future use or for sale or trade to others with approval of the Service. Approximately 36.2 acres of Leitner Prairie will be managed to the performance standards described in the Leitner Prairie site management plan (appendix C of the HCP), leaving 14 acres of available mitigation credit. Management of the mitigation site for these additional credits is considered in this Opinion, but the issuance of an Permit for any impacts to Yelm pocket gophers beyond the three identified development sites or Leitner Prairie is anticipated to be a future Federal action, so that impact is not considered here. Therefore, HCP implementation will result in the permanent loss of a maximum of 16.7 acres of currently occupied Yelm pocket gopher habitat and 10.9 acres of additional suitable habitat for the subspecies.

Permit issuance for HCP implementation will result in gradual loss of occupied and unoccupied habitat for Yelm pocket gophers over 27.7 acres of fragmented and degraded habitat concurrent with restoration of a single block of habitat on 36.2 acres of a 35-acre mitigation site. The mitigation site has greater habitat potential for the Yelm pocket gopher than the smaller development sites because of its larger size, and good connectivity to a source population in the subspecies range. The mitigation site will provide higher quality forage compared to the development sites. Suitable habitat for the Yelm pocket gopher on the development sites will be capable of supporting individual gophers for a period (i.e., until development or re-development of the site), but will not support long-term survival and productivity. By contrast, the mitigation site will provide better forage, better connectivity for dispersing juveniles, and a larger contiguous area of high functioning pocket gopher habitat to establish and support a greater number of individuals and territories. For these reasons, Yelm pocket gophers on the restored mitigation site are likely to establish a self-sustaining population, thereby providing a significant long-term and range-wide benefit to the subspecies. By extinguishing the development rights on the mitigation site and managing for persistence of the grassland ecosystem, the HCP will result in long-term protection of habitat with greater potential and productivity for Yelm pocket gopher than the small, fragmented, and degraded habitats present on the development sites.

Construction activities associated with developing and/or redeveloping sties will significantly disturb, permanently displace, injure, or kill all of the Yelm pocket gophers on the above-described 27.7 acres. We anticipate that most individuals will be displaced when development activities begin. Any individuals that remain on-site will be injured or killed, most likely as the result of severe damage or collapse of burrows and nests by heavy equipment operations. Likewise, displaced individuals will be subject to a significantly increased risk of injury or mortality from predation, vehicles, or inability to locate suitable habitat nearby. Therefore, habitat loss (i.e., reduced amounts and quality of suitable habitat) will incrementally injure or kill all Yelm pocket gophers on 27.7 acres of development sites as each site is developed or re-developed.

Habitat Management

The HCP includes conservation measures to maintain and enhance suitable habitat for Yelm pocket gophers on both the development sites and on the mitigation site. Yelm pocket gophers may occur on the mitigation site at any time during HCP implementation. Increasing numbers of individuals are expected during the first decade of HCP implementation due to improving habitat conditions on the mitigation site.

Management activities intended to improve habitat for pocket gophers, such as mowing, planting, tree and shrub removal, human traffic, and equipment operation, may injure individuals or damage their burrow systems. As described above for the Olympia pocket gopher, the Yelm pocket gopher shares the same fossorial and foraging habits. Therefore, the actions required for habitat management and the effects of those actions are the same as described above. Although most tree removal from Leitner Prairie is already complete, preventing recurrence of the intense shrub growth may necessitate a similar management intensity as described above for Deschutes Corridor.

In consideration of the above analysis for Olympia pocket gophers and its applicability to the Yelm pocket gopher, the Service expects that the net effect of habitat management will be to restore and maintain 36.2 acres of suitable habitat for Yelm pocket gophers. However, to achieve net benefits, the unavoidable effects of equipment operation will injure individual gophers or damage their burrow systems. Damage to burrow systems can represent increased energetic demand with related decreases in reproductive potential. Damage to burrows also can force individuals to the surface where predation risks are greater. Based on HCP performance targets for vegetation conditions, equipment operation for habitat maintenance will injure or kill Yelm pocket gophers on a small portion of the:

- 27.7 acres of Yelm pocket gopher habitat on three development sites during habitat maintenance activities until each site is developed, ranging from one to 20 years per site.

- 36.2 acres of Yelm pocket gopher habitat on the Leitner Prairie mitigation site during habitat maintenance activities from years one to 20 of HCP implementation.

Cumulative Effects: Yelm Pocket Gopher

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

The Service is not aware of any specific future actions that are reasonably certain to occur in the action area. The Service is not aware of any specific future actions that are likely to contribute to cumulative effects on Yelm pocket gophers.

Integration and Synthesis of Effects: Yelm Pocket Gopher

In the range of the Yelm pocket gopher, the proposed permit issuance for HCP implementation will result in commercial development or re-development of 34.9 acres across the proposed development sites, and permanent enhancement of the 36.2-acre Leitner Prairie mitigation site. The development sites include 27.7 acres of potential habitat for Yelm pocket gophers, all of which may directly support Yelm pocket gophers at any time before development begins. Each development site is degraded in terms of habitat quality and connectivity, and some sites are severely degraded by compaction or woody plant encroachment. Approximately 20.7 acres of the development sites, with moderately-degraded habitat, are occupied by Yelm pocket gophers prior to HCP implementation.

The mitigation site will provide 36.2 acres of suitable Yelm pocket gopher habitat by the end of the first decade of the permit term, in the form of a single large patch of high-quality grassland with current occupancy by Yelm pocket gophers. We anticipate that the fragmented and degraded development sites serve, at best, as moderately productive habitat for Yelm pocket gophers. The larger contiguous patch of enhanced habitat on the Leitner Prairie mitigation site, as maintained under HCP conservation measures, will serve as a highly productive site for Yelm pocket gophers.

The adverse effects on Yelm pocket gophers from HCP implementation will result from vegetation management on all covered lands, and development of covered lands.

Construction activities will fill, grade, and otherwise destroy soil conditions that are important to Yelm pocket gophers on the development sites. When construction begins, all individuals present on the development sites will be permanently displaced, injured, or killed. Over the period of twenty years, habitat losses will occur in three increments as each site is developed, ranging from 3.2 to 16.7 acres of habitat loss at any one time. *Construction activities associated with developing and/or redeveloping sites will significantly disturb, permanently displace, injure, or kill all of the Yelm pocket gophers, including all life history stages, on the 27.7 acres of suitable habitat on development sites incrementally, as each site is built, over 20 years.*

Because we anticipate the Yelm pocket gopher on the development sites has low long-term productivity and resilience to disturbance, it is extremely unlikely that the losses on these sites will amount to a measurable demographic effect for the subspecies. In fact, we expect that HCP implementation, over the long-term, will have a positive demographic effect for the Yelm pocket gopher because of increased productivity and resilience resulting from management for higher-quality habitat on the mitigation site.

Although the net effect of HCP habitat management is positive for Yelm pocket gophers, the Service expects that habitat management on the development sites and the Leitner Prairie mitigation site will cause moderate to severe damage to soils and/or forage resources in some instances, and will have measurable adverse effects to all life stages of Yelm pocket gopher occupying portions of the site as follows:

- 27.7 acres of Yelm pocket gopher habitat on three development sites during habitat maintenance activities until each site is developed, ranging from one to 20 years per site.

- 36.2 acres of Yelm pocket gopher habitat on the Leitner Prairie mitigation site during habitat maintenance activities from years one to 20 of HCP implementation.

The effect of Permit issuance for HCP implementation on Yelm pocket gophers, summarized above, will be to replace degraded habitat threatened by development with high quality habitat protected from development in perpetuity. Some individuals will be permanently displaced, injured, or killed by construction activities associated with development or re-development. Habitat maintenance activities may also disturb the normal behaviors of some individuals. The HCP will enhance the subspecies' rangewide productivity and resilience, fully mitigating for the anticipated adverse effects on the subspecies. Habitat lost from development sites has inherently low productivity. By contrast, habitat enhancement on the larger mitigation site with an existing source population will impart significant short-term and long-term benefits for the subspecies by improving the reproduction and numbers of Yelm pocket gopher. Increased productivity from habitat enhancement on Leitner Prairie will also result in improved distribution of the subspecies because it will increase the numbers of dispersing juveniles each year and the mitigation site has better connectivity to other suitable habitat than do the mitigation sites. The long-term stability of habitat on the mitigation site will also support ongoing reproduction of Yelm pocket gopher, whereas the fragmented and degraded development sites provide for irregular occupancy and unreliable reproduction. As a result, HCP implementation will enhance productivity of Yelm pocket gophers in the action area. Therefore, HCP implementation will not appreciably reduce the likelihood of survival and recovery of the species in the wild.

Conclusion: Yelm pocket gopher

After reviewing the current status of the Yelm pocket gopher, the environmental baseline for the action area, the effects of the proposed Permit issuance and the cumulative effects, it is the Service's Opinion that the HCP, as proposed, is not likely to jeopardize the continued existence of the Yelm pocket gopher. Critical habitat for this species has been designated at outside the action area (79 FR 19712-19757). This action does not affect that area and no destruction or adverse modification of that critical habitat is anticipated.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. *Harm* is defined by the Service as an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering (50 CFR 17.3). *Harass* is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The proposed Kaufman HCP and its associated documents clearly identify anticipated impacts to affected species likely to result from the proposed taking and the measures that are necessary and appropriate to minimize those impacts. All conservation measures described in the proposed HCP, together with the terms and conditions described in any associated Implementing Agreement and any section 10(a)(1)(B) permit or permits issued with respect to the proposed HCP, are hereby incorporated by reference as reasonable and prudent measures and terms and conditions within this Incidental Take Statement pursuant to 50 CFR §402.14(i). Such terms and conditions are non-discretionary and must be undertaken for the exemptions under section 10(a)(1)(B) and section 7(o)(2) of the ESA to apply. If the permittee fails to adhere to these terms and conditions, the protective coverage of the section 10(a)(1)(B) permit and section 7(o)(2) may lapse. The amount or extent of incidental take anticpated under the proposed Kaufman HCP, associated reporting requirements, and provisions for disposition of dead or injured animals are as described in the HCP and its accompanying section 10(a)(1)(B) permit.

AMOUNT OR EXTENT OF TAKE

Streaked Horned Lark

The Service anticipates take, in the form of harm, of streaked horned larks exposed to mowing or other vegetation management. During the 20-year permit term, vegetation management on the covered lands will:

- Disturb or destroy a maximum total of one streaked horned lark nest, including associated individuals: one adult pair and three eggs or chicks once between years four through 20 of HCP implementation.

- Injure or kill a maximum total of three adult streaked horned larks foraging on the covered lands, one individual every six years, between years four and 20 of implementation.

To the extent that this statement concludes that take of any threatened or endangered species of migratory bird will result from the agency action for which consultation is being made, the Service will not refer the incidental take of any such migratory bird for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C.§§ 703-711), if such take is in compliance with the terms and conditions (including amount and/or number) specified herein.

Taylor's Checkerspot Butterfly

The Service anticipates incidental take of Taylor's checkerspot butterfly will be difficult to detect for the following reasons: incidental take of actual species numbers may be difficult to detect when the species has small body size; finding a dead or impaired specimen is unlikely; losses may be masked by seasonal fluctuations in numbers or other causes; and the life history phases of the species makes detection difficult. The take of this species is anticipated in the form of harm to Taylor's checkerspot butterfly in all life stages as a result of crushing by equipment or associated foot traffic. Harm will occur on 8.5 acres of the 17 acres of suitable habitat on mitigation lands annually from years 10 to 20 of HCP implementation.

Olympia Pocket Gopher

The Service anticipates incidental take of Olympia pocket gophers will be difficult to detect for the following reasons: Olympia pocket gophers are fossorial, and as such finding a dead or injured specimen is unlikely. However, the following level of take of this species can be anticipated by changes in habitat area and exposure of suitable habitat to equipment operation for construction, habitat restoration, and habitat maintenance:

Take of Olympia pocket gophers is anticipated in the form of harm because habitat losses on development sites and equipment operation for habitat restoration and maintenance will injure or kill individuals.

- Harm of all life history stages on the 40.3 acres of suitable habitat on development sites incrementally, as each site is built, over 20 years.
- Harm of all life stages of Olympia pocket gopher occupying portions of the development sites and the Deschutes Corridor mitigation site as follows:
    - Habitat restoration:
        - Three times per year on all 46 acres of suitable habitat from years one to three of HCP implementation
        - Twice per year on 60 percent of the suitable habitat (27.6 acres) from years four to nine of HCP implementation
    - Habitat maintenance:
        - 9.2 acres of suitable habitat annually from years one to three of HCP implementation

- 18.4 acres of suitable habitat annually from years four through nine of HCP implementation.
- 46 acres of suitable habitat annually from years 10 to 20 of HCP implementation
- 40.3 acres of Olympia pocket gopher habitat on 10 development sites until each site is developed, ranging from 1 to 20 years

Yelm Pocket Gopher

The Service anticipates incidental take of Yelm pocket gophers will be difficult to detect for the following reasons: Yelm pocket gophers are fossorial, and as such finding a dead or impaired specimen is unlikely. However, the following level of take of this species can be anticipated by changes in habitat area and exposure of suitable habitat to equipment operation for construction and habitat maintenance:

Take of Yelm pocket gophers is anticipated in the form of harm because habitat losses on development sites and equipment operation for habitat maintenance will injure or kill individuals.

- Harm of all life history stages of Yelm pocket gopher, on the 27.7 acres of suitable habitat on development sites incrementally, as each site is built, from years one to 20 of HCP implementation.
- Harm from habitat maintenance of all life history stages of Yelm pocket gopher occupying portions of the development sites and the Leitner Prairie mitigation site:
    - 27.7 acres of suitable habitat annually on three development sites until each site is developed, ranging from years one to 20 years of HCP implementation.
    - 36.2 acres of suitable habitat annually on the Leitner Prairie mitigation site from years one to 20 of HCP implementation.

EFFECT OF THE TAKE

In the accompanying Opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the streaked horned lark, Taylor's checkerspot butterfly, Olympia pocket gopher, or Yelm pocket gopher.

REASONABLE AND PRUDENT MEASURES AND TERMS AND CONDITIONS

The Service believes that no more than the numbers described above of streaked horned lark, Taylor's checkerspot butterfly, Olympia pocket gopher, and Yelm pocket gopher will be incidentally taken as a result of the proposed action. The reasonable and prudent measures (see the *Description of the Proposed Action* in this document) with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Applicant must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

The Service is to be notified within three working days upon locating a dead, injured or sick endangered or threatened species specimen. Initial notification must be made to the nearest U.S. Fish and Wildlife Service Law Enforcement Office. Notification must include the date, time, precise location of the injured animal or carcass, and any other pertinent information. Care should be taken in handling sick or injured specimens to preserve biological materials in the best possible state for later analysis of cause of death, if that occurs. In conjunction with the care of sick or injured endangered or threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. Contact the U.S. Fish and Wildlife Service Law Enforcement Office at (425) 883-8122, or the Service's Washington Fish and Wildlife Office at (360) 753-9440.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. Within the scope of the proposed action, we have no conservation recommendations beyond those that are part of the proposed HCP.

REINITIATION – CLOSING STATEMENT

This concludes formal consultation on the issuance of a Permit for the actions outlined in the Kaufman HCP. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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APPENDIX A
STATUS OF THE SPECIES – STREAKED HORNED LARK

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Appendix A: Status of the Species - Streaked Horned Lark

Legal Status

The streaked horned lark was listed as a threatened species on October 3, 2013 (78 FR 61452), under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.) The final rule designating critical habitat for the subspecies was published on the same date (78 FR 61506 [October 3, 2013]).

Life History

Taxonomy

The horned lark is found throughout the northern hemisphere (Beason 1995, p. 1); it is the only true lark native to North America (Beason 1995, p. 1). Subspecies of horned larks are based primarily on differences in color, body size, and wing length. Western populations of horned larks are generally paler and smaller than eastern and northern populations (Beason 1995, p. 3). The streaked horned lark was first described as *Otocorys alpestris strigata* by Henshaw (1884, pp. 261–264, 267–268). In addition to the streaked horned lark, there are four other subspecies of horned larks that occur in Washington and Oregon: pallid horned lark (*E. a. alpina*), dusky horned lark (*E. a. merrilli*), Warner horned lark (*E. a. lamprochroma*), and arctic horned lark (*E. a. articola*) (Marshall et al. 2003, p. 426; Wahl et al. 2005, p. 268). None of these other subspecies breed within the range of the streaked horned lark, but all four subspecies frequently overwinter in mixed species flocks in the Willamette Valley (Marshall et al. 2003, pp. 425–427). Genetic analyses indicate that the streaked horned lark population is well-differentiated and isolated from all other sampled localities, including coastal California, and has “remarkably low genetic diversity” (Drovetski et al. 2005, p. 875).

The lack of mitochondrial DNA (mtDNA) diversity exhibited by streaked horned larks is consistent with a population bottleneck (Drovetski et al. 2005, p. 881). The streaked horned lark is differentiated and isolated from all other sampled localities, and although it was “…historically a part of a larger Pacific Coast lineage of horned larks, it has been evolving independently for some time and can be considered a distinct evolutionary unit” (Drovetski et al. 2005, p. 880). The streaked horned lark is recognized as a valid subspecies by the Integrated Taxonomic Information System (ITIS 2012).

Physical Description

The streaked horned lark is endemic to the Pacific Northwest (British Columbia, Washington, and Oregon) (Altman 2011, p. 196) and is a subspecies of the wide-ranging horned lark (*Eremophila alpestris* sp.). Horned larks are small, ground-dwelling birds, approximately 16 to 20 centimeters (6−8 inches) in length (Beason 1995, p. 2). Adults are pale brown, but shades of brown vary geographically among the subspecies. The male’s face has a yellow wash in most subspecies. Adults have a black bib, black whisker marks, black “horns” (feather tufts that can be raised or lowered), and black tail feathers with white margins (Beason 1995, p. 2). Juveniles lack the black face pattern and are varying shades of gray, from almost white to almost black with a silver-speckled back (Beason 1995, p. 2).

The streaked horned lark have unique characteristics that differentiate them from other horned larks including a dark brown back, yellowish underparts, a walnut brown nape and yellow eyebrow stripe and throat (Beason 1995, p. 4). The streaked horned lark subspecies is conspicuously more yellow beneath and darker on the back than almost all other subspecies of horned lark. The combination of small size, dark brown back, and yellow underparts distinguishes this subspecies from other horned larks.

Current and Historical Range

The current range and distribution of the streaked horned lark can be divided into three regions: 1) The south Puget Sound in Washington; 2) the Washington coast and lower Columbia River islands (including dredge spoil deposition and industrial sites near the Columbia River in Portland, Oregon); and 3) the Willamette Valley in Oregon (Figure 1).

The streaked horned lark's breeding range historically extended from southern British Columbia, Canada, south through the Puget lowlands and outer coast of Washington, along the lower Columbia River, through the Willamette Valley, the Oregon coast and into the Umpqua and Rogue River Valleys of southwestern Oregon (Altman 2011, pp. 200-202). The subspecies has been extirpated as a breeding species throughout much of its range, including all of its former range in British Columbia, the San Juan Islands, the northern Puget Trough, the Washington coast north of Grays Harbor County, the Oregon coast, and the Rogue and Umpqua Valleys in southwestern Oregon (Pearson & Altman 2005, pp. 4–5).

Current Breeding Range

Streaked horned larks currently breed on seven sites in the south Puget Sound. Four of these sites are on Joint Base Lewis McChord: 13th Division Prairie, Gray Army Airfield, McChord Field, and 91st Division Prairie. The largest population of streaked horned larks currently breeds at the Olympia Regional Airport and a small population nests at the Port of Shelton's Sanderson Field (airport) (Pearson and Altman 2005, p. 23; Pearson et al. 2008, p. 3). One additional breeding population has recently been documented at the Tacoma Narrows Airport (Tirhi, in litt. 2014); however, there is very limited population abundance information available.

On the Washington coast, there are four known breeding sites in Grays Harbor and Pacific Counties: Damon Point; Midway Beach; Graveyard Spit; and Leadbetter Point. On the lower Columbia River, streaked horned larks breed on several of the sandy islands downstream of Portland, Oregon. Recent surveys have documented breeding streaked horned larks on Rice, Miller Sands Spit, Pillar Rock, Welch, Tenasillahe, Coffeepot, Whites/Browns, Wallace, Crims, and Sandy Islands in Wahkiakum and Cowlitz Counties in Washington, and Columbia and Clatsop Counties in Oregon (Pearson and Altman 2005, p. 23; Anderson 2009, p. 4; Lassen, in litt. 2011). Streaked horned larks also breed at the Rivergate Industrial Complex and the Southwest Quad at Portland International Airport; both sites are owned by the Port of Portland, and are former dredge spoil deposition fields (Moore 2011a, pp. 9–12).

In the Willamette Valley, streaked horned larks breed in Benton, Clackamas, Lane, Linn, Marion, Polk, Washington, and Yamhill Counties. Streaked horned larks are most abundant in the southern part of the Willamette Valley. The largest known breeding population of streaked horned larks rangewide are resident at Corvallis Municipal Airport in Benton County, with 75 to 102 pairs annually (Moore 2008, p. 15); other resident populations occur at the Baskett Slough, William L. Finley, and Ankeny units of the Service's Willamette Valley National Wildlife Refuge Complex (Moore 2008, pp. 8–9). Breeding populations also occur at municipal airports in the valley (including McMinnville, Salem, and Eugene) (Moore 2008, pp. 14–17). In 2008, a large population of streaked horned larks colonized a wetland and prairie restoration site on M-DAC Farms, a privately-owned parcel in Linn County; as the vegetation at the site matured in the following 2 years, the site became less suitable for larks, and the population declined (Moore and Kotaich 2010, pp. 11–13). This is likely a common pattern, as breeding streaked horned larks shift sites as habitat becomes available among private agricultural lands in the Willamette Valley (Moore 2008, pp. 9–11).

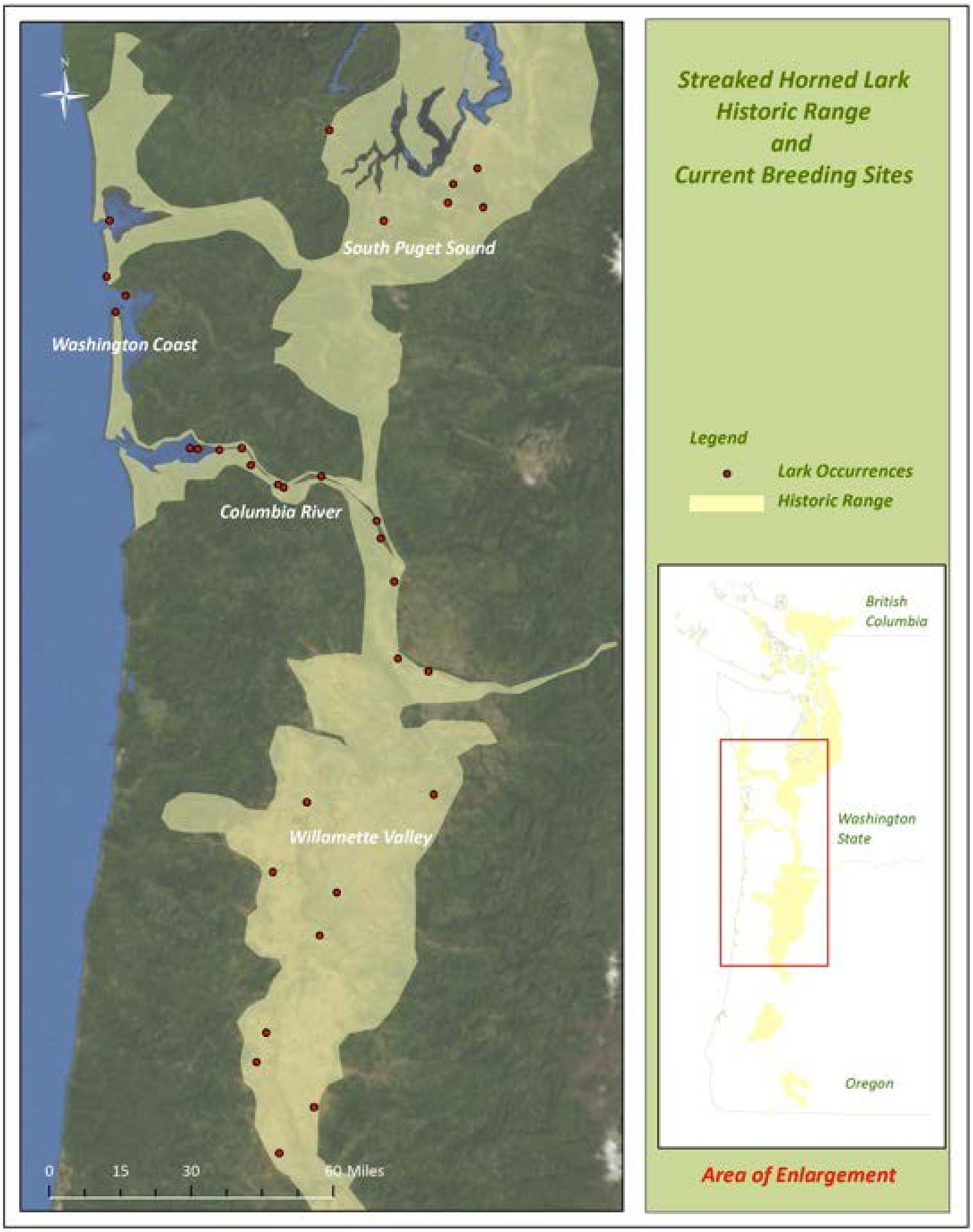

Figure 1. Historic and current range of streaked horned larks (rangewide) (Anderson, in litt. 2014a).

Wintering Range

Pearson *et al*. (2005b, p. 2) found that most streaked horned larks winter in the Willamette Valley (72 percent) and on the islands in the lower Columbia River (20 percent); the rest of the winter is spent on the Washington coast (8 percent) or in the south Puget Sound (1 percent). In the winter, most of the streaked horned larks that breed in the south Puget Sound migrate south to the Willamette Valley or west to the Washington coast; streaked horned larks that breed on the Washington coast either remain on the coast or migrate south to the Willamette Valley; birds that breed on the lower Columbia River islands remain on the islands or migrate to the Washington coast; and birds that breed in the Willamette Valley remain there over the winter (Pearson *et al*. 2005b, pp. 5–6). Streaked horned larks spend the winter in large groups of mixed subspecies of horned larks in the Willamette Valley, and in smaller flocks along the lower Columbia River and Washington Coast (Pearson et al. 2005b, p. 7; Pearson and Altman 2005, p. 7). During the winter of 2008, a mixed flock of over 300 horned larks was detected at the Corvallis Municipal Airport (Moore, pers. comm. 2011b).

Range Contraction

Streaked horned lark has experienced a substantial contraction of its range; it has been extirpated from all formerly documented locations at the northern end of its range (British Columbia, and the San Juan Islands and northern Puget Trough of Washington), the Oregon coast, and the southern edge of its range (Rogue and Umpqua Valleys of Oregon). The streaked horned lark's current range appears to have been reduced to less than half the size of its historical range in the last 100 years. The pattern of range contractions for other Pacific Northwest species (e.g., western meadowlark (*Sturnella neglecta*) shows a loss of populations in the northern part of the range, with healthier populations persisting in the southern part of the range (Altman 2011, p. 214). The streaked horned lark is an exception to this pattern—its range has contracted from both the north and the south simultaneously (Altman 2011, p. 215).

Habitat and Biology

Habitat Selection

Habitat used by streaked horned larks is generally flat with substantial areas of bare ground and sparse low-stature vegetation primarily comprised of grasses and forbs (Pearson and Hopey 2005, p. 27). Suitable habitat is generally 16–17 percent bare ground, and may be even more open at sites selected for nesting (Altman 1999, p.18; Pearson and Hopey 2005, p. 27). Vegetation height is generally less than 13 in (33 cm) (Altman 1999, p.18; Pearson and Hopey 2005, p. 27). A key attribute of habitat used by larks is open landscape context. Our data indicate that sites used by streaked horned larks are generally found in open (i.e., flat, treeless) landscapes of 300 acres (120 ha) or more (Converse et al. 2010, p. 21).

Some patches with the appropriate characteristics (i.e., bare ground, low stature vegetation) may be smaller in size if the adjacent areas provide the required open landscape context; this situation is common in agricultural habitats and on sites next to water. For example, many of the sites used by streaked horned larks on the islands in the Columbia River are small (less than 100 ac (40 ha)), but are adjacent to open water, which provides the open landscape context needed. Streaked horned lark populations are found at nearly every airport within the range of the subspecies, because airport maintenance requirements provide the desired open landscape context and short vegetation structure.

Although streaked horned larks use a wide variety of habitats, populations are vulnerable because the habitats used are often ephemeral or subject to frequent human disturbance. Ephemeral habitats include bare ground in agricultural fields and wetland mudflats; habitats subject to frequent human disturbance include mowed fields at airports, managed road margins, agricultural crop fields, and disposal sites for dredge material (Altman 1999, p. 19).

Foraging

Horned larks forage on the ground in low vegetation or on bare ground (Beason 1995, p. 6); adults feed on a wide variety of grass and weed seeds, but feed insects to their young (Beason 1995, p. 6). Larks eat a wide variety of seeds and insects (Beason 1995, p. 6), and appear to select habitats based on the structure of the vegetation rather than the presence of any specific food plants (Moore 2008, p. 19).

Breeding and Nesting

The majority of streaked horned larks that breed in Washington are migratory, with birds spending the winter in the Willamette Valley, Columbia River or along the Washington coast. In the south Puget Sound geographic area, the first males begin to arrive mid-to-late February (Wolf, in litt. 2013). The first females begin arriving in early March (Anderson, in litt. 2014b) but don't start arriving in numbers until late March and April (Pearson 2003, p.11).

Horned larks form pairs in the spring (Beason 1995, p. 11) and establish territories approximately 1.9 acres (0.77 ha) in size (range 1.5 to 2.5 acres) (Altman, 1999, p. 11). Some areas used by streaked horned larks at study sites in Washington can be 9 acres or more in size (CNLM 2012, p. 20; CNLM, in litt. 2013). Horned larks create nests in shallow depressions in the ground and line them with soft vegetation (Beason 1995, p. 12). Female horned larks select the nest site and construct the nest without help from the male (Beason 1995, p. 12). Streaked horned larks establish their nests in areas of extensive bare ground with little or no woody vegetation, and nests are placed adjacent to clumps of bunchgrass, most often on the north side of the plant (Pearson and Hopey 2004, pp. 1–2; Anderson 2006, p.18; Moore 2013, p. 18). Studies from Washington sites (the open coast, Puget lowlands and the Columbia River islands) have found strong natal fidelity to nesting sites – that is, streaked horned larks return each year to the place they were born and will nest in the same territories every year (Pearson et al. 2008, p. 11; Anderson et al. 2013, pp. 3, 7).

Historically, nesting habitat was found on grasslands, estuaries, and sandy beaches in British Columbia, in dune habitats along the coast of Washington, in western Washington and western Oregon prairies, and on the sandy beaches and spits along the Columbia and Willamette Rivers.

Today, the streaked horned lark nests in a broad range of habitats, including native prairies, coastal dunes, fallow and active agricultural fields, wetland mudflats, sparsely-vegetated edges of grass fields, recently planted Christmas tree farms with extensive bare ground, moderately- to heavily-grazed pastures, gravel roads or gravel shoulders of lightly-traveled roads, airports, and dredge deposition sites in the lower Columbia River (Altman 1999, p. 18; Pearson and Altman 2005, p. 5; Pearson and Hopey 2005, p. 15; Moore 2008, pp. 9–10, 12–14, 16; Anderson et al. 2013, p. 4). The areas adjacent to road ways, airport runways and other vehicle rights-of ways are some of the most consistently (annually) available habitat for the streaked horned larks to breed (Moore 2013, p. 14) and the subspecies likely would not have persisted if not for the regular activities and disturbance that maintains habitat in the surrogate landscapes currently used for nesting. Wintering streaked horned larks use habitats that are very similar to breeding habitats (Pearson et al. 2005, p. 8).

Nesting Phenology in the South Puget Sound Geographic Area

The nesting season for streaked horned larks begins in early April and ends mid- to late August (Figure 2 and 3) (Pearson and Hopey 2004, p. 11; Anderson 2007, p. 6; Moore 2011a, p. 32). Clutches range from 1 to 5 eggs, with a mean of 3 eggs (Pearson and Hopey 2004, p. 12). After the first nesting attempt in April, streaked horned larks will often re-nest in late June or early July (Pearson and Hopey 2004, p. 11). In some situations, they can renest up to 6 times per season (R. Moore, pers. comm. *in* CNLM 2012, p. 24) and can produce two or three successful broods per season. Young streaked horned larks leave the nest by the end of the first week after hatching, and are cared for by the parents until they are about 4 weeks old when they become independent (Beason 1995, p. 15).

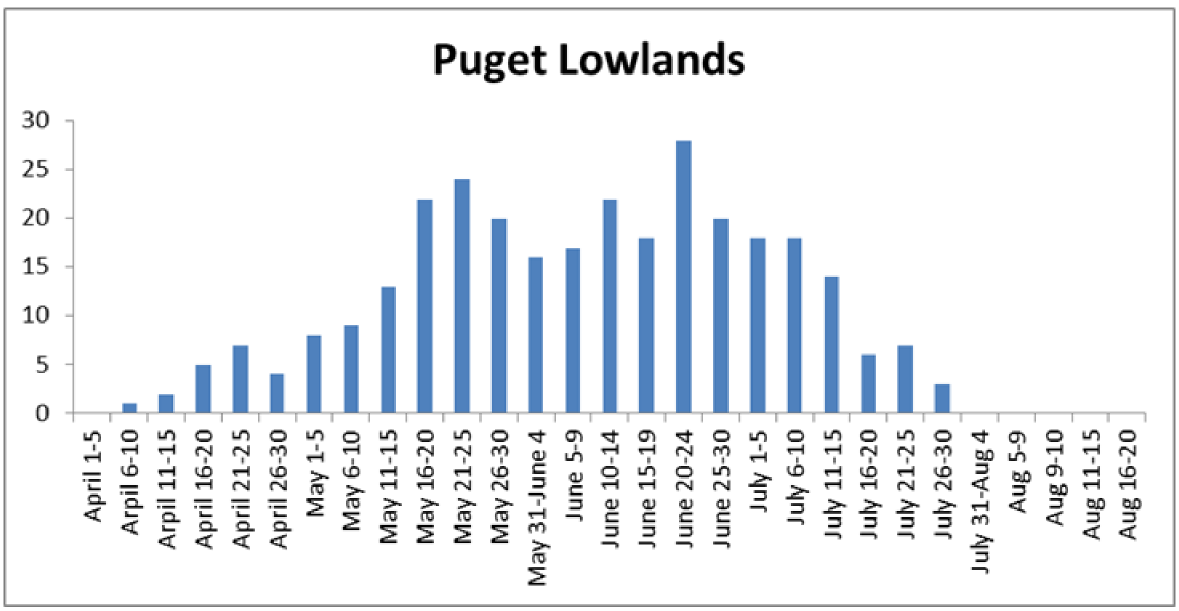

Figure 2. Clutch initiation dates for the Puget Lowlands (draft, WDFW).

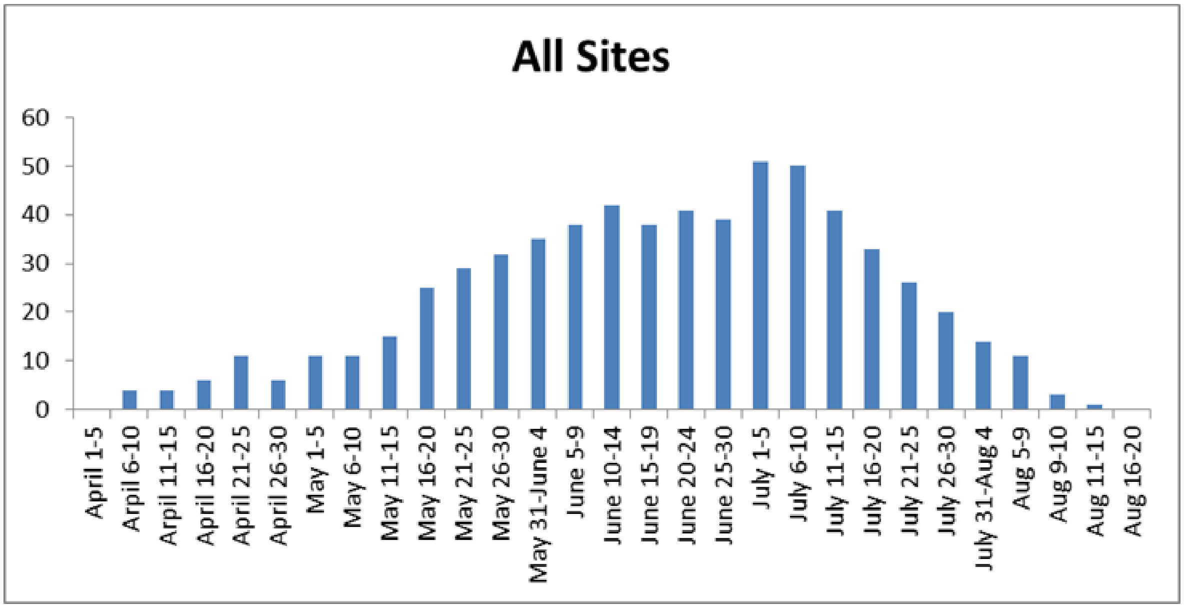

Figure 3: Clutch initiation dates for all nesting sites in Washington and Oregon.

Nest success studies (i.e., the proportion of nests that result in at least one fledged chick) in streaked horned larks report highly variable results. Nest success on the Puget lowlands of Washington is low, with only 28 percent of nests successfully fledging young (Pearson and Hopey 2004, p. 14; Pearson and Hopey 2005, p. 16). According to reports from sites in the Willamette Valley, Oregon, nest success has varied from 23 to 60 percent depending on the site (Altman 1999, p. 1; Moore and Kotaich 2010, p. 23). At one site in Portland, Oregon, Moore (2011a, p. 11) found 100 percent nest success.

Nestlings leave the nest about 8 to 10 days after hatching (once they leave the nest, they are fledglings). Fledgling grassland songbirds leave the nest much earlier than most other passerines and therefore have a lower percentage of muscle mass upon fledging (Moore 2013, p. 8). Immediately after leaving the nest, fledglings are quite ungainly and hop and flutter around following their parents. The young can fly poorly at 4 to 5 days old (Wolf, in litt. 2014). Young flightless birds generally avoid areas without much cover and rely on camouflage for concealment (Wolf, in litt. 2014). About 17 days after they leave the nest, they can walk and fly well. Young streaked horned larks are not able to efficiently flee danger (i.e., walk and fly *well*) until they are approximately 17 days out of the nest (approximately 27 days after hatching (Beason 1970, p. 134).

Population Estimates and Current Status of the Streaked Horned Lark

Data from the North American Breeding Bird Survey (BBS) indicate that most grassland-associated birds, including the horned lark, have declined across their ranges in the past three decades (Sauer et al. 2011, pp. 3–5). The BBS can provide population trend data only for those species with sufficient sample sizes for analyses, but the data are insufficient for the streaked horned lark for a rangewide population trend analysis (Altman 2011, p. 214). An analysis of recent data from a variety of sources concludes that the streaked horned lark has been extirpated from British Columbia, Canada, the Oregon coast, and the Rogue and Umpqua Valleys (Altman 2011, p. 213); this analysis estimates the current rangewide population of streaked horned larks to be about 1,170 to 1,610 individuals (Altman 2011, p. 213).

In the south Puget Sound, approximately 150 to 170 streaked horned larks breed at six sites (Altman 2011, p. 213), and breeding has been recently documented at the Tacoma Narrows Airport (WDFW, in litt 2014). Recent studies have found that larks have very low nest success in Washington (Pearson et al. 2008, p. 8); comparisons with other ground-nesting birds in the same prairie habitats in the south Puget Sound showed that streaked horned larks had significantly lower values in all measures of reproductive success (Anderson 2010a, p. 16). Estimates of population growth rate (λ, lambda) that include vital rates from nesting areas in the south Puget Sound, Washington coast, and Whites Island in the lower Columbia River indicate that the Washington population is declining precipitously. One study estimated that the population of streaked horned larks was declining by 40 percent per year ($\lambda = 0.61 \pm 0.10$ SD), apparently due to a combination of low survival and fecundity rates (Pearson et al., 2008, p. 12). More recent analyses of territory mapping at four sites in the south Puget Sound found that the total number of breeding streaked horned lark territories decreased from 77 territories in 2004 to 42 territories in 2007– a decline of over 45 percent in three years (Camfield et al. 2011, p. 8). Pearson et al. (2008, p. 14) concluded that there is a high probability that populations may be lost in Puget Sound in the future given the low estimates of fecundity and adult survival along with high emigration out of Puget Sound.

On the Washington coast and Columbia River islands there are about 120 to 140 breeding streaked horned larks (Altman 2011, p. 213). Data from the Washington coast and Whites Island were included in the population growth rate study discussed above; populations at these sites appear to be declining by 40 percent per year (Pearson et al. 2008, p. 12). Although nest success is high at the Portland industrial sites, fewer streaked horned larks are nesting at the Rivergate industrial site because the size of the site is decreasing with development.

There are about 900 to 1,300 breeding streaked horned larks in the Willamette Valley (Altman 2011, p. 213). The largest known population of streaked horned larks breeds at the Corvallis Municipal Airport and the population have been as high as 100 breeding pairs in years when the adjacent grass fields are suitable (Moore and Kotaich 2010, pp. 13–15). The population at the Corvallis Airport was 60 to 70 percent lower in 2014, with only 23 confirmed breeding pairs (Moore, in litt. 2014). In 2007, a large (580-acre (235-ha)) wetland and native prairie restoration project was initiated on a former rye grass field in Linn County (Cascade Pacific RC&D 2012, p. 1). Large semi-permanent wetlands were created at the site, and the prairie portions were burned and treated with herbicides (Moore and Kotaich 2010, pp. 11–13). These conditions created excellent quality ephemeral habitat for streaked horned larks and the site was used by about 75 breeding pairs in 2008 (Moore and Kotaich 2010, p. 12). The site had high use again in 2009, but the number of breeding streaked horned larks has steadily declined as the vegetation matured and most of the pairs have moved to other agricultural habitats (Moore and Kotaich 2010, p. 13).

There are no population trend data in Oregon that are comparable to the study in Washington by Pearson et al. (2008, entire); however, research on breeding streaked horned larks indicates that nest success in the southern Willamette Valley is higher than in Washington (Moore, pers.

comm. 2011b). The best information on trends in the Willamette Valley comes from surveys conducted by the Oregon Department of Fish and Wildlife (ODFW); the agency conducted surveys for grassland-associated birds, including the streaked horned lark, in 1996 and again in 2008 (Altman 1999, p. 2; Myers and Kreager 2010, p. 2). Point count surveys were conducted at 544 stations in the Willamette Valley (Myers and Kreager 2010, p. 2). Over the 12-year period between the surveys, measures of relative abundance of streaked horned larks increased slightly from 1996 to 2008 (Myers and Kreager 2010, p. 11). Population numbers decreased slightly in the northern Willamette Valley and increased slightly in the middle and southern portions of the valley (Myers and Kreager 2010, p. 11).

Although there are no conclusive data on population trends throughout the streaked horned lark's range, the rapidly declining population in Puget Sound, along the coast and the Columbia River islands suggests that the range of the streaked horned lark may still be contracting.

Table 1. High counts of streaked horned larks during May to July surveys at breeding sites in Washington, 2010-2013 (Linders, in litt. 2014; WDFW 2013, p. 70[1]).

South Sound Sites	2010	2011	2012	2013[1]	Columbia River and coastal sites	2010	2011	2012	2013[1]
Gray Army Airfield	29	25	18	18	**Whites/ Brown Island**	32	24	30	40
13th Division Prairie	3	6	18	14	**Rice Island**	14	24	24	34
91st Division Prairie, Range 74	12	9	4	5	**Kalama and Johns River***	-	-	4 (2 at each site)	-
McChord	26	18	17	23	**Leadbetter**	-	20	13	10
Olympia Airport	47	41	46	45	**Midway**	-	-	2	2
Shelton Airport	15	11	16	16	**Damon Point**	-	6	4	4
Total #	132	110	119	94	**Total #**	46	74	77	90

* Newly documented (2014) breeding areas include Johns River (2 pairs), the Tacoma Narrows Airport (3 pairs) and Range 50 in the Artillery Impact Area (7 or 8 pairs).

Threats

Reasons for listing

The streaked horned lark was listed as threatened species because of the following:

- The streaked horned lark has disappeared from all formerly documented locations in the northern portion of its range, the Oregon coast, and the southern edge of its range.
- There are currently estimated to be fewer than 1,600 streaked horned larks rangewide, and population numbers are declining.
- Their range is small may be continuing to contract;
    - The south Puget Sound breeding population is estimated to be less than 170 individuals.
    - The Washington coast and Columbia River islands breeding population is less than 140 individuals.
    - Recent research estimates the number of streaked horned larks in Washington and on the Columbia River islands is declining.
        - This decline considered with evidence of inbreeding depression on the south Puget Sound indicated the larks range may contract further in the future.
- Their habitat is threatened throughout their entire range from loss of natural disturbance regimes, invasion of unsuitable vegetation that alter habitat structure, and incompatible land management practices.
- Winter congregations are limited to one location, in Oregon's Willamette Valley, putting it at risk from stochastic weather events.
- Most sites currently used by larks require some level of disturbance or management to maintain the habitat structure they need and natural mechanisms that used to provide this function no longer exist.

Land Conversion and Development

The prairies of south Puget Sound and western Oregon are considered one of the rarest ecosystems in the United States (Noss *et al.* 1995, p. I-2; Dunn and Ewing 1997, p. v). Dramatic changes have occurred on the landscape over the last 150 years, including a 90 to 95 percent reduction in the prairie ecosystem. In the south Puget Sound region, where most of western Washington's prairies historically occurred, less than ten percent of the original prairie persists, and only three percent remains dominated by native vegetation (Crawford and Hall 1997, pp. 13–14). In the remaining prairies, many of the native bunchgrass communities have been replaced by nonnative pasture grasses (Rogers 2000, p. 41), which streaked horned larks avoid using for territories and nest sites (Pearson and Hopey 2005, p. 27). In Oregon's Willamette Valley native grassland has been reduced from being the most common vegetation type to scattered parcels intermingled with rural residential development and farmland; it is estimated that less than one percent of the native grassland and savanna remains in Oregon (Altman et al. 2001, p. 261).

Land Use Practices

Horned larks, including the streaked horned lark subspecies, need expansive areas of flat, open ground to establish breeding territories. As native prairies and scoured river banks in the Pacific Northwest have declined, the large, flat, treeless areas, which airports necessarily require, have become attractive breeding sites for streaked horned larks. Six of the seven streaked horned lark nesting sites remaining in the Puget lowlands are located on or adjacent to airports and military airfields (Rogers 2000, p. 37; Pearson and Hopey 2005, p. 15; Linders, in litt. 2014). At least four breeding sites are found at airports in the Willamette Valley, including the largest known population (historically) at Corvallis Municipal Airport (Moore 2008, pp. 14–17). Stinson (2005, p. 70) concluded that if large areas of grass had not been maintained at airports the streaked horned lark might already have been extirpated from the south Puget Sound area. Although routine mowing to meet flight path regulations helps to maintain grassland habitat in suitable condition for nesting larks, the timing of mowing is critical to avoid effects to nesting larks.

Mowing during the active breeding season (mid-April to late July) can destroy nests or flush adults, which may result in nest failure (Pearson and Hopey 2005, p. 17; Stinson 2005, p. 72). Some of the airports in the range of the streaked horned lark have adjusted the frequency and timing of mowing in recent years to minimize impacts to larks (Pearson and Altman 2005, p. 10). In 2011, McChord Air Field at Joint Base Lewis-McChord (JBLM) agreed to a mowing regime that would protect the lark during their nesting period. Unfortunately, recent unseasonably wet weather doesn't allow this strategy to be implemented. WDFW coordinates mowing schedules at the Olympia Airport to reduce impacts to larks.

In 2008, the Port of Olympia prepared an Interlocal Agreement with the WDFW that outlines management recommendations and mitigation for impacts to state-listed species from development at the airport. In December, 2010, a white paper and supplemental planning memorandum was developed as part of the Airport Master Plan Update (Port of Olympia 2010). This document, which is outlined in Appendix 2 of the Master Plan Update, describes management recommendations for the protection of critical areas and priority species, including the streaked horned lark. The recommendations include minimizing development, retaining open or bare ground, and avoiding mowing during the nesting season (April 15 through August 15) in known or potential lark nesting areas. Although the Port of Olympia does not anticipate any development to occur in the streaked horned lark nesting areas within the next 20 years, the agreement is not a regulatory document and would not preclude future development, which is a primary source of revenue for the Port of Olympia.

Airport expansions could result in further losses of some populations. At the Olympia Airport, hangars were built in 2005 on habitat used by streaked horned larks for foraging, resulting in a loss of grass and forb-dominated habitat. This could have resulted in a smaller local population due to reduced habitat availability for breeding and wintering larks (Pearson and Altman 2005, p. 12). Based on discussions with staff at Sanderson Field in Shelton, future development plans do not include impacts to streaked horned lark habitat at this time. Most of the proposed development at Sanderson Field will occur in areas already impacted (between existing buildings). The West Ramp at Gray Army Air Field on JBLM was expanded in 2005 into areas previously used by breeding larks, resulting in a loss of available breeding habitat (Stinson 2005, p. 72).

At the Portland International Airport, streaked horned larks nest in an area called the Southwest Quad. This is an old dredge material deposition site in a currently unused part of the airport. The Port of Portland, which owns the airport, may propose to develop the Southwest Quad to accommodate future expansion; however, there is currently no plan in place (Green, in litt. 2012). Future development of the Southwest Quad would result in the loss of at least 33 ac (13 ha) of habitat and three breeding territories (Moore 2011a, p. 12).

Industrial development has also reduced habitat available to breeding and wintering larks. The Rivergate Industrial Park, owned by the Port of Portland, is a large industrial site in north Portland near the Columbia River; the site is developed on a dredge spoil field, and still has some large areas of open space between the industrial buildings. Rivergate has been an important breeding site for streaked horned larks, and a wintering site for mixed flocks of up to five horned lark subspecies (including the streaked horned lark). In 1990, the field used by larks at Rivergate measured more than 650 acres (260 ha) of open sandy habitat (Dillon, pers. comm. 2012). In the years since, new industrial buildings have been constructed on the site; now only one patch of 79 acres (32 ha) of open dredge spoil field remains and the breeding population has dropped from 20 pairs to 5 pairs in this time (Moore 2011a, pp. 9-10).

The 13th Division Prairie at JBLM is used for helicopter operations (paratrooper practices, touch-and-go landings, and load drop and retrievals) and troop training activities. Foot traffic and training maneuvers that are conducted during the streaked horned lark breeding season are likely contributing factors to nest failure and low nest success at 13th Division Prairie. Recently, a streaked horned lark nest was destroyed at 13th Division Prairie by a porta-potty service vehicle (Linders, in litt. 2012). Artillery training, off-road vehicle use, and troop maneuvers at the 91st Division Prairie are also conducted in areas used by larks during the nesting season. Because access into this training area is limited and streaked horned lark surveys are only conducted opportunistically, we do not know the degree to which streaked horned lark nests are lost due to military activities at 91st Division Prairie.

Streaked horned lark populations on JBLM are exposed to differing levels of training activities. The Department of Defense's (DOD) proposed actions under 'Grow the Army' (GTA) include stationing 5,700 new soldiers, new combat service support units, a combat aviation brigade, facility demolition and construction to support the increased troop levels, additional aviation, maneuver, and live fire training (75 FR 55313, September 10, 2010). The increased training activities will affect nearly all training areas at JBLM resulting in an increased risk of accidental fires, and habitat destruction and degradation through vehicle travel, dismounted training, bivouac activities, and digging. Although training areas on the base have degraded habitat for the species, with implementation of conservation measures, these areas still provide habitat for the streaked horned lark. Military training, including bombardment with explosive ordnance and hot downdraft from aircraft, has been documented to cause nest failure and abandonment for streaked horned larks at Gray Army Airfield and McChord Field at JBLM (Stinson 2005, pp. 71–72). These activities harass and may kill some streaked horned larks, but the frequent disturbance also helps to maintain sparse vegetation and open ground needed for streaked horned lark nesting.

In odd-numbered years since 2005, McChord Field has hosted a military training event known as the Air Mobility Rodeo. This international military training exercise is held at the end of July, during lark breeding season. This event includes aircraft, vehicles, and tents staged on or near lark nesting areas, although the majority of these activities take place on concrete hardstand areas (Geil, in litt. 2010). In even-numbered years, McChord Field hosts a public air show known as Air Expo, which is scheduled in mid-July. At the Air Expo, aerial events incorporate simulated bombing and fire-bombing, including explosives and pyrotechnics launched from an area adjacent to the most densely populated streaked horned lark nesting site at this location; these disturbances likely have adverse effects to fledglings of late nests (Stinson 2005, p. 72).

Surveys in 2004 detected 31 pairs of streaked horned larks at McChord Field (Anderson 2011, p. 14). In 2006, the number of lark pairs at McChord Field had dropped by more than half to 14 pairs, and the number of lark pairs has remained low, with just 11 pairs detected in 2011 (Anderson 2011, p. 14). The Rodeo and Air Expo events are scheduled to take advantage of the good weather that typically occurs in the summer on the south Puget Sound; this timeframe also coincides with the streaked horned lark nesting season, and the disturbance may continue to cause nest failure and abandonment (Pearson et al. 2005a, p. 18). During the airshows, tents, vehicles and concession stands are set up in the grassy areas along the runways used by streaked horned larks for nesting and thousands of visitors a day line the runways for viewing the shows.

Airports routinely implement a variety of approaches to minimize the presence of hazardous wildlife on or adjacent to airfields and to prevent wildlife strikes by aircraft. McChord Field uses falcons to scare geese and gulls off the airfield, and also uses two dogs for this purpose; the falcons and dogs are part of McChord Field’s Integrated Bird/Wildlife Aircraft Strike Hazard program and are designed to minimize aircraft and crew exposure to potentially hazardous bird and wildlife strikes (Geil, in litt. 2010). The falcons and dogs cause streaked horned larks to become alert and fly (Pearson and Altman 2005, p. 12), which imposes an energetic cost to adults and could expose nests to depredation. Portland International Airport uses a variety of hazing and habitat management tools to minimize wildlife hazards. Raptors and waterfowl pose the greatest danger to aircraft operations, but the airport’s Wildlife Hazard Management Plan aims to reduce the potential for any bird strikes (Port of Portland 2009, pp. 5–6). Streaked horned larks are not known to nest near the runways at Portland International Airport, but foraging individuals from the nearby Southwest Quad could be harassed by the hazing program, which could impose resulting energetic costs.

JBLM has committed to restrictions both seasonally and operationally on military training areas, in order to avoid and minimize potential effects to the streaked horned lark. These restrictions include identified non-training areas, seasonally restricted areas during breeding, and the adjustment of mowing schedules to protect the species. These conservation management practices are outlined in an operational plan that the Service has assisted the DOD in developing for JBLM (Thomas, pers. comm. 2012).

Habitat features are not the only influence on where streaked horned larks nest, although it is usually attributed as the major influential component of nest site selection. More recent research has demonstrated that social information and behavioral cues can be as or more important than environmental cues in habitat selection (Ahlering et al. 2010). A recent conspecific attraction study by the CNLM used social cues (decoys and calls) to try luring birds to newly created habitats. Two years of observations resulted in 23 detections of streaked horned larks at the habitat restoration sites, but no birds established territories or bred on them (Anderson et al. 2013, p. 3).

Loss of Ecological Disturbance Regimes

Habitat has been rendered unusable for the streaked horned lark due to invasion of nonnative grasses and woody vegetation. These invasive species have established themselves across vast portions of the landscape because ecological disturbance regimes that prevented them, such as fire and flooding, have been suppressed or entirely ceased. The basic ecological processes that maintain prairies, meadows, and scoured river banks have disappeared from, or have been altered on, all but a few protected and managed sites.

Historically, the prairies and meadows of the south Puget Sound region of Washington and western Oregon are thought to have been actively maintained by the native peoples of the region, who lived here for at least 10,000 years before the arrival of Euro-American settlers (Christy and Alverson 2011, p. 93). Frequent burning reduced the encroachment and spread of shrubs and trees (Chappell and Kagan 2001, p. 42), favoring open grasslands with a rich variety of native plants and animals. Following Euro-American settlement of the region in the mid-19th century, fire was actively suppressed on grasslands, allowing encroachment by woody vegetation into the remaining prairie habitat and oak woodlands (Franklin and Dyrness 1973 p. 122; Kruckeberg 1991, p. 287; Agee 1993, p. 360; Altman et al. 2001, p. 262).

The result of fire suppression has been the invasion of the prairies and oak woodlands by native and nonnative plant species (Dunn and Ewing 1997, p. v; Tveten and Fonda 1999, p. 146), notably woody plants such as the native Douglas-fir (*Psuedotsuga menziesii*) and the nonnative Scot's broom, and nonnative grasses such as *Arrhenatherum elatus* (tall oatgrass) in Washington and *Brachypodium sylvaticum* (false brome) in the Willamette Valley of Oregon. This increase in woody vegetation and nonnative plant species has resulted in less available prairie habitat overall and habitat that streaked horned larks avoid (Pearson and Hopey 2005, pp. 2, 27).

On tallgrass prairies in midwestern North America, fire suppression has led to degradation and the loss of native grasslands (Curtis 1959, pp. 296, 298; Panzer 2002, p. 1297). On northwestern prairies, fire suppression has allowed Douglas fir to encroach on and out-compete native prairie vegetation for light, water, and nutrients (Stinson 2005, p. 7). On JBLM alone, over 16,000 acres (6,477 ha) of prairie has converted to Douglas-fir forest since the mid-19th century (Foster and Shaff 2003, p. 284). Where controlled burns or direct tree removal are not used as a management tool, this encroachment will continue to cause the loss of open grassland habitats for the streaked horned lark.

Restoration in some of Washington's south Puget Sound native grasslands has resulted in temporary control of Scot's broom and other invasive plants through the careful and judicious use of herbicides, mowing, grazing, and fire. Fire has been used as a management tool to maintain native prairie composition and structure. Use of fire for these purposes is acknowledged to improve the health and composition of grassland habitat by providing a short-term nitrogen addition, which results in a fertilizer effect to vegetation, thus aiding grasses and forbs as they re-sprout.

Unintentional fires ignited by military training burns patches of prairie grasses and forbs on JBLM on an annual basis. These "low-intensity" ground fires create a mosaic of conditions within the grassland, maintaining a low vegetative structure of native and nonnative plant composition, and patches of bare soil. Because of the topography of the landscape, these fires create patches that burn completely, some areas that do not burn, and areas where consumption of the vegetation is mixed in its effects to the habitat. One of the benefits to fire in grasslands is that it tends to kill regenerating conifers, and reduces the cover of nonnative shrubs such as Scot's broom; however, Scot's broom seeds that are stored in the soil can be stimulated by fire (Agee 1993, p. 367). On sites where regular fires occur, such as on JBLM, there is a high complement of native plants and fewer invasive species. Management practices such as intentional burning and mowing require expertise in timing and technique to achieve desired results. If applied at the wrong season, frequency, or scale, fire and mowing can be detrimental to the restoration of native prairie species.

Prior to the construction of dams on the Columbia River, annual flooding and scouring likely created nesting and wintering habitat for streaked horned larks on sandy islands and beaches along the river's edge (Stinson 2005, p. 67). Once the dams were in place, willows (*Salix* spp.), black cottonwood (*Populus trichocarpa*), and other vegetation established broadly on the sandbars and banks (Rogers 2000, pp. 41–42), resulting in unsuitable habitat for larks. Loss of these habitats may have been partially ameliorated by the formation of dredge spoil islands that have been established as part of the U.S. Army Corps of Engineers' (Corps) shipping channel maintenance (Stinson 2005, p. 67).

Streaked horned larks currently use sand islands in the lower Columbia River for both breeding and wintering habitat. These islands are a mosaic of Federal, State, and private lands, but there are no management or conservation plans in place to protect larks or these important habitats. The Corps has a dredging program to maintain the navigation channel in the Columbia River. In 2002, the Corps established a deeper navigation channel in the river, a regular maintenance dredging program, and a plan for disposing dredge material on the islands in the lower Columbia River (USFWS 2002, pp. 1–14). In this plan, the Corps addressed the disposition of dredge material in the lower Columbia River, which has the potential to both benefit and harm streaked horned larks, depending on the location and timing of deposition. Recent studies by Anderson (2010a, p. 29) on the islands in the lower Columbia River have shown that fresh dredge material stabilizes and develops sparse vegetation suitable for lark nesting approximately three years after deposition, and can be expected to remain suitable for approximately two years before vegetation becomes too dense. Thus, deposition of dredge material can be both a tool for habitat creation and a threat, as deposition of dredge material at the wrong time (e.g., during the nesting season) can destroy nests and young or degrade suitable habitat.

Destruction of occupied lark habitat through the deposition of dredge materials has been documented several times on the lower Columbia River islands (Stinson 2005, p. 67; Pearson and Altman 2005, p. 11; Pearson et al. 2008, p. 14). In 2006, dredge spoils were deposited on Whites Island while larks were actively nesting. All nests at this site were apparently destroyed (Pearson, pers. comm. 2012). This site had at least 21 nests and 13 territories during the 2005 nesting season (Pearson et al. 2008, p. 21). In a similar situation, singing males were observed on Rice Island in June 2000, but dredge spoil was placed on the site in July 2000, which destroyed nesting habitat during the breeding season (MacLaren 2000, p. 3). In 2004 on Miller Sands Spit, the Corps deposited dredge material on lark breeding habitat, which likely resulted in nest failure (Pearson and Altman 2005, p. 10). The Corps has recently begun working with the Center for Natural Lands Management to coordinate dredge spoil depositions with timing of lark breeding season (Anderson, in litt. 2011).

Dredge spoil deposition also creates habitat for Caspian terns (*Sterna caspia*), a native bird species that nests in very large numbers in the lower Columbia River. These large terns have been shown to eat substantial numbers of salmon smolts, and for the past decade, an interagency effort has focused on reducing tern depredation on young salmon (Lyons et al. 2011, p. 2). One aspect of the effort to reduce the numbers of terns in the lower Columbia River has been a program to discourage tern nesting on Rice Island by planting vegetation and placing barrier fencing on open sandy habitats; these measures have also reduced habitat available to larks on the island and are ongoing (Stinson 2005, p. 73; Roby et al. 2011, p. 14).

Larks appear to respond positively to habitat management that simulates natural processes. From 2001 through 2004, JBLM mowed and controlled burns to control Scot's broom during the nonbreeding season (Pearson and Hopey 2005, p. 30). The September 2004 burns resulted in increased lark abundance and a dramatic vegetative response on 13th Division Prairie. Relative to the control sites, larks increased their use of burned areas immediately after a late summer fire in 2006, and in the breeding season following the fires (Pearson and Hopey 2005, p. 30).

Throughout the year, streaked horned larks use areas of bare ground or sparse vegetative cover in grasslands. These grasslands may be native prairies in the Puget lowlands, perennial or annual grass seed fields in the Willamette Valley, or the margins of airport runways throughout the range of the species. All of these habitats receive management to maintain desired structure: prairies require frequent burning or mowing to prevent succession to woodlands; agricultural fields are mowed during harvest or burned to reduce weed infestations; airports mow to maintain low-stature grasses around airfields to minimize attracting hazardous wildlife. Burning and mowing are beneficial to larks because these activities maintain the habitat structure required by the lark, but these activities can also harm larks if the activities occur during the breeding season when nests and young are present (Pearson and Hopey 2005, p. 29). In the nesting seasons from 2002 to 2004, monitoring at the Puget lowlands sites (Gray Army Airfield, McChord Field, and Olympia Airport) documented nest failure of 8 percent of nests caused by mowing over the nests, young, and adults (Pearson and Hopey 2005, p. 18). Habitat management to maintain low-stature vegetation is essential to maintaining suitable habitat for streaked horned larks, but the timing of the management is important, as improperly-timed actions can destroy nests and young.

Restoration Activities

Management for invasive species and encroachment of conifers requires control through equipment, herbicides, and other activities. While restoration has conservation value for the species, management activities to implement restoration may also have direct impacts to the species that are the target of habitat restoration. The introduction of Eurasian beachgrass (*Ammophila arenaria*) and American beachgrass (*A. breviligulata*), currently found in high and increasing densities in most of coastal Washington and Oregon, has dramatically altered the structure of dunes on the outer coast (Wiedemann and Pickart 1996, p. 289). The tall leaf canopy of beachgrass creates areas of dense vegetation, which is unsuitable habitat for streaked horned lark nesting (MacLaren 2000, p. 5).

Streaked horned larks require sparse, low-stature vegetation with at least 16–17 percent bare ground; areas invaded by beachgrass are too dense for streaked horned larks. The area suitable for streaked horned lark breeding on the Washington coast has decreased as a result of the spread of beachgrasses (Stinson 2005, p. 65; USFWS 2011, p. 4-2). In a 10-year period (from 1977 to 1987) at Leadbetter Point on the Willapa National Wildlife Refuge, spreading beachgrass reduced the available nesting habitat for streaked horned larks by narrowing the distance from vegetation to water by 112 feet (34 meters) (WDFW 1995, p. 19). Since 1985, encroaching beachgrasses have spread to cover over two-thirds of Damon Point at Grays Harbor, another lark breeding site on the Washington coast (WDFW 1995, p. 19). At Damon Point, Scot's broom is also encroaching on lark habitat, reducing the area available for nesting (Pearson, in litt. 2011). On the Oregon coast, the disappearance of the streaked horned lark has been attributed to the invasion of exotic beachgrasses and the resultant dune stabilization (Gilligan et al. 1994, p. 205).

Some efforts have been successful in reducing the cover of encroaching beachgrasses. The Service's Willapa National Wildlife Refuge has restored habitat on Leadbetter Point. In 2007, the area of open habitat measured 84 acres (34 ha); after mechanical and chemical treatment to clear beachgrass (mostly American beachgrass) and spreading oyster shell across 45 acres (18 ha), 121 acres (50 ha) of sparsely vegetated open habitat suitable for lark nesting was created (Pearson et al. 2009, p. 23). The main target of the Leadbetter Point restoration project was the threatened western snowy plover (*Charadrius alexandrinus nivosus*), but the restoration actions also benefited the streaked horned lark. Before the restoration project, this area had just 2 streaked horned lark territories (Pearson et al. 2005a, p. 7); after the project, an estimated 8 to 10 territories were located in and adjacent to the restoration area (Pearson, pers. comm. 2012).

Transient Agricultural Habitat

Roughly half of all the agricultural land in the Willamette Valley is devoted to grass seed production fields (Oregon Seed Council 2012, p. 1). Grasslands–both rare native prairies and grass seed fields–are important habitats for streaked horned larks in the Willamette Valley; open areas within the grasslands are used for both breeding and wintering habitat (Altman 1999, p. 18; Moore and Kotaich 2010, p. 11; Myers and Kreager 2010, p. 9). About 420,000 acres (170,000 ha) in the Willamette Valley are currently planted in grass seed production fields. Demand for grass seed is declining in the current economic climate (Oregon Department of Agriculture 2011, p. 1); this decreased demand for grass seed has resulted in farmers switching to other agricultural commodities, such as wheat or nurseries and greenhouses (Oregon Department of Agriculture 2011, p. 1). The continued decline of the grass seed industry in the Willamette Valley will likely result in conversion from grass seed fields to other agricultural types; this will result in fewer acres of suitable breeding and wintering habitat for streaked horned larks.

Another potential threat related to agricultural lands is the streaked horned lark's use of ephemeral habitats. In the breeding season, streaked horned larks will move into open habitats as they become available, and as the vegetation grows taller over the course of the season, will abandon the site to look for other open habitats later in the season (Beason 1995, p. 6). This ability to shift locations in response to habitat changes is a natural feature of the streaked horned lark's life history strategies, as breeding in recently disturbed habitats is part of their evolutionary history. In the Willamette Valley, patches of suitable habitat in the agricultural fields shift from place to place as fields are burned, mowed, or harvested. Other suitable sites appear when portions of grass fields perform poorly, inadvertently creating optimal habitat for larks. The shifting nature of suitable habitat is not in itself a threat; the potential threat is in the overall reduction of compatible agriculture, which would reduce the area within which streaked horned lark habitat could occur.

Depredation and Pest Control

Depredation on adult streaked horned larks has not been identified as a threat, but it is the most frequently documented source of mortality for eggs and young larks. In most studies of streaked horned lark nesting ecology, depredation has been the primary documented source of nest failure (Altman 1999, p. 18; Pearson and Hopey 2004, p. 15; Pearson and Hopey 2005, p. 16; Pearson and Hopey 2008, p. 1; Moore and Kotaich 2010, p. 32). Sixty-nine percent of nest failures were caused by depredation at four south Puget Sound study sites (Gray Army Airfield, 13th Division Prairie, Olympia Airport, McChord Field) in 2002–2004 (Pearson and Hopey 2005, p. 18). Anderson (2006, p. 19) concluded that the primary predators of streaked horned lark eggs and young were avian, most likely American crows (*Corvus brachyrhynchos*), although garter snakes (*Thamnophis* spp.) and western meadowlarks have also been documented preying on eggs and young in the region (Pearson and Hopey 2005, p. 16; Pearson and Hopey 2008, p. 4). On the Washington coast and lower Columbia River islands, 46 percent of nest failures were caused by predation at three study sites (Midway Beach, Damon Point, and Puget Island) in 2004 (Pearson and Hopey 2005, p. 18). A study of five sites in the Willamette Valley (Corvallis Airport, M-DAC Farms, William L. Finley, Baskett Slough, and Ankeny National Wildlife Refuges) determined that 23 to 58 percent of all streaked horned lark nests were lost to predation (Moore and Kotaich 2010, p. 32).

Video cameras were used to identify predators in the Willamette Valley study; documented predators include: red-tailed hawk (*Buteo jamaicensis*), northern harrier (*Circus cyaneus*), American kestrel (*Falco sparverius*), great-horned owl (*Bubo virginianus*), and rats and mice (Family Cricetidae) (Moore and Kotaich 2010, p. 36). Streaked horned larks are ground-nesting birds and are vulnerable to a many other potential predators, including domestic cats and dogs, coyotes (*Canis latrans*), raccoons (*Procyon lotor*), striped skunks (*Mephitis mephitis*), red foxes

(*Vulpes vulpes*), long-tailed weasels (*Mustela frenata*), opossums (*Didelphis virginiana*), meadow voles (*Microtus pennsylvanicus*), deer mice (*Peromyscus maniculatus*), and shrews (*Sorex* spp.) (Pearson and Hopey 2005, p. 17; Stinson 2005, p. 59).

Depredation is a natural part of the streaked horned lark's life history, and in stable populations, the effect of predation would not be considered a threat to the species. However, in the case of the streaked horned lark, the effect of depredation may be magnified when populations are small, and the disproportionate effect of depredation on declining populations has been shown to drive rare species even further towards extinction (Woodworth 1999, pp. 74–75). We consider the effect of depredation on streaked horned lark populations, particularly in the south Puget Sound, to be a threat to the subspecies.

The one area where depredation does not appear to be a threat to nesting streaked horned larks is in Portland at Rivergate Industrial Complex and the Southwest Quad at Portland International Airport. In 2009 and 2010, nesting success was very high, and only a single depredation event was documented at these sites (Moore 2011a, p. 11). The reason for the unusually low depredation pressure may be that the two industrial sites have few predators since both sites are isolated from other nearby natural habitats.

Depredation may have contributed to the extirpation of streaked horned larks on the San Juan Islands. The subspecies was last documented on the islands in 1962 (Lewis and Sharpe 1987, p. 204). The introduction of several exotic animal species to the island roughly coincides with the disappearance of the streaked horned lark, including feral ferrets (*Mustela outorius*) and red foxes. These introduced predators may have significantly affected ground nesting birds and played a role in the eventual extirpation of streaked horned larks (Rogers 2000, p. 42).

Disease and Genetics

Genetic analysis has shown that streaked horned larks have suffered a loss of genetic diversity due to a population bottleneck (Drovetski *et al.* 2005, p. 881), the effect of which may be exacerbated by continued small total population size. In general, decreased genetic diversity has been linked to increased chances of inbreeding depression, reduced disease resistance, and reduced adaptability to environmental change, leading to reduced reproductive success (Keller and Waller 2002, p. 235).

Recent studies in Washington have found that streaked horned larks have lower fecundity and nest success than other Northwestern horned lark subspecies (Camfield et al. 2010, p. 277). In a study on the south Puget Sound, all measures of reproductive success were lower for streaked horned larks than for other ground-nesting birds at the same prairie sites (Anderson 2010a, p. 15). The streaked horned lark's egg hatching rate at these sites is extremely low (i.e., 44 percent at 13th Division Prairie) (Anderson 2010a, p. 18). Comparisons with savannah sparrows (*Passerculus sandwichensis*), a bird with similar habitat requirements that nests on the same prairies, found that streaked horned lark fecundity was 70 percent lower (Anderson 2010b, p. 18).

If the streaked horned lark's very low reproductive success was caused by poor habitat quality, other ground-nesting birds at the study sites would be expected to show similarly low nest success rates. Other bird species have much higher nest success in the same habitat, suggesting that inbreeding depression may be playing a role in the decline of streaked horned larks in the south Puget Sound (Anderson 2010a, p. 27). Other factors consistent with hypothesized inbreeding depression in the south Puget Sound population include two cases of observed mother-son pairings (Pearson and Stinson 2011, p. 1), and no observations of immigration from other sites into the Puget lowland breeding sites (Pearson *et al.* 2008, p. 15).

Estimates of population growth rate (λ) that include vital rates from all of the nesting areas in Washington (south Puget Sound, Washington Coast, and one lower Columbia River island) indicate that streaked horned larks in Washington are declining by 40 percent per year, apparently due to a combination of low survival and fecundity rates (Pearson et al. 2008, pp. 10, 13; Camfield et al. 2011, p. 7). Territory mapping at 4 sites on the south Puget Sound found that the total number of breeding streaked horned lark territories decreased from 77 territories in 2004 to 42 territories in 2007—a decline of over 45 percent in 3 years (Camfield et al. 2011, p. 8). The combination of low genetic variability, small and rapidly declining nesting populations, high breeding site fidelity, and no observed migration into the Puget lowlands populations suggests that the south Puget Sound population could become extirpated in the near future (Pearson et al. 2008, pp. 1, 14, 15).

In 2011, a project was initiated to increase genetic diversity in the south Puget Sound streaked horned lark population. Twelve eggs (four three-egg clutches) were collected from streaked horned lark nests in the southern Willamette Valley and were placed in nests at the 13th Division Prairie site at JBLM (Wolf 2011, p. 9). At least five young successfully fledged at the receiving site; if even one of these birds return to breed in future years, it will likely increase genetic diversity in the receiving population, resulting in improved fitness and reduced extinction risk for the south Puget Sound larks (Wolf 2011, p. 9). For 2014, these genetic rescue efforts were abandoned due to a 60 to 70 percent decline in the streaked horned lark population at the Corvallis Airport, the source of the transplanted eggs. Based on our consideration of these factors, we conclude that the loss of genetic diversity, the current number of small and isolated populations (particularly in Washington State), and the species' low reproductive success are likely to combine to result in continued population declines for the streaked horned lark.

Summary of Threats

The streaked horned lark population decline in the south Puget Sound of Washington indicates that the observed range contraction for this subspecies may be continuing, and the subspecies may disappear from that region in the near future. There are many other ongoing threats to the streaked horned lark's habitat throughout its range, including: (1) converting land use to agriculture and industry; (2) loss of natural disturbance processes such as fire and flooding; (3) encroachment of woody vegetation; (4) invasion of coastal areas by nonnative beachgrasses; and (5) incompatible management practices. The continued loss and degradation of streaked horned lark habitat may result in smaller, more isolated habitats available to the subspecies, which could further depress the rangewide population or reduce the geographic distribution of the streaked horned lark.

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APPENDIX B
STATUS OF THE SPECIES – TAYLOR'S CHECKERSPOT BUTTERFLY

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Appendix B: Status of the Species – Taylor's Checkerspot Butterfly

Legal Status

The Taylor's checkerspot butterfly (*Euphydyas editha taylori*) was listed as an endangered species on October 3, 2013, throughout the subspecies range in Washington, Oregon, and British Columbia (78 FR 61452 [October 3, 2013]). The primary reasons for listing included extensive habitat loss through conversion and degradation of habitat, particularly from agricultural and urban development, successional changes to grassland habitat, military training, and the spread of invasive plants; inadequate existing regulatory mechanisms that allow significant threats such as habitat loss; and, other factors, including low genetic diversity, small or isolated populations, low reproductive success, and declining population sizes. Classified as an endangered species, the Taylor's checkerspot butterfly is considered to be presently in danger of extinction throughout its entire range.

Taxonomy and Species Description

The Taylor's checkerspot is a butterfly in the Order Lepidoptera (butterflies and moths), and family Nymphalidae (brushfoots), subfamily Melitaeinae (checkerspots). Taylor's checkerspot butterfly is a medium-sized (less than or equal to 2.25 inches), colorfully marked butterfly with a checkerboard pattern on the upper (dorsal) side of the wings (Pyle 2002, p. 310). The upperside of the wings are black with orange and yellowish (or white) spot bands, giving them a checkered appearance (Pyle 2002, p. 310). Taylor's checkerspot is one of several subspecies of the Edith's checkerspot butterfly (*Euphydryas editha*), that includes the threatened bay checkerspot (*E. e. bayensis*) and the endangered Quino checkerspot (*E. e. quino*) which occur in California.

Habitat

Taylor's checkerspot butterfly requires open grassland habitat dominated by short-statured grasses, with abundant forbs to serve as larval host plants and nectar sources. These habitats are found on prairies, shallow-soil balds (Chappell 2006, p. 1), grassland bluffs, and grassy openings within a forested matrix on south Vancouver Island, British Columbia; the north Olympic Peninsula; south Puget Sound, Washington; and the Willamette Valley, Oregon. Occupied habitats range in elevation from near sea-level to over 3,200 ft in elevation, and occupied grassland patches range in size from less than 1 acre up to 100-plus acres (0.4 to 40 ha).

In British Columbia, Canada, Taylor's checkerspot butterflies were historically known to occupy coastal grassland habitat on south Vancouver Island and the nearby Gulf Islands, not forests that were converted to early successional conditions by clear-cutting. The recently discovered population on Denman Island in Canada, discovered in May 2005, occupies an area that had been clear-cut harvested, and is now dominated by grass and forb vegetation, but is changing rapidly and requires management to maintain early seral conditions.

In Washington, Taylor's checkerspot butterflies inhabit glacial outwash prairies in the south Puget Sound region. Northwest prairies were formerly more common, larger, and interconnected, and supported a greater distribution and abundance of Taylor's checkerspot butterflies than prairie habitat does today. On the north Olympic Peninsula they use shallow-soil balds dominated by prairie forbs and bunchgrasses within a forested landscape, as well as roadsides, former clear-cut areas within a forested matrix, and a coastal stabilized dune site near the Strait of Juan de Fuca (Stinson 2005, pp. 93–96). The two Oregon sites are on grassland hills in the Willamette Valley within a forested matrix (Ross 2008, p. 1; Benton County 2010, Appendix N, p. 5). The total area and quality of habitat for the Taylor's checkerspot butterfly has rapidly declined over the past century due to development, conversion, successional changes to grassland habitat, and the spread of nonnative invasive plants.

Biology and Life History

Annual Life Cycle

The Taylor's checkerspot butterfly is univoltine (producing a single generation per year) and is nonmigratory. All butterflies have four stages of development (egg, larvae, pupae, and adult). Taylor's checkerspot butterflies emerge as adults in the spring, typically flying in May, although depending on local site and climatic conditions, the flight period may begin in mid-April (Stinson 2005, p. 79) and extends into June, as in Oregon, where the flight season has been documented as lasting up to 43 days (Ross 2008, p. 3). The life-span of individual adult butterflies is usually brief, lasting only 4 to 14 days (Cushman et al 1994, p. 196). During the flight period adult butterflies patrol their habitat for mates, nectar sources and host plants. Adult checkerspot butterflies are non-migratory, rarely dispersing from their natal habitats (Singer and Hanski 2004, pp. 184-185). Males seek females for mating, and once mated, the females seek larval host plants on which to lay eggs (oviposit). Female *E. editha* generally only mate once and may lay up to 1,200 eggs in clusters of 20 to 350 directly onto larval host plants (James and Nunnallee 2011, p. 286). Captive Taylor's checkerspot typically produce 100-400 eggs depending on body condition of the female (Linders and Lewis 2013, pp. 12-14). Eggs hatch after 13 to 15 days (Murphy et al 2004, p. 25). In *E. editha*, newly hatched caterpillars live colonially in a loose silk web during early development. The web is thought to deter generalist predators and parasitoids (Kuusaari et al. 2004, p. 139).

Checkerspot larvae (caterpillars) feed on the green leaves and flowers of host plants and undergo a series of molts as they develop. The larval stages between molts, called instars, express changes in color or markings. Taylor's checkerspot larvae generally grow through four or five instars during the spring and early summer months, and then enter diapause during mid- to late summer and will overwinter in this state until the following late winter or early spring (Guppy and Shephard 2001, p. 311). Diapause is a dormant state similar to hibernation when no feeding, growth or development occurs (Scott 1986, p. 26). Larvae of *E. editha* diapause in a sheltered spot under rocks, dry wood and vegetation, or in the soil and leaf litter at the base of a host or nonhost plant (Moore 1989, p. 1727). Prediapause larvae race to mature before host plants dry out and become unpalatable. First and second instar larvae cannot enter diapause, so if host plants senesce too early, the larvae suffer high rates of mortality (Murphy et al 2004, p. 26). Prediapause larvae move to new host plants when a host becomes completely eaten, and may shift to an alternate host plant species with changes in palatability as the season advances (Hellmann et al. 2004).

When temperatures begin to rise in late February or March, the caterpillars break diapause and resume feeding as post-diapause larvae for several weeks (Stinson 2005, p. 80). When the caterpillar is fully grown (5th instar) it forms a pupa, and undergoes metamorphosis into the adult form. Pupation lasts about two weeks, after which the adult butterfly ecloses (emerges) and lives for a few days to two weeks (Stinson 2005, p. 80). All nontropical checkerspot butterflies, including the Taylor's checkerspot butterfly, have the capability to reenter diapause prior to metamorphosis during years that weather is extremely inhospitable or when the larval food resources are restricted (Ehrlich and Hanski 2004, p. 22). The portion of the larval population that overwinters for a 2nd year is unknown, but may be as high as 30 to 50 percent in some years (Oregon Zoo 2009, cited in COSEWIC 2011, p. 36). Larvae that overwinter for a second year may aid in local population persistence during years when conditions are unfavorable.

Areas of habitat with open bare soil are an important habitat component for the butterfly as these areas warm more quickly than the surrounding vegetation, and butterflies thermoregulate by basking (Scott 1986, p. 296; Kuussaari et al. 2004, p. 140; Stinson 2005, p. 81). Post-diapause larvae forage singularly and are capable of moving much greater distances than pre-diapause larvae (Kuussaari et al. 2004, p. 140). Edith's checkerspot larvae have been documented to move up to 10 m (33 ft) from a release site, often moving within a habitat patch to different exposures to raise their body temperature, and presumably to find suitable foraging conditions (Kuussaari et al. 2004, p. 140). Dispersal within a habitat patch benefits the larvae because they are able to elevate their body temperature to an optimal range for foraging and development (Kuussaari et al. 2004, p. 156).

Larval Host Plants

For most butterfly species, larvae feed on plants within a single family (Scott 1986, p. 64). Some butterfly species are highly specialized and feed on only a single plant species or a few closely related species. Female Taylor's checkerspot butterflies and their larvae use plants that contain defensive chemicals known as iridoid glycosides, which have been recognized to influence the selection of oviposition sites by adult nymphalid butterflies (butterflies in the family Nymphalidae) (Murphy *et al.* 2004, p. 22; Page *et al.* 2009, p. 2), and function as a feeding stimulant for some checkerspot larvae (Kuussaari *et al*. 2004, p. 147). As maturing larvae feed, they accumulate these defensive chemical compounds from their larval host plants into their bodies. According to the work of Bowers (1981, pp. 373–374), this accumulation appears to deter predation. These larval host plants include members of the Broomrape family (Orobanchaceae), such as *Castilleja* (paintbrushes) and *Orthocarpus*, which is now known as *Triphysaria* (owl's clover), and native and nonnative *Plantago* species, which are members of the Plantain family (Plantaginaceae) (Pyle 2002, p. 311).

Taylor's checkerspot butterfly larvae have been confirmed feeding on *Plantago lanceolata* (narrow-leaf plantain) and *P. maritima* (sea plantain) in British Columbia (Guppy and Shepard 2001, p. 311), narrow-leaf plantain and *Castilleja hispida* (harsh paintbrush) in Washington (Char and Boersma 1995, p. 29; Pyle 2002, p. 311; Severns and Grosboll 2011, p. 4), and exclusively on narrow-leaf plantain in Oregon (Dornfeld 1980, p. 73; Severns and Warren 2008, p. 476). In 2012, the Taylor's checkerspot butterfly was documented preferentially ovipositing on the threatened *Castilleja levisecta* (golden paintbrush) in studies conducted in Washington, and in 2013, *Castilleja levisecta* was subsequently observed being utilized as a larval host plant in both Washington and Oregon (Kaye 2013, Aubrey 2013, in litt). The recent rediscovery in 2005 of Taylor's checkerspot butterflies in Canada led to the observation that additional food plants (*Veronica serpyllifolia* (thymeleaf speedwell) and *V. beccabunga ssp. americana* (American speedwell)) were being used by Taylor's checkerspot butterfly larvae (Page et al. 2009, p. 2).

Oviposition choices made by females determine which individual plant and which plant species prediapause larvae will feed upon. It is important to distinguish between pre- and post-diapause host plants when considering Taylor's checkerspot conservation because oviposition has only been observed to occur on two plant species in Oregon and Washington (*P. lanceolata* and *C. hispida*), whereas post-diapause larvae have been documented to eat *C. hispida, P. lanceolata, Plectritis congesta* (sea blush), *Collinsia parviflora* (small-flowered blue-eyed Mary), *Triphysaria pusilla* (dwarf owl-clover), and *Symphoricarpos albus* (snowberry) (Severns and Grosboll 2011, p. 71). Other larval host plants documented in Washington include *Collinsia grandiflora* (large-flowered blue-eyed Mary) and *Orthocarpus attenuatus* (narrow-leaved owl-clover) (Stinson 2005, p. 88).

Adult Nectar Sources

Adult butterflies do not grow, but feeding is required to maintain activity and egg development. In general, adult butterflies are less specialized in their use of food plants than larvae, and can meet their needs in the general vicinity of the larval food plants. Total egg production in checkerspots is affected by the availability of nectar sources and can double when nectar is plentiful (Murphy 1983, p. 261). Taylor's checkerspots may be somewhat specialized on certain nectar sources, and the number of nectar sources is limited during their spring flight period. Adult nectar sources for feeding include several species found as part of the native (and one nonnative) species mix on northwest grasslands, including, but not limited to: *Balsamorhiza deltoidea* (Puget balsam root); *Eriophyllum lanatum* (Oregon sunshine); *Lomatium utriclatum* (fine-leaved desert parsley or spring gold); *Lomatium triternatum* (Nineleaf biscuitroot); *Camassia quamash* (common camas); *Cerastium arvense* (field chickweed); and wild strawberry (*Fragaria virginiana*) (Stinson 2005, p. 91).

Significance of Habitat Diversity

Landscape and habitat diversity, or heterogeneity, are essential elements for the conservation of Edith's checkerspot butterflies (Ehrlich and Murphy 1987, p. 122; Hellman et al. 2004, p. 41). Patches of habitat where Taylor's checkerspot butterfly populations are robust also tend to have high topographic diversity including areas with mima mounds (low, domelike, mounds of earth found in certain prairies) and areas composed of swales (depressions) that produce ecotone habitat (Johnson and O'Neil 2001, p. 715) between dry upland habitat typical of south Puget Sound prairies, and wet prairie habitat more typical of the Willamette Valley (Easterly et al. 2005, p. 1). Habitat diversity is important for species persistence at a site, because during drought, butterflies survive best in cool, moist habitats, during extremely wet periods, butterflies persist best on warm, dry exposures (Murphy et al. 2004, p. 32).

Dispersal and Colonization

Taylor's checkerspot butterflies are non-migratory, but some limited dispersal of adult butterflies away from their natal sites does occur, potentially allowing for the colonization of adjacent habitat patches, or genetic exchange between local populations (Singer and Hanski 2004, pp. 184-185) In general, dispersal movements in checkerspots have rarely been found to exceed 2–3 km (Wahlberg et al. 2004, p. 223). Mark-recapture studies with checkerspot butterflies in Finland documented that they generally flew less than 1,640 ft (500 m), and studies of dispersal indicates that 95 percent of colonizations have been within 2.3 km of the nearest source, and the longest recorded colonizations were within 4 to 5 km of source populations (Singer and Hanski 2004, p. 184). Research conducted in California on Edith's checkerspot butterflies indicate the species is relatively sedentary, with over 96 percent of individuals marked recaptured in the area of previous capture; and dispersal of individuals between closely situated populations (less than 1 km) is rare even though the occupied patches were well within potential dispersal distance for the species (Hellmann et al. 2004, pp. 39-40).

Little work has been carried out on the ability of the Taylor's checkerspot butterfly to disperse. However, a mark-recapture study conducted in Oregon showed that dispersal distance was short (less than 984 ft (300 m) (Kaye et al. 2011, p. 16) and that Taylor's checkerspot butterflies tended to move to the nearest open patch, or from poor resource patches to rich resource patches, although rates of recapture were low (Kaye et al. 2011, p. 12). The recent observation of a single Taylor's checkerspot on Vancouver Island, approximately 5 km distant from the nearest known population on Denman island likely represents a potential within-year long-distance dispersal for this species (Page et al 2009, p. 18). Based on these various studies, we consider the typical dispersal distance for Taylor's checkerspot between habitat patches to be approximately 500 m (77 FR 61977), with the recognition that longer distance movements (up to 5 km) can occur in some years. This is consistent with research on other checkerspot species, which have described maximum colonization distances of 4-5 km for *E. e. bayensis* (Hellmann et al. 2004, p. 59).

Distribution and Status of Populations

The Taylor's checkerspot butterfly was historically known to occur in British Columbia, Washington, and Oregon, and its current distribution represents a reduction from over 80 locations rangewide to 14 sites in 2013. Historically, the Taylor's checkerspot butterfly was likely distributed throughout grassland habitat found on prairies, balds, grassland bluffs, and grassland openings within a forested matrix on south Vancouver Island, the northern Olympic Peninsula, the south Puget Sound prairies, and the Willamette Valley.

Nearly all localities for the Taylor's checkerspot butterfly in British Columbia have been lost; the only location currently known from British Columbia was discovered in 2005 (COSEWIC 2011, p. iv). In Oregon, the number of locations occupied by Taylor's checkerspot butterflies has declined from 13 to 2 (Ross 2011, *in litt.*, p. 1). In Washington State, 43 historical locales were documented for the Taylor's checkerspot butterfly. In 2013, there were 11 documented locations for the Taylor's checkerspot butterflies in Washington, with only one of the localities consistently harboring more than 1,000 individuals, and the majority of known sites have daily counts of fewer than 100 individual butterflies.

Total population sizes for Taylor's checkerspot butterfly are unknown, as this type of information requires intensive monitoring using mark-recapture techniques. Because butterfly populations vary so much year-to-year, and are very difficult to estimate accurately without intrusive techniques, no population estimate has been attempted. Current information on relative population sizes are derived from day counts which reflect only a portion of the total population during any given flight season.

Based on historical and current data, the distribution and abundance of Taylor's checkerspot butterflies have declined significantly rangewide, with the majority of recent extirpations occurring from approximately the mid-1990s in Canada (COSEWIC 2011, p. 15), 1999–2004 in south Puget Sound prairies, and around 2007 at the Bald Hills location in Washington. At the time of listing, there were 14 individual locations that were considered occupied by the Taylor's checkerspot butterfly rangewide, distributed in four disjunct geographic areas: Denman Island (BC) (1 occupied site), North Olympic Peninsula (WA) (6 occupied sites), South Puget Prairies (WA) (5 occupied sites), and the Willamette Valley (OR) (2 occupied sites) (Table 1). The Taylor's checkerspot butterfly is a declining taxon found only on a few declining habitat patches throughout the subspecies' range.

The distances between each of these disjunct geographic areas is great enough that there is no potential for connectivity or genetic exchange between these distant populations. Populations at each of the occupied sites face ongoing threats of habitat loss and degradation associated with succession and invasive nonnative plants, and other factors (see *Threats* discussion, below). A number of sites in Oregon and Washington where Taylor's checkerspot butterfly have been recently extirpated are considered high priority sites for habitat restoration and reintroduction of the species. These sites, which were unoccupied at the time the species was listed, are identified in the October 11, 2012 proposed rule to designate critical habitat for the Taylor's checkerspot butterfly (77 FR 61938).

Table 1. Summary of extant Taylor's checkerspot butterfly populations at the time of Federal listing in October 2013.

Region	Site	Approximate habitat area[1] (acres)	Potential estimated population size[2]	Distance to nearest occupied site (miles)[3]	Sources
BC	Denman Island	2,000+	1,000 - 10,000+	200+	COSEWIC 2011
WA – Olympic Peninsula	Sequim	151 (5 acres occupied)	50-500+	10.5	Severns & Grosboll 201l, Hays 2011
	Dan Kelly Ridge	209	50-100+	1.6	
	Eden Valley	26	50-100+	1.6	
	Upper Dungeness	93	50-100+	1.2	Holtrop 2010
	Three O'clock Ridge	103	50-100+	1.2	
	Bear Mountain	3	50-100+	3.9	
WA – South Puget Prairies	91st Division Prairie (East) (Range 72-76)	980	1,000 – 10,000+	2	Linders & Lewis 2013
	91st Division Prairie (West) (Range 50-51)	397	Reintroduced (2009-2011) 1,000-2,000+	2	
	13th Division Prairie (Training Area 15 and Pacemaker)	674	Reintroduced (2009, 2012) 0-50	8	
	Scatter Creek (South unit)	399	Reintroduced (2009-2013) 100-200+	2.1	
	Glacial Heritage	545	Reintroduced (2012-2013) 100 – 200+	2.1	
OR – Willamette Valley	Beazell Memorial Forest (5 sites)	61	200 – 800+	4.3	Ross 2012
	Fitton Green (4 sites)	83	500 – 1,000+	4.3	

Footnotes:

1. Approximate habitat area is a gross estimate based on areas mapped as proposed critical habitat for the Taylor's checkerspot butterfly (77 FR 61983) and includes areas that are not currently suitable habitat (i.e, areas occupied by trees and shrubs, etc.). Denman Island habitat area is from COSEWIC 2011, p. 15.
2. Actual population sizes for the Taylor's checkerspot butterfly are unknown, and can fluctuate considerably from year to year. Estimates listed here are considered to be general in nature and represent the cumulative total of adult butterflies on a site over the entire flight season. These estimates provide only a relative index of adult butterfly abundance based on multiple day counts or other monitoring surveys completed from 2008-2013.
3. Typical dispersal distances for checkerspot butterflies are generally considered to be less than or equal to 0.3 mile (less than or equal to 0.5 km)(77 FR 61977). Maximum known dispersal distance for Taylor's checkerspot are estimated at less than or equal to 3.1 miles (less than or equal to 5 km)(Page et al. 2009, p. 18).

Reintrodution of Taylor's checkerspot butterfly to a formerly-occupied prairie site (Training Area 7) at Joint Base Lewis-McChord in Washington is planned for spring 2014.

Population Dynamics

Checkerspot butterfly populations can fluctuate widely from year to year primarily due to the complex interactions of host plant phenology, annual weather conditions, and local topography (McLaughlin et al., 2002, p. 538, Hellmann et al., 2004, p. 41). Some Taylor's checkerspot butterfly populations in Washington have exhibited boom years with several thousand individuals and then declined dramatically with only 100 or so butterflies remaining the following year (Stinson 2005, p. 85). Long-term monitoring of checkerspot populations has revealed that population dynamics in *E. editha* are driven by both density-dependent factors (e.g., host plant availability) and density-independent factors (e.g., weather and topography) and that the response of local butterfly populations to the same weather conditions is highly variable depending on site topography and habitat conditions (McLaughlin et al., 2002, p. 538). Local topography is important, as minor variations in aspect and moisture directly influence development of larvae and pupae, as well as host plant development (Hellmann et al. 2004, p. 47).

Female checkerspots lay a large number of eggs, which represents a great potential for population growth, but in most populations and in most years, nearly all larvae die before reaching the adult stage due to the effects of weather and the availability and quality of host plants (Hellman et al 2004, p. 41). Population dynamics for the Taylor's checkerspot have not been studied, but probably have similarities to that of the bay checkerspot (*E.e. bayensis*). Bay checkerspot populations fluctuate widely in size from year to year, often due to pre-diapause mortality rates that can be in excess of 90 percent (Kuussaari et al. 2004, p. 149). Egg to adult survival in Taylor's checkerspot populations is unknown, but may be similar to that of bay checkerspots which is estimated to be 1 to 5 percent per year (Moore 1989, p. 1735).

Population survival for checkerspots depends on the production of large numbers of larvae, so that some larvae survive to maturity. Drought affects populations by reducing the period of host plant availability, while extended periods of rain reduces reproduction, egg survival, and larval growth (Hellmann et al. 2004, p. 44). Pre-diapause mortality strongly affects adult abundance in the subsequent year (McLaughlin et al., 2002, p. 538). Climate and topography also affect growth of post-diapause larvae in the winter, when aspect-determined contrasts in solar exposure are greatest and weather patterns strongly influence post-diapause larval development (McLaughlin et al., 2002, p. 539).

The availability and quality of larval host plants is an important factor affecting larval survival. Larval survival can vary depending on the host plant species used, presumably due to the relative nutritional value of the host plant species (Moore 1989, p. 1735). Populations with more than one potential host plant species available for use may be more likely to persist during adverse conditions (Hanski et al 2004, p. 270). Larvae are able to disperse between host plants and may shift use from one host species to another depending on the availability and senescence of host plant species (Hellmann et al. 2004, p. 43). Larval mortality from starvation can also occur due to competition when large numbers of larvae defoliate the available host plants (Kuussaari et al. 2004, p. 149). Predation and parasitism can be important sources of mortality in some butterfly species. However, there is no evidence that predation or parasitism is a significant source of larval mortality in *E. editha* (Kuussaari et al. 2004, p. 149).

Metapopulations

A metapopulation is a set of local populations that are connected over time by migration of individuals through dispersal and colonization (Nieminen et al. 2004, p. 64). Taylor's checkerspot butterfly most likely exhibited and persisted as a series of metapopulations composed of large and small local populations that interacted within a larger landscape context, with periodic extinction and colonization events. Most checkerspots are relatively sedentary and only a small percentage of individuals migrate to another habitat patch in any given year (Singer and Hanski 2004, p. 184). Colonization of empty patches may not occur in most years, but can occur in response to either very high or very low densities of butterflies within a habitat patch (Singer and Hanski 2004, pp. 189-190). Where there are other suitable habitat patches within dispersal distance, a vacant patch may become occupied, or genetic exchange between closely situated local populations may occur.

In *E. editha*, metapopulation dynamics are largely dependant on a few larger populations that act as sources of migrants to colonize habitat patches in the surrounding landscape (Hellman et al. 2004, p. 59). Not all habitat patches are occupied simultaneously, but in order for a metapopulation to persist over time, there is a balance between local extinctions and recolonizations. The conservation of butterfly species requires the protection of minimum viable metapopulations that include key source populations as well as smaller populations that allow the re-colonization of vacant patches to continue (Murphy and Weiss 1988, p. 183, Harrison 1989, p. 1242). Population modeling for other checkerspot species indicate a theoretical threshold of 15-20 well-connected habitat patches are necessary for long-term survival of a metapopulation (Hanski et al. 1996, pp. 539, Baguette and Schickzelle 2003, p. 410).

It is important to recognize that the total abundance and number of sites occupied by Taylor's checkerspot has been steadily declining over time. Habitat loss due to development, invasive plants, and natural succession has increased the isolation between occupied sites. The recent losses of multiple local populations due to stochastic extirpations has resulted in the loss of entire metapopulations (e.g., Bald Hills and south Puget Prairies in the vicinity of Rochester/Tenino, WA). The remaining extant populations of Taylor's checkerspot represent a relict distribution that is well below minimum habitat thresholds for long-term persistence. Management intervention is required to maintain and restore occupied habitat, and reintroduction efforts are needed to re-establish occupancy in habitats where metapopulations have been lost to local extinctions (Schultz et al. 2011, p. 374). Without metapopulation structure, the Taylor's checkerspot butterfly will likely continue to decline and may become extirpated at several of the locations where it currently is found (78 FR 61461).

Extinction Risk and Minimum Viable Populations

Most checkerspots live in small local populations. Small populations are influenced by several types of stochastic processes which can be grouped into environmental, demographic, and genetic processes (Whalberg et al 2004, p. 222). Checkerspots are highly vulnerable to perturbations in weather patterns, and populations can decline dramatically after years of extreme weather (hot and dry or cold and wet) because these extremes reduce reproductive success and larval survival (Hellmann et al. 2004, p. 51). Demographic factors can also lead to population declines due to competition for host plants at sites with high densities of larvae (Kuussarri et al 2004, p. 159), or genetic factors associated with inbreeding depression in very small populations (Nieminen et al. 2001, p. 243).

Stochastic extirpations are often related to patch size and isolation (Thomas et al. 1992, p. 563, Hanski et al. 1995, p. 25), and habitat-driven extinctions are often due to successional changes causing the habitat to become unsuitable (Thomas 1994, p. 373). The extirpations of local *E.e. bayensis* populations have ultimately been traced to successive years of adverse weather coupled with isolation and habitat loss in the surrounding area that precluded colonization from adjacent populations (Hellmann et al 2004, p. 58). The population monitoring data for the bay checkerspot demonstrate that even sites that consistently support populations of 1,000 to 10,000 butterflies can decline rapidly to extirpation within a matter of a few years due to environmental stochasticity (McLaughlin et al. 2002, p. 542).

The total abundance and number of sites occupied by *E.e. taylori* has declined steadily over the past several decades, with observed local extirpations at multiple sites documented from the mid 1990's to present (Stinson 2005, pp. 93-96). Habitat loss, habitat degradation, and loss of metapopulation structure has reduced local populations of Taylor's checkerspot to such low levels that they have become highly vulnerable to local extirpation. Population dynamics for Taylor's checkerspot have not been modelled, and basic information concerning the size of and trend of extant populations is generally not available. The limited information available suggests that most extant local populations likely consist of less than 1,000 individuals in most years, indicating the remaining Taylor's checkerspot populations are at high risk for stochastic extirpation. Estimates of minimum viable population size for Taylor's checkerspot have not been developed, but are likely comparable to other sedantary butterfly species, which indicate that in order for metapopulations to persist over the long-term (greater than 100 years), each metapopulation should consist of 10 to 20 well connected habitat patches, supporting minimum metapopulations of 1,000's of butterflies (Hanski et al 1996, p. 539; Bergman and Kindvall 2004, p. 57, Schiktzelle 2005, p. 578). Most of the remaining Taylor's checkerspot populations do not currently meet these theoretical criteria for metapopulation viability.

Threats

Habitat Loss and Fragmentation Associated with Land Conversion

The primary long-term threat to the Taylor's checkerspot butterfly is the loss, conversion, and degradation of habitat, particularly as a consequence of agricultural and urban development, successional changes to grassland habitat, and the spread of invasive plants.

Prairies, which historically covered over 145,000 acres (60,000 ha) of the south Puget Sound region, have largely been lost over the past 150 years (Crawford and Hall 1997, p. 11). The primary causes of prairie habitat loss in the region are attributed to the conversion of prairie habitat to urban development and agricultural uses (over 60 percent of losses), and succession to Douglas-fir forest (32 percent) (Crawford and Hall 1997, p. 11). Today approximately 8 percent of the original prairies in the south Puget Sound area remain, but only about 3 percent contain native prairie vegetation (Crawford and Hall 1997, p.11). In the remaining prairies, many of the native bunchgrass communities have been replaced by nonnative pasture grasses (Rogers 2000, p. 41). In the Willamette Valley, Oregon, native grassland has been reduced from the most common vegetation type to scattered parcels intermingled with rural residential development and farmland; it is estimated that less than 1 percent of the native grassland and savanna remains in Oregon (Altman *et al.* 2001, p. 261).

Native prairies and grasslands have been severely reduced throughout the range of the Taylor’s checkerspot butterfly as a result of human activity due to conversion of habitat to residential and commercial development and agriculture. Prairie habitat continues to be lost, particularly to residential development (Stinson 2005, p. 70) by removal of native vegetation and the excavation and grading of surfaces and conversion to non-habitat (buildings, pavement, other infrastructure). Residential development is associated with increased infrastructure such as new road construction, which is one of the primary causes of landscape fragmentation (Watts *et al*. 2007, p. 736). Activities that accompany low-density development are correlated with decreased levels of biodiversity, mortality to wildlife, and facilitated introduction of nonnative, invasive species (Trombulak and Frissell 2000, entire; Watts *et al*. 2007, p. 736). Four historical locales for Taylor’s checkerspot butterflies in the south Puget Sound region were lost to development or conversion. Dupont, Spanaway, and Lakewood were all converted to urban areas, and Joint Base Lewis McChord (JBLM) Training Area 7S became a gravel pit (Stinson 2005, pp. 93–96).

The decline in native grassland habitats is exemplified by the reduction in the distribution of the Taylor’s checkerspot butterfly from 43 historic populations to 11 populations in Washington, from 13 historic populations to 2 populations in Oregon, and from 24 historic populations to 1 population known from Canada (78 FR 61480). Most sites with extant populations of Taylor’s checkerspot butterfly are protected from further development through either state, Federal, or local conservation ownership, but habitats at many of these sites are further degraded by invasive species and competing uses such as recreation or military training (Schultz et al. 2011, p. 370).

As prairie habitat has been lost to urban development and agricultural conversion, the resulting fragmentation of remnant prairie habitat has led to a significant reduction in total prairie area, patch size and potential connectivity between habitat patches. Because of this, sites where Taylor’s checkerspot have been locally extirpated are unlikely to be re-colonized given their isolation from any source population (Schultz et al., 2011, p. 371). The historic metapopulation dynamics that linked various local populations of the Taylors checkerspot butterfly have been lost due to the fragmentation and isolation of remnant prairie patches, leaving the subspecies at high risk of extirpation due to habitat factors, weather extremes, increased mortality due to human impacts, and inbreeding (Stinson 2005, p. 100).

Loss of Ecological Disturbance Processes, Invasive Species, and Succession

The suppression and loss of natural and anthropogenic disturbance regimes, such as fire, across vast portions of the landscape has resulted in altered vegetation structure in the prairies and meadows and has facilitated invasion by nonnative grasses and woody vegetation, rendering habitat unusable for Taylor’s checkerspot butterflies. Historically, the prairies and meadows of the south Puget Sound region of Washington and western Oregon are thought to have been actively maintained by the native peoples of the region, who lived there for at least 10,000 years before the arrival of Euro-American settlers (Boyd 1986, entire; Christy and Alverson 2011, p. 93). Frequent burning reduced the encroachment and spread of shrubs and trees (Boyd 1986, entire; Chappell and Kagan 2001, p. 42; Storm and Shebitz 2006, p. 264), favoring open grasslands with a rich variety of native plants and animals. The basic ecological processes that maintain prairies or meadows have disappeared from, or have been altered on, all but a few protected and managed sites. At JBLM, approximately 39 percent (over 16,200 acres [6560 ha]) of the original prairie habitat has transitioned to Douglas-fir forest, and only a fraction of the original prairie habitat remains as small, isolated prairies (Tveten 1997, p. 124, Foster and Shaff 2003, p. 283).

Fires on the prairie create a mosaic of vegetation conditions, which serve to maintain native prairie forbs like *Camassia quamash* (common camas), *Achillea millefolium* (yarrow), and *Lomatium* spp. (desert parsley or biscuit root), which are adult nectar foods for the Taylor's checkerspot butterfly. Stands of native perennial grasses (*Festuca idahoensis* ssp. *roemeri* (Roemer's fescue)) are also well adapted to regular fires and produce habitat favorable to the Taylor's checkerspot butterfly. In some prairie patches, fires will reset succession back to bare ground, creating early successional vegetation conditions suitable for Taylor's checkerspot butterflies (Pearson and Altman 2005, p. 13). The historical fire return frequency on prairies has been estimated to be 3 to 5 years (Foster 2005, p. 8).

The result of fire suppression has been the invasion of the prairies and oak woodlands by native and nonnative plant species (Dunn and Ewing 1997, p. v; Tveten and Fonda 1999, p. 146), notably woody plants such as the native Douglas-fir (*Pseudotsuga menziesii*) and the nonnative Scot's broom, and nonnative grasses such as *Arrhenatherum elatius* (tall oatgrass) in Washington and *Brachypodium sylvaticum* (false brome) in the Willamette Valley of Oregon. This increase in woody vegetation and nonnative plant species has resulted in less available prairie habitat overall, and habitat that is avoided by Taylor's checkerspot butterflies (Tveten and Fonda 1999, p. 155). Where controlled burns or direct tree removal are not used as a management tool, this encroachment will continue to cause the loss of open grassland habitats for the Taylor's checkerspot butterfly.

Unintentional fires ignited by military training burns patches of prairie grasses and forbs on JBLM on an annual basis. These light ground fires create a mosaic of conditions within the grassland, maintaining a low vegetative structure of native and nonnative plant composition, and patches of bare soil. On sites where regular fires occur, such as on JBLM, there is a high complement of native plants and fewer invasive species, and a higher percentage of bare soil. These types of fires promote the maintenance of the native, short-statured vegetation communities (Severns and Warren 2008, p. 476) favored by the Taylor's checkerspot butterflies for larval and nectar food resources. Fire management to maintain or restore native vegetation is essential to maintaining suitable habitat for the Taylor's checkerspot butterfly, but requires careful planning and implementation because prescribed fire can destroy larvae, eggs, or adult butterflies when occupied habitats are burned.

Bald habitat at National Forest and Washington State Department of Natural Resources sites where Taylor's checkerspot butterflies are found were created due to shallow soil conditions or they may have been formerly forested and recently harvested, which resulted in early seral vegetation conditions suitable for Taylor's checkerspot. On bald habitat that was formerly forested, these areas appear to have been colonized by the Taylor's checkerspot butterfly shortly after they were cleared. At the time the trees were harvested from each of these balds they were replanted with conifers. The establishment and growth of the conifers, and the establishment and expansion of *Acer macrophyllum* (bigleaf maple), *Holodiscus discolor* (oceanspray), and other shrubs has resulted in shaded habitat that has replaced habitat occupied by the Taylor's checkerspot butterfly. Management of these balds should focus on removing shade-forming trees and shrubs coupled with active management to revegetate native forbs.

Sites that currently have Taylor's checkerspot butterflies present will quickly become unsuitable if trees and shrubs are not removed and if the sites are not managed specifically for the long-term conservation of the Taylor's checkerspot butterfly or the maintenance of bald habitat. This is the case for several balds recently occupied by the Taylor's checkerspot butterfly but no longer supporting the subspecies, including Bald Hills NAP in Thurston County of south Puget Sound, and Highway 112 and Striped Peak in Clallam County, on the north Olympic Peninsula.

<u>Military Training and Associated Activities</u>

JBLM contains the largest patches of remnant prairie habitat remaining in the south Puget Sound region (Stinson 2005, p. 11), and also contains the only remaining native population of Taylor's checkerspot butterfly on Puget prairie habitat. Frequent, low-intensity fires on the 91st Division Prairie on JBLM have maintained large areas of relatively high-quality prairie habitat (Stinson 2005, p. 12), and active prairie restoration and habitat maintenance programs on JBLM have facilitated recent reintroduction efforts both on and off JBLM. However, ongoing military training activities on JBLM has resulted in direct mortality of Taylor's checkerspot butterflies and the destruction of Taylor's checkerspot butterfly habitat through road construction, land conversion, and other developments. Off-road vehicle use, training with explosives, and soldier foot traffic in occupied habitat can kill butterfly eggs, larvae, and adults, and destroy larval host plants. These actions disrupt intact prairie plant communities by disturbing the vegetation and exposing soils, directly introducing invasive plant seeds carried in on tires or boots, and accelerating the rate of establishment of invasive grasses or other nonnative plants.

Several Department of Defense policies and an Integrated Natural Resources Management Plans (INRMP) are in place on JBLM to provide conservation measures to reduce the impacts of training activities to habitat occupied by Taylor's checkerspot. JBLM's INRMP includes provisions that will promote protection and conservation practices to support the Taylor's checkerspot butterfly, and to prevent further population declines associated with habitat loss or inappropriate management on JBLM properties. Despite these conservation measures, military training continues to have significant, habitat-altering impacts on the Taylor's checkerspot butterfly. All training areas on JBLM that are currently occupied by Taylor's checkerspot butterflies experience regular training, including mounted vehicle training and infantry training, with foot soldiers directly impacting the area where the subspecies is found. The U.S. Fish and Wildlife Service has worked closely with the Department of Defense to develop protection areas within the primary habitat for the Taylor's checkerspot butterfly on JBLM. These include areas where no vehicles are permitted on occupied habitat, where vehicles will remain on roads only, and where foot traffic is allowed. These conservation measures are important for reducing the impacts of the training activities, but these activities are likely to continue to harm individuals because not all areas on JBLM that are occupied by Taylor's checkerspot butterfly are protected by existing policy or the INRMP.

Habitat Management and Restoration

The ongoing threat of habitat loss and degradation associated with succession and the presence of nonnative invasive plants requires active management of prairie and grassland habitat in order for the Taylor's checkerspot butterfly to persist. Restoration activities are recognized as necessary and beneficial for the long-term persistence of the subspecies, but restoration activities must be carefully planned and implemented to minimize impacts to extant populations (Schultz et al. 2011, p. 375). On occupied sites, Taylor's checkerspot butterflies are present throughout the year in some life cycle form. Restoration activities (application of herbicides, use of restoration equipment, and prescribed fire) can result in trampling, crushing, and destruction of Taylor's checkerspot butterfly eggs, larvae, and adults, and the destruction of larval host plants.

Mowing to reduce the cover and competition from woody species, if done at the wrong time of year, can crush larval host plants and nectar plants used by adult butterflies on a site or even crush and kill larvae. Mowing activities should be timed to coincide with the diapause period for the subspecies, and mowing should be relatively high above the soil level to avoid any larvae that may not have burrowed into the soil. Restoration actions to improve Taylors' checkerspot butterfly habitat or increase the number of checkerspots on specific prairie patches is likely to have short-term adverse impacts to individuals. However, with careful planning and implementation, impacts to local populatons can be minimized and allow for successful reintroduction efforts or the expansion of occupied habitats.

Pesticides and Herbicides

In the south Puget Sound region, currently occupied Taylor's checkerspot butterfly sites are found in a matrix of rural agricultural lands and low-density development. In this context, herbicide and insecticide use may have direct effects on nontarget plants (butterfly larval and nectar hosts) and butterflies (Stark *et al*. 2012, p. 23). Herbicides are commonly used to manage rare butterfly habitat and control invasive nonnative plants in south Puget Sound prairies (Schultz *et al.* 2011, p. 373). Herbicide use can affect butterflies by damaging or destroying larval or adult food sources, or through the direct ingestion of a toxic substance, resulting in reduced larval survival and decreased rates of development from larvae to adult, as well as decreased wing area in some species of butterflies (Russell and Schultz 2010, p. 53). These studies indicate that the direct application of herbicide onto eggs, larvae, and larval host plants can result in reduced rates of larva-to-adult survival in some butterfly species, emphasizing the need for careful management using selective applications in habitats occupied by Taylor's checkerspot butterflies.

Aerial applications of pesticide also pose a potential threat to Taylor's checkerspot. The lepidopteran-specific insecticide, *Bacillus thurengensis var. kurstaki* (Btk) has been aerially applied to control Asian gypsy moth (*Lymantria dispar*) in the Puget Sound region and likely contributed to the extirpation of three historical locales for Taylor's checkerspot butterflies in

Pierce County, Washington, in 1992 (Vaughan and Black 2002, p. 13). Although grasslands are not targeted for Btk applications, drift from aerial applications can be lethal to non-target butterflies up to 1.8 miles (3 km) away from the target area (Whaley et al. 1998, p.539). Severns (2002) sampled butterfly diversity, richness, and abundance (density) for two years following a Btk application at Schwarz Park in Lane County, Oregon. Diversity, richness, and density were found to be significantly reduced for 2 years following spraying of Btk (Severns 2002, p. 168). Species like Taylor's checkerspot butterflies, which have a single brood per year, are active in the spring and their larvae are active during the spray application period. For nontarget lepidoptera, the early instar stages of larvae are the most susceptible stage (Wagner and Miller 1995, p. 21). A widespread application of Btk could have substantial impact on a local butterfly population if the pesticide were sprayed in an area where the habitat is exposed to the pesticide from direct application or through aerial drift.

Recreation and Off-Road Vehicles

Recreational foot traffic may be a threat to the Taylor's checkerspot butterfly, as trampling will crush larvae if they are present underfoot. The incidence of trampling is limited to the few locations where Taylor's checkerspot butterflies and recreation overlap. For example, foot traffic is relatively common at Scatter Creek Wildlife Area in Washington, where plants and butterfly habitat have been trampled by horses during specialized dog competitions in which dogs are followed by observers on horseback (Stinson 2005, p. 6), and by foot traffic using the trail system to access the meadows of Beazell Memorial Forest (Park) in Oregon. Recreation by JBLM personnel and local individuals occurs on and near the 13th Division Prairie. Trampling by humans and horses, as well as people walking dogs on the 13th Division Prairie, is likely to crush some larvae, as well as the larval and nectar prairie plant communities that are restored and managed for in this area.

Larvae have potentially been crushed on Dan Kelly Ridge, on the north Olympic Peninsula by vehicles that access the site to maintain a cell tower on the ridge. Also, recreational off-road vehicle (ORV) traffic on Dan Kelly Ridge, and on Eden Valley, has damaged larval host plants. The ORV damage on Dan Kelly Ridge occurs despite efforts by Washington State Department of Natural Resources to block access into the upper portions of the road system through gating of the main road. Based on our review, we conclude that ground-disturbing recreational activities are a threat to the Taylor's checkerspot butterfly and where the population is depressed may constitute a serious threat to the long-term conservation of the subspecies.

Low Genetic Diversity, Small or Isolated Populations, and Low Reproductive Success

There are a number of studies that demonstrate that habitat patch size, local population size, and proximity to adjacent populations have important implications for the long-term persistence of butterfly populations with limited dispersal capabilities (e.g., Thomas and Jones, 1993, p. 472; Hanski *et al.* 1995, p. 618; Saccheri *et al.* 1998, p. 492; Maes *et al.* 2004, pp. 234-235). Studies that examined butterfly population dynamics generally define "small" populations as having fewer than 500 adults and "very small" as having fewer than 100 adults at peak emergence (e.g., Maes *et al.* 2004, p. 232; Davies *et al.* 2005, p. 192). Essentially all populations of the Taylor's Checkerspot butterfly except two are currently classified as small or very small populations.

Extremely small butterfly populations (e.g. fewer than 20 individuals) are not only highly vulnerable to environmental factors such as adverse weather conditions (Schtickzelle *et al.* 2005, p. 578), but such small populations are also at increased risk of extinction due to genetic effects associated with inbreeding (Saccheri *et al.* 1998, p. 491; Nieminen *et al.* 2001, p. 243). Inbreeding in small populations of the Glanville fritillary butterfly (*Melitaea cinxia*) resulted in reduced egg hatching rates, larval survival, and adult longevity (Nieminen *et al.* 2001, p. 243).

Although the genetic diversity and population structure of the Taylor's checkerspot butterfly is unknown, a loss of genetic diversity may have occurred as a result of geographic isolation and fragmentation of habitat patches across the distribution of the existing populations. Dispersal of individuals between local populations directly affects the genetic composition of populations and possibly the abundance of individuals in a population (Hellmann *et al.* 2004, p. 59). For other subspecies of Edith's checkerspot and their closely related European relative *Melitaea*, small populations led to a high rate of inbreeding (Boggs and Nieminen 2004, p. 98). Due to the Taylor's checkerspot small population size and fragmented distribution, we conclude that the negative factors associated with small populations, as well as the potential historical loss of genetic diversity, may contribute to further population declines for the Taylor's checkerspot butterfly.

Climate Change

Over the next century, climate change at global and regional scales is predicted to result in changes in butterfly species distributions and altered life histories (McLaughlin et al. 2002, p. 6074, Hill et al. 2002, p. 2163, Singer and Parmesan 2010, p. 3161). Rare butterflies, including the Taylor's checkerspot, may be vulnerable to climate change, as their populations are often fragmented due to habitat losses that restrict the species' ability to adapt to changing environmental conditions (Schultz et al. 2011, p. 375).

In the Pacific Northwest, mean annual temperatures rose 0.8 °C (1.5 °F) in the 20th century and are expected to continue to warm from 0.1 °C to 0.6 °C (0.2 °F to 1.0 °F) per decade (Mote and Salathe 2010, p.29). Global climate models project an increase of 1 to 2 percent in annual average precipitation, with some models predicting wetter autumns and winters with drier summers (Mote and Salathe 2010, p.29). Regional models of potential climate changes are much more variable, but the models generally indicate a warming trend in mean annual temperature, reduced snowpack, and increased frequency of extreme weather events (Salathe et al. 2010, pp. 72-73). Downscaled regional climate models, such as those presented by www.climatewizard.org have tremendous variation in projections for annual changes in temperature or precipitation depending upon the climate model or scenario. Averaged values across large areas generally indicate a general warming trend in mean annual temperature consistent with the climate projections reported by Salathe and others (2010, pp. 72-73).

Because the Taylor's checkerspot butterfly occupies a relatively small area of specialized habitat, it may be vulnerable to climatic changes that could decrease suitable habitat or alter food plant seasonal growth patterns (phenology). The relationship between climate change and survival for the *Euphydryas editha* complex is driven more by the indirect effects of the interaction between seasonal growth patterns of host plants and the life cycle of the checkerspot butterfly than by the direct effects of temperature and precipitation (Guppy and Fischer 2001, p. 11; Parmesan 2007, p. 1868; Singer and Parmesan 2010, p. 3170). Predicting seasonal growth patterns of butterfly host plants is complicated, because these patterns are likely more sensitive to moisture than temperature (Cushman et al 1992, pp. 197–198; Bale *et al*. 2002, p. 11), which is predicted to be highly variable and uncertain in the Pacific Northwest (Mote and Salathé 2010, p. 31). Climate models for the Georgia Basin—Puget Sound Trough—Willamette Valley Ecoregion consistently predict a deviation from the historical monthly average precipitation, with the months of January through April projected to show an increase in precipitation across the region, while June through September are predicted to be much drier than the historical average (Climatewizard 2012).

It is likely that the overlap of seasonal growth patterns between primary larval host plants and the Taylor's checkerspot butterfly will display some level of stochasticity due to climatic shifts in precipitation and increased frequency of extreme weather events. For the Edith's checkerspot (*E. editha*), Parmesan (2007, p. 1869) reported that a lifecycle mismatch can cause a shortening of the time window available for larval feeding, causing the death of those individuals unable to complete their larval development within the shortened period, citing a study by Singer (1972, p. 75). In that study, Singer documented routine mortality of greater than 98 percent in the field due to phenological mismatches between larval development and senescence of their annual host plant *Plantago erecta* (California plantain). When mismatches such as these form the 'starting point,' insects may be highly vulnerable to small changes in synchrony with their hosts (Parmesan 2007, p. 1869).

The interplay between host plant distribution, larval and adult butterfly dispersal, and female choice of where to lay eggs will ultimately determine the population response to climate change (Singer and Parmesan 2010, p. 3164). However, determining the long-term responses to climate change from even well-studied butterflies in the genus *Euphydryas* is difficult, given their ability to switch to alternative larval food plants in some instances (Singer and Thomas 1996, pp. S33–34; Hellmann 2002, p. 933; Singer *et al*. 1992, pp. 17–18). Attempts to analyze the interplay between climate and host plant growth patterns using predictive models or general State-wide assessments and to relate these to the Taylor's checkerspot butterfly are equally complicated (Murphy and Weiss 1992, p. 8). Despite the potential for future climate change in Western Washington, we have not identified, nor are we aware of any data on an appropriate scale to evaluate the effects of climate change to habitat or population trends for the Taylor's checkerspot butterfly. However, we recognize that weather events and climatic factors strongly influence the reproduction and larval survival rates for the Taylor's checkerspot, and these effects are most profound in species with small, isolated populations such as the Taylor's checkerspot.

<u>Stochastic Weather Events</u>

Adverse weather (freezing temperatures, heavy rain events, or prolonged drought) can extirpate local butterfly populations by killing adults, larvae, or larval food plants (Guppy and Shephard 2001, p. 59). Even large populations of butterflies (greater than 5,000 individuals) can rapidly decline in response to successive seasons of unfavorable weather conditions during reproduction and larval development (Ehrlich et al. 1980, pp. 102-103). Poor weather conditions, such as cool temperatures and rainy weather, reduce the number of days in the flight period for several early spring flying butterflies, including the Taylor's checkerspot butterfly. A shorter flight season reduces the number of opportunities for oviposition (egg laying) for female butterflies, thus affecting the emergence of adult butterflies in the future.

Butterflies, including the Taylor's checkerspot butterfly, may experience increased mortality or reduced fecundity if the timing of plant development does not match the timing of larval or adult butterfly development (Peterson 1997, p. 167), and large fluctuations in population sizes have been observed based on local weather patterns (Hellmann *et al*. 2004, p. 45). During 2010 and 2011, the emergence of Taylor's checkerspot butterfly adults was approximately 3 weeks later than "normal" due to wet and cool spring weather. In addition, it has been reported that both drought and deluge may interrupt the insect-plant interaction, resulting in decreased populations (Hellmann *et al*. 2004, p. 45). The effects of drought have been shown to negatively affect populations of Edith checkerspot butterflies in California (Hellmann *et al*. 2004, p. 45).

Because the historical numbers and distribution of the Taylor's checkerspot butterfly has been reduced to a handful of relict populations, the subspecies is particularly vulnerable to the effects of adverse weather events, particulary when compounded with other ongoing threats associated with habitat loss and degradation associated with succession and invasive plants.

Conservation and Recovery Actions

The imperiled status of the Taylor's checkerspot butterfly has led to a number of habitat restoration actions and reintroduction efforts. The Washington Department of Fish and Wildlife in cooperation with the Oregon Zoo and others have an ongoing captive rearing program to support reintroduction of Taylor's checkerspot butterflies at south Puget prairie sites that have been managed for butterfly habitat (Linders 2011, p. 383). Sites targeted for reintroduction include areas that historically supported Taylor's checkerspot butterfly. Reintroductions of captive-reared postdiapause larvae and adult butterflies have resulted in the tentative establishment of three Taylor's checkerspot populations since 2007 (Table 1, above), while efforts at fourth site (JBLM-Pacemaker) have been discontinued, and very few butterflies were seen at this site in 2013 (Linders & Lewis 2013, p. 45).

Habitat restoration efforts to manage invasive species and restore native forb and grass communities is ongoing at most sites currently occupied by the Taylor's checkerspot butterfly (e.g., Linders & Lewis 2013, Hayes 2011, Ross 2008). In 2007, JBLM, started an Army Compatible Use Buffer (ACUB) initiative that includes support for interagency butterfly habitat management on several Puget prairie sites (Fimbel et al 2011, p. 379). Habitat restoration using prescribed fire, herbicide applications, followed by seeding and planting of native grasses and forbs have proven to be successful methods for restoring degraded prairie habitats (Fimbel et al 2011, p. 379). Removal of small trees and shrubs within natural balds and occupied clearcut areas on the Olympic Peninsula has been undertaken to slow the rate of natural succession occurring there, as these sites are undergoing rapid transition from grass to forested habitat (Hayes 2011, p. 10). Habitat restoration and maintenance is an ongoing conservation need at all sites currently occupied by Taylor's checkerspot butterfly, as native plant communities have largely been replaced by non-native grasses and invasive shrubs.

Summary of Species Status and Threats

The distribution of the Taylor's checkerspot butterfly has been reduced from more than 80 populations to the 14 occupied locations with small populations that are known rangewide today. Some of the populations that have been extirpated have disappeared in the past decade, and some declined from robust population sizes of 1,000s of individual butterflies to zero within a 3-year interval and have not returned (Stinson 2005, p. 94). In the south Puget prairies, only one native local population remains, others are the result of recent reintroduction efforts. Most remaining populations of Taylor's checkerspot butterflies are very small; 5 of the 14 known populations are estimated to have fewer than 100 individuals.

The threats of land development and loss of habitat from conversion to other uses (agriculture); the impacts of military training and recreation; existing and likely future habitat fragmentation, habitat disturbance; long-term fire suppression; and ongoing loss and degradation of habitat associated with native and nonnative invasive species continues. These factors have resulted in the present isolation and limited distribution of the subspecies, and are currently ongoing and will continue into the foreseeable future. The combination of ongoing threats coupled with small population sizes and highly variable population dynamics leads us to conclude that the Taylor's checkerspot butterfly is currently in danger of extinction throughout its range.

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APPENDIX C
STATUS OF THE SPECIES - MAZAMA POCKET GOPHER

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Appendix C: Status of the Species - Mazama Pocket Gopher

<u>Status of the Species</u>

On December 11, 2012, the U.S. Fish and Wildlife Service (Service) proposed to list four subspecies of the Mazama pocket gopher (*Thomomys mazama ssp.*) as threatened species under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.) (Act). The Service determined that the listing of four subspecies, with a present range in Pierce and Thurston Counties, Washington, is warranted (77 FR 73770; 11 December 2012): *T. m. pugetensis* (Olympia pocket gopher), *T. m. tumuli* (Tenino pocket gopher), *T. m. yelmensis* (Yelm pocket gopher), and *T. m. glacialis* (Roy Prairie pocket gopher). The Service also determined that the Tacoma pocket gopher (*T. m. tacomensis*) is extinct, and that the listing of three other subspecies of Mazama pocket gopher is not warranted at this time: *T. m. couchi* (Shelton pocket gopher), *T. m. louiei* (Cathlamet pocket gopher), and *T. m. melanops* (Olympic pocket gopher).

On April 9, 2014, the Service published a final rule in the Federal Register listing four subspecies of the Mazama pocket gopher as threatened throughout their ranges in the State of Washington (79 FR 19760; April 9, 2014). The Service also published a final rule designating critical habitat for three of the four subspecies (79 FR 19712; April 9, 2014).

Species Information - Taxonomy

Although the species *Thomomys mazama*, or Mazama pocket gopher, includes numerous subspecies that are found in the States of Washington, Oregon, and California, only the subspecies found in the State of Washington have recently been considered for listing. The Mazama pocket gopher complex consists of 15 subspecies, eight of which occur only in Washington, five of which occur only in Oregon, one that occurs only in California, and one subspecies with a distribution that spans the boundary between Oregon and California (Hall 1981, p. 467).

The first pocket gophers collected in western Washington were considered subspecies of the northern pocket gopher (*Thomomys talpoides*)(Goldman 1939), until 1960 when the complex of pocket gophers found in western Washington was determined to be more similar to the western pocket gopher (*T. mazama*)(Johnson and Benson 1960, p. 20). Eight western Washington subspecies of Mazama pocket gopher (*T. mazama, ssp. couchi*, *glacialis*, *louiei*, *melanops*, *pugetensis*, *tacomensis*, *tumuli*, and *yelmensis*) have been identified (Hall 1981, p. 467).

Thomomys mazama is recognized as a valid species by the Integrated Taxonomic Information System (ITIS 2012). Although there have been suggestions that potential changes to the classification of some of these subspecies should be considered, we have no information to suggest that any of the presently recognized subspecies are the subject of serious dispute.

We follow the subspecies designations of Verts and Carraway (2000), as this text represents the currently accepted taxonomy for the species *T. mazama*. Verts and Carraway (2000, p.1) recognize *T. m. glacialis*, *pugetensis*, *tumuli*, and *yelmensis* as separate subspecies (the Roy Prairie, Olympia, Tenino, and Yelm pocket gophers, respectively) based on morphological characteristics, distribution, and differences in number of chromosomes. Due to the close proximity of the four subspecies located in Thurston and Pierce Counties, and the fact that at least three of them occur in the same clade, we refer to these four subspecies (*T. m. glacialis*, *pugetensis*, *tumuli*, and *yelmensis*) as "the four Thurston/Pierce subspecies" of the Mazama pocket gopher.

Adult Mazama pocket gophers are reddish brown to black above, and the underparts are lead-colored with buff-colored tips. The lips, nose, and patches behind the ears are black; the wrists are white. Adults range from 7 to 9 inches (189 to 220 millimeters (mm)) in total length, with tails that range from 2 to 3 inches (45 to 85 mm)(Verts and Carraway 2000, p.2). Mazama pocket gophers are morphologically similar to other species of pocket gophers that exploit a subterranean existence. They are stocky and tubular in shape, with short necks, powerful limbs, long claws, and tiny ears and eyes. Their short, nearly hairless tails are highly sensitive and probably assist when navigating tunnels. The "pockets" are external, fur-lined cheek pouches on either side of the mouth that are used to transport nesting material and plant cuttings. Mazama pocket gophers reach reproductive age in the spring of the year after their birth and produce litters between spring and early summer. Litter size ranges from one to nine (Wight 1918, p. 14), with an average of five (Scheffer 1938, p. 222). They do not hibernate in winter; they remain active throughout the year (Case and Jasch 1994, p. B-20).

In Washington, Mazama pocket gophers are found west of the Cascade Mountain Range, in the Olympic Mountains and in the Puget Sound trough, with an additional single locality known from Wahkiakum County (Verts and Carraway 2000, p.3). Their populations are concentrated in well-drained friable soils often associated with glacial outwash.

Species Information - Habitat and Life History

The Mazama pocket gopher (pocket gopher) is associated with glacial outwash prairies in western Washington, an ecosystem of conservation concern (Hartway and Steinberg 1997, p. 1), as well as alpine and subalpine meadows and other meadow-like openings at lower elevations. Steinberg and Heller (1997, p. 46) found that pocket gophers are even more patchily distributed than are prairies, as there are some seemingly high quality prairies within the species' range that lack pocket gophers; e.g., Mima Mounds Natural Area Preserve (NAP), and 13th Division Prairie on Joint Base Lewis-McChord (JBLM).

Pocket gopher distribution is affected by the rock content of soils, drainage, forage availability, and climate (Case and Jasch 1994, p. B-21; Hafner et al. 1998, p. 279; Reichman 2007, pp. 273-274; Steinberg and Heller 1997, p. 45; Stinson 2005, p. 31; WDFW 2009). Prairie and meadow habitats used by pocket gophers have a naturally patchy distribution. In their prairie habitats, there is an even patchier distribution of soil rockiness which may further restrict the total area that pocket gophers can utilize (Steinberg and Heller 1997, p. 45; WDFW 2009). We assume that meadow soils have a similarly patchy distribution of rockiness, though the soil surveys to support this are, at this time, incomplete.

In western Washington, pocket gophers currently occupy the following soils series: Alderwood, Cagey, Carstairs, Everett, Everett-Spanaway complex, Everett-Spanaway-Spana complex, Godfrey, Grove, Indianola, Kapowsin, McKenna, Murnen, Nisqually, Norma, Shelton, Spana, Spana-Spanaway-Nisqually complex, Spanaway, Spanaway-Nisqually complex, and Yelm. No soil survey information is currently available for occupied sites in the Olympic National Park, so the soils occupied there are unknown.

We purposely avoid using specific map unit names, because we know that there are imperfections in soil mapping. Maps are based on the technology, standards, and tools available at the time soil surveys were conducted, sometimes up to 50 years ago. We recognize that soil survey boundaries may be adjusted in the future, and that soil series names may be added or removed to soil survey maps and databases. As a result, the overlap of pocket gopher locations with soil series names may be different in the future. The soils information presented here is based on best scientific data available at the time of listing.

We also recognize that some of these soil series or soil series complexes are not typically either deep or well-drained. For a variety of reasons, mapped soil types may or may not have all of the characteristics described by the U.S. Department of Agriculture, Natural Resources Conservation Service, and the actual soils that occur on sites may have characteristics that make them more or less habitable by pocket gophers. These reasons may include: map boundary or transcription errors, map projection errors or differences, map identification or typing errors, soil or hydrological manipulations that have occurred since mapping took place, and small-scale inclusions that are different from the mapped soil. Because soils are mapped at large scales, mapped soils may not identify smaller inclusions.

Any of the soil series or soil series complexes listed above could potentially be suitable for the four Thurston/Pierce subspecies of the Mazama pocket gopher. And, the four Thurston/Pierce subspecies of the Mazama pocket gopher may also inhabit soil series not included in the above list. Although some soils are sandier, more gravelly, or may have more or less silt than described, most all soils used by pocket gophers are friable (easily pulverized or crumbled), loamy, and deep, and generally have slopes less than 15 percent.

There have been reports of pocket gophers (subspecies unknown) occurring on other types of soils, on managed forest lands in Capitol State Forest (owned by the Washington State Department of Natural Resources, WDNR) and Vail Forest (owned by Weyerhaeuser) in Thurston County. These were subsequently determined to be moles (*Scapanus spp*.), based on trapping conducted in these areas by the Washington State Department of Fish and Wildlife (WDFW) during 2012 (Thompson, pers. comm. 2012b).

A study of the relationship between soil rockiness and pocket gopher distribution revealed a strong negative correlation between the proportion of medium-sized rocks in the soil, and the presence of pocket gophers (eight of nine prairies sampled); medium sized rocks were considered greater than 0.5 inch (12.7 mm), but less than 2 inches (50.8 mm) in diameter (Steinberg 1996, p. 32). In observations of pocket gopher distribution on JBLM, pocket gophers did not occur in areas with a high percentage of Scot's broom cover (*Cytisus scoparius*), or where mole populations were particularly dense (Steinberg 1995, p. 26). A more recent study on

JBLM also found that pocket gopher presence was negatively associated with Scot's broom; however, the researcher found no relationship between pocket gopher presence and mole density (Olson 2011a, pp. 12, 13).

Pocket gopher burrows consist of a series of main runways, off which lateral tunnels lead to the surface of the ground (Wight 1918, p. 7). Pocket gophers dig their burrows using their sharp teeth and claws and then push the soil out through the lateral tunnels (Case and Jasch 1994, p. B-20; Wight 1918, p. 8). Nests containing dried vegetation are generally located near the center of each pocket gopher's home tunnel system (Wight 1918, p. 10). Food caches and store piles are usually placed near the nest, and excrement is piled into blind tunnels or loop tunnels, and then covered with dirt, leaving the nest and main runways clean (Wight 1918, p. 11).

A variety of natural predators prey on pocket gophers, including weasels (*Mustela* spp.), snakes, badgers (*Taxidea taxus*), foxes (*Vulpes* spp.), skunks (*Mephitis mephitis*), bobcats (*Lynx rufus*), coyotes (*Canis latrans*), great horned owls (*Bubo virginianus*), barn owls (*Tyto alba*), and several hawks (Case and Jasch 1994, p. B-21; Fichter et al. 1955, p. 13; Hisaw and Gloyd 1926; Huntly and Inouye 1988, p. 792; Stinson 2005, pp. 29, 30). In addition to natural predators, predation by feral and domestic dogs (*Canis lupus familiaris*) and cats (*Felis catus*) is an increasing problem for the four Thurston/Pierce subspecies of the Mazama pocket gopher. Pocket gophers are exposed to increased levels of predation in developed semi-urban and rural environments.

Pocket gophers are generalist herbivores and their diet includes a wide variety of plant material, including leafy vegetation, succulent roots, shoots, and tubers. In natural settings pocket gophers play a key ecological role by aerating soils, activating the seed bank, and stimulating plant growth, though they can be considered pests in agricultural systems. In prairie and meadow ecosystems, pocket gopher activity plays an important role in maintaining species richness and diversity.

Foraging primarily takes place below the surface of the soil, where pocket gophers snip off roots of plants before occasionally pulling the whole plant below ground to eat or store in caches. If above-ground foraging occurs, it's usually within a few feet of an opening and forage plants are quickly cut into small pieces and carried back to the nest or cache (Wight 1918, p. 12). Any water they need is obtained from their food (Gettinger 1984, pp. 749-750; Wight 1918, p. 13). The probability of pocket gopher occupancy is much higher in areas with less than 10 percent woody vegetation cover (Olson 2011a, p. 16), presumably because such vegetation will shade out the forbs, bulbs, and grasses that pocket gophers prefer to eat, and high densities of woody plants make travel both below and above the ground difficult.

The pocket gopher's home range is composed of suitable breeding and foraging habitat. Home range size varies based on factors such as soil type, climate, and density and type of vegetative cover (Case and Jasch 1994, p. B-21; Cox and Hunt 1992, p. 133; Hafner et al. 1998, p. 279). Little research has been conducted regarding home range size for individual pocket gophers in western Washington. Witmer et al. (1996b, p. 96) reported an average home range size of approximately 1,076 square feet (100 square meters) for one location in Thurston County, Washington. Pocket gopher density varies greatly due to local climate, soil suitability, and vegetation types (Case and Jasch 1994, p. B-21; Howard and Childs Jr. 1959, pp. 329-336), and densities are likely to be higher when habitat quality is better. Therefore, this one report (Witmer et al. 1996b) is unlikely to represent the average density across all soil types, vegetation types, and other unique site characteristics across the ranges of the four Thurston/Pierce subspecies of the Mazama pocket gopher.

Research on other species of *Thomomys* pocket gophers show a wide range of home range sizes, from approximately 80 to 14,370 square feet (7.4 to 1,335 square meters). Studies that have included live-capture and enumeration continue to find that densities of the four Thurston/Pierce subspecies of the Mazama pocket gopher vary significantly, between sites with dissimilar characteristics, between sites with similar characteristics, and within the same sites over time.

In the absence of studies demonstrating the minimum possible patch size for persistence of pocket gophers, we used 50 acres (20 hectares (ha)) as the smallest area necessary for recovery of populations, which was the agreed upon estimate of an expert panel assembled to assist with the construction of a prairie habitat modeling exercise (Converse et al. 2010, pp. 14, 15). We acknowledge uncertainty with this estimate, but there are currently no studies regarding minimum patch size, nor are there any obvious means by which a better answer can be obtained. Thus, the best available scientific data in this case is the opinion of an informed expert panel.

Pocket gophers reach sexual maturity during the spring of the year following their birth, and generally produce one litter per year (Case and Jasch 1994, p. B-20), though timing of sexual maturity has been shown to vary with habitat quality (Patton and Brylski 1987, p. 502; Patton and Smith 1990, p. 76). Gestation lasts approximately 18 days (Andersen 1978, p. 421; Schramm 1961, p. 169). Young are born in the spring to early summer (Wight 1918, p. 13), and are reared by the female. Aside from the breeding season, males and females remain segregated in their own tunnel systems. There are 1-9 pups per litter (averaging 5), born without hair, pockets, or teeth, and they must be kept warm by the mother or “packed” in dried vegetation (Case and Jasch 1994, p. B-20; Wight 1918, p. 14). Juvenile pelage starts growing in at just over a week (Andersen 1978, p. 420). The young eat vegetation in the nest within three weeks of birth, with eyes and ears opening and pockets developing at about a month (Andersen 1978, p. 420; Wight 1918, p. 14). At six weeks they are weaned, fighting with siblings, and nearly ready to disperse (Andersen 1978, p. 420; Wight 1918, p. 15), which usually occurs at about two months of age (Stinson 2005, p. 26). They attain their adult weight between four and five months of age (Andersen 1978, pp. 419, 421). Most pocket gophers live only a year or two, with few living to three or four years of age (Hansen 1962, pp. 152, 153; Livezey and Verts 1979, p. 39).

Pocket gophers rarely surface completely from their burrow except as juveniles, when they disperse above ground from spring through early fall (Howard and Childs Jr. 1959, p. 312; Ingles 1952, p. 89). They are highly asocial and intolerant of other pocket gophers. Each pocket gopher maintains its own burrow system, and occupancy of a burrow system by multiple individuals occurs only for brief periods during mating seasons and prior to weaning young (Ingles 1952, pp. 88, 89; Marsh and Steele 1992, p. 209; Witmer and Engeman 2007, p. 288).

The mating system is probably polygynous (a single male mates with multiple females) and most likely based on female choice. The adult sex ratio has been reported as biased toward females in most species of pocket gophers that have been studied, often as much as 4:1 (Howard and Childs Jr. 1959, p. 296; Patton and Feder 1981, p. 917), though Witmer et al. (1996a, p. 95) reported a sex ratio of close to 1:1. Sex ratio may vary with population density, which is often influenced by forage density and soil suitability for burrowing (Patton and Smith 1990, p. 6). One site having a deep soil layer with considerably less rock was estimated to have a pocket gopher population density five times that of another site having rocky soil (Steinberg 1996, p. 26).

Pocket gophers have limited dispersal capabilities (Williams and Baker 1976, p. 303). Mazama pocket gophers are smaller in size than other sympatric or peripatric *Thomomys* species (Verts and Carraway 2000, p. 1). Both dispersal distance and home range size are therefore likely to be smaller than for other *Thomomys* species. Dispersal distances may vary based on surface or soil conditions and size of the animal. For other, larger, *Thomomys* species, dispersal distances average about 131 feet (40 meters) (Barnes Jr. 1973, pp. 168, 169; Daly and Patton 1990, pp. 1286, 1288; Williams and Baker 1976, p. 306). Initial results from research being conducted on JBLM indicate that juvenile pocket gophers usually make movements from 13.1 to 32.8 feet (4-10 meters), though these may not be dispersal movements. One juvenile made a distinct dispersal movement of 525 feet (160 meters) in a single day (Olson 2012, p. 5).

Suitable dispersal habitat is free of barriers to movement, and may need to contain foraging habitat if an animal is required to make a long-distance dispersal movement. Potential barriers include, but are not limited to, forest edges, roads (paved and unpaved), abrupt elevation changes, Scot's broom thickets (Olson 2012, p. 3), highly cultivated lawns, inhospitable soil types or substrates (Olson 2008, p. 4), development and buildings, slopes greater than 35 percent, and open water. Barriers may be permeable, meaning that they impede movement from place to place without completely blocking it, or they may be impermeable, meaning they cannot be crossed. Permeable barriers, as well as lower quality dispersal habitats, may present a risk of mortality for animals that use them (e.g., open areas where predation risk is increased, or a paved area where vehicular mortality is high).

The WDFW conducted a study to determine dispersal distances of juvenile pocket gophers on JBLM. Twenty-eight juveniles were radio-collared and tracked for 17 to 56 days, with all but three animals tracked for more than 30 days. Of these, only nine gophers moved more than 32.8 feet (10 meters), and 10 gophers were never found more than 13.1 feet (4 meters) from any previous location (Olson 2012, p. 5). Only one animal dispersed what would be considered a larger distance, moving 525 feet (160 meters) in a single day.

Historical and Current Range and Distribution

The following general description of the distribution of the four Thurston/ Pierce subspecies of Mazama pocket gopher (*Thomomys mazama glacialis*, *pugetensis*, *tumuli*, and *yelmensis*) is based on our current knowledge. Steinberg (1996, p. 9) surveyed all historical and many currently known sites. This included all current and formerly known occupied sites listed by the WDNR as having Carstairs, Nisqually, or Spanaway gravelly or sandy loam soil, and that WDNR determined to have vegetation that was intact prairie or restorable to prairie. WDFW and a group of consultants have surveyed areas of potential pocket gopher habitat in both counties, usually associated with proposed development (WDFW 2012). WDFW has also surveyed areas in relation to various research studies, as well as conducting distribution surveys across five counties in 2012 (Thompson, in litt. 2012a).

The Roy Prairie pocket gopher occurs generally south and east of I-5, south of State Highway 512, and west of State Highway 7. There are prairie-type areas within this described area that have been surveyed multiple times with no detections, so this description is likely to be an overestimate of the subspecies' range. This description also includes areas thought to be within the historical range of the Tacoma pocket gopher, which is presumed extinct. Few surveys have been conducted off JBLM lands in this area, and our specific knowledge of the range of this subspecies could change in the future.

In Thurston County, the Olympia, Tenino, and Yelm pocket gophers are known to occur east of the Black River and south of Interstate 5 and State Highway 101. There are no historical records of pocket gophers occurring outside of these areas within Thurston County. Soil series and soil series complexes that are known to support pocket gophers do occur outside of these areas. Multiple surveys conducted west of the Black River have consistently yielded negative results (WDFW 2013a). For that reason, there is some confidence that the Black River is a range-restrictive landscape feature. Fewer surveys have been conducted north of Interstate 5 and State Highway 101 (WDFW 2013a), but those also yielded negative results. It is possible that pocket gophers may occur north of these highways in Thurston County, but we presently have no data to support that conclusion.

The present outermost boundaries of the ranges of each of the four Thurston/Pierce subspecies of the Mazama pocket gopher are likely approximately the same as they were historically. However, entire prairie areas or portions thereof within those outer perimeters have been lost to development and woody plant encroachment. Therefore, at present pocket gophers likely occupy fewer total acres than they did historically, and also occupy fewer total areas (that is, there are fewer populations within the area of their diminished range). The four subspecies are known to still occur in their type locality locations (described below), and the areas immediately around those locations are considered to still be part of each subspecies' range. Beyond these areas, uncertainty remains as to the entire areal extent of each subspecies' range, and where or if populations of the subspecies coexist or abut one another. Each subspecies' range is presumed to extend beyond their type localities. For this reason, the list of soils given for each subspecies (below) is shorter than the list given in our final designation of critical habitat.

The type locality for the Olympia pocket gopher (*Thomomys mazama pugetensis*) was the prairie on and around the Olympia Airport (Dalquest and Scheffer 1944, p. 445). Gophers continue to occupy this area. Soil series and soil series complexes in and around this area that may support pocket gophers include Alderwood, Cagey, Everett, Indianola, McKenna, Nisqually, Norma, Spana, Spanaway- Nisqually complex, and Yelm.

The Roy Prairie pocket gopher (*Thomomys mazama glacialis*) is found in the vicinity of the Roy Prairie and on JBLM in Pierce County. The subspecies was described as plentiful in 1983 but by 1993 the type locality was described as a "small population" (Steinberg 1996, p. 24). Due to proximity to the subspecies' type locality, it is likely that the 91st Division Prairie and Marion Prairie in Pierce County support this subspecies. Soil series and soil series complexes in and around this area that may support pocket gophers include Alderwood, Everett, Everett-Spanaway complex, Everett-Spanaway-Spana complex, Nisqually, Spana-Spanaway-Nisqually complex, and Spanaway.

Tenino pocket gophers (*Thomomys mazama tumuli*) were originally found in the vicinity of the Rocky Prairie NAP, near Tenino (Dalquest and Scheffer 1942, p. 96), a relatively small prairie area. Gophers still reside there, but WDFW researchers have not seen consistent occupancy of the area in recent years (Olson, in litt. 2010), suggesting that the activity intermittently detected in the NAP may be attributable to individuals dispersing from a currently unidentified nearby source. Soil series and soil series complexes in this area that may support pocket gophers include Everett, Nisqually, Norma, Spanaway, and Spanaway-Nisqually complex.

Yelm pocket gophers (*Thomomys mazama yelmensis*) were originally found on prairies in the area of Grand Mound, Vail, and Rochester (Dalquest and Scheffer 1944, p. 446). Surveys conducted during 1993 and 1994 found no pocket gophers near the towns of Vail or Rochester (Steinberg 1995, p. 28). More recent surveys have reported pocket gophers near Grand Mound, Littlerock, Rainier, Rochester, and Vail (Krippner 2011, p. 31), though WDFW biologists question the validity of the reports near Littlerock and Vail (WDFW 2013b, enclosure 1, p. 3). Soil series and soil series complexes in and around these areas that may support pocket gophers include Alderwood, Everett, Godfrey, Kapowsin, McKenna, Nisqually, Norma, Spana, Spanaway, Spanaway-Nisqually complex, and Yelm.

Population Estimates

There are few data on historical or current population sizes of Mazama pocket gopher (pocket gopher) populations in Washington, although several local populations and one subspecies are believed to be extinct. Knowledge of the past status of the pocket gopher is limited to distributional information.

Recent surveys have focused on determining current distribution, primarily in response to development applications. In addition, in 2012, WDFW initiated a five county-wide distribution survey. Because the object of all of these surveys has mainly been presence/absence only, total population numbers for each subspecies are unknown. And, the precise boundaries of each subspecies' range are not currently known.

Local population estimates have been reported but are based on using apparent gopher mounds to delineate the number of territories, a method that has not been validated (Stinson 2005, pp. 40, 41). Olson (2011a, p. 2) evaluated this methodology on pocket gopher populations at the Olympia Airport and Wolf Haven International. Although there was a positive relationship between the number of mounds and number of pocket gophers, the relationship varies spatially, temporally, and demographically (Olson 2011a, pp. 2, 39). Based on the results of Olson's 2011 study, we believe past population estimates (Stinson 2005) may have been too high. As there is no generally accepted standard survey protocol to determine population size for pocket gophers, it is not currently possible to obtain an estimate of subspecies population sizes or trends. Overall habitat availability has declined, however, and habitat has a finite ability to support pocket gophers. For these reasons, the Service concludes that the overall population trend of each of the four Thurston/Pierce subspecies of the Mazama pocket gopher is negative.

Increased survey effort since 2007 has resulted in the identification of numerous additional occupied sites located on private lands, especially in Thurston County (WDFW 2013a).

Some of these new detections are adjacent to other known occupied sites, such as the population at the Olympia Airport. The full extent of these smaller discontiguous sites is currently unknown, and no research has been done to determine whether or not these aggregations are "stepping stone" sites that may facilitate dispersal into nearby unoccupied suitable habitat, or if they are population sinks (sites that do not add to the overall population through recruitment). Others of these additional occupied sites are separate locations, seemingly unassociated (physically) with known populations (Tirhi, in litt. 2008). The largest known expanse of areas occupied by any subspecies in Washington occur on JBLM (Roy Prairie and Yelm pocket gophers), and at the Olympia and Shelton airports (Olympia and Shelton pocket gophers, respectively).

A translocated population occurs on Wolf Haven International's land near Tenino, Washington. Between 2005 and 2008, over 200 gophers from a variety of areas in Thurston County (some from around Olympia Airport (Olympia pocket gopher, *T. m. pugetensis*)) and some from near the intersection of Rich Road and Yelm Highway (assumed to be Olympia pocket gophers) were released into the 38 acres (15 ha) mounded prairie site. Based on the best available information, we do not believe the property previously supported pocket gophers. Today pocket gophers continue to occupy the site (Tirhi, in litt. 2011); however, current population estimates are not available.

Another site, West Rocky Prairie Wildlife Area, has received a total of 560 translocated pocket gophers (*T. m. pugetensis*) from the Olympia Airport between 2009 and 2011. Initial translocation efforts were unsuccessful; a majority of the pocket gophers died within three days due to predation (Olson 2009, p. 3). Modified release techniques used in 2010 and 2011 resulted in improved survival rates (Olson 2011b, p. 4). It is too soon to know if the population will become self-sustaining, or if additional translocations of gophers will be necessary. This research is ongoing.

Factors and Threats Affecting the Species

The four Thurston/Pierce subspecies of Mazama pocket gopher (*Thomomys mazama glacialis*, *pugetensis*, *tumuli*, and *yelmensis*) face significant threats that contribute to a risk of extinction. Best available scientific and commercial information identifies the following significant threats to the subspecies; each of these threats is discussed in greater detail below:

1. Destruction, modification, or curtailment of habitat and range, including the on-going, cumulative effects of development, military training, and loss or curtailment of natural disturbance processes;

2. Poor connectivity between small and isolated populations; and,

3. Predation and pest control, including that which is attributable to domesticated pets.

Destruction, Modification, or Curtailment of Habitat and Range

The primary long term threats to the pocket gopher are the loss, conversion, and degradation of habitat, particularly to urban development, successional changes to grassland habitat, and the spread of invasive plants. The threats also include increased predation pressure, which is closely linked to habitat degradation.

The prairies of south Puget Sound are one of the rarest ecosystems in the United States (Dunn and Ewing 1997b, p. v; Noss et al. 1995, p. I-2). Dramatic changes have occurred on the landscape over the last 150 years, including a 90 to 95 percent reduction in the extent of the prairie ecosystem. In the south Puget Sound region, where most of western Washington's prairies historically occurred, less than 10 percent of the original prairie persists, and only three percent remains dominated by native vegetation (Crawford and Hall 1997, pp. 13, 14).

Development: Native prairies and grasslands have been severely reduced throughout the range of the four Thurston/Pierce subspecies of Mazama pocket gopher, especially as a result of conversion to residential and commercial development and agriculture. Prairie habitat continues to be lost, particularly to residential development (Stinson 2005, p. 70), by removal and fragmentation of native vegetation, and the excavation, and/or heavy equipment-caused compaction of surfaces and conversion to non-habitat (e.g., buildings, pavement, other infrastructure), rendering soils unsuitable for burrowing.

Residential development is associated with increased infrastructure, such as new road construction, which is one of the primary causes of landscape fragmentation (Watts et al. 2007, p. 736). Activities that accompany low-density development are correlated with decreased levels of biodiversity, mortality to wildlife, and facilitated introduction of nonnative invasive species (Trombulak and Frissell 2001; Watts et al. 2007, p. 736). In the south Puget Sound lowlands, the glacial outwash soils and gravels underlying the prairies are deep and valued for use in construction and road building, which leads to their degradation and destruction.

In the south Puget Sound, Nisqually loamy soils appear to support high densities of pocket gophers (Stinson, in litt. 2010a Olson 2008, p. 6), the vast majority of which occur in developed areas of Thurston County, or within the Urban Growth Areas for the cities of Olympia, Tumwater, and Lacey (WDFW 2009), where future development is most likely to occur. Where pocket gopher populations presumably extended across an undeveloped expanse of open prairie (Dalquest and Scheffer 1942, pp. 95, 96), areas currently occupied by the four Thurston/Pierce subspecies of the Mazama pocket gopher are now isolated to small fragmented patches due to development and conversion of suitable habitat to incompatible uses.

The presumed extinction of the Tacoma pocket gopher is likely linked directly to residential and commercial development, which has replaced nearly all pocket gopher habitats in the historical range of the subspecies (Stinson 2005, pp. 18, 34, 46). One of the historical Tacoma pocket gopher sites was converted to a large gravel pit and golf course (Steinberg 1996, pp. 24, 27; Stinson 2005, pp. 47, 120). In addition, two gravel pits are now operating on part of the site recognized as the type locality for the Roy Prairie pocket gopher (Stinson 2005, p. 42), and another is in operation near Tenino (Stinson, in litt. 2010b) in the vicinity of the type locality for the Tenino pocket gopher.

Multiple pocket gopher sites in Pierce and Thurston Counties may be, or have been, lost to gravel pit development, golf course development, or residential and commercial development (Stinson, in litt. 2005; Stinson 2005, pp. 26, 42; Stinson, in litt. 2010b). Multiple prairies that used to contain uninterrupted expanses of prairie habitat suitable for pocket gophers within the range of the four Thurston/Pierce subspecies have been developed to cities, neighborhoods, agricultural lands, or military bases, and/or negatively impacted by such development, including Baker Prairie, Bush Prairie, Chambers Prairie, Frost Prairie, Grand Mound Prairie, Little Chambers Prairie, Marion Prairie, Roy Prairie, Ruth Prairie, Woods Prairie, Violet Prairie, and Yelm Prairie. Some of these prairie areas still contain smaller areas that support pocket gophers, and some appear to no longer support pocket gophers at all (WDFW 2012).

Where their properties coincide with pocket gopher occupancy, many private lands developers and landowners in Thurston County have agreed to create set-asides or agree to other mitigation activities in order to obtain development permits from the County (Tirhi, in litt. 2008). However, it is unknown if any pocket gophers will remain on these sites due to the small size of the set-asides, extensive grading in some areas adjacent to set-asides, lack of dedicated funding for enforcement or monitoring of set-aside maintenance (Thurston County Long Range Planning and Resource Stewardship, in litt. 2011, p. 2), and lack of control of predation by domestic or feral cats and dogs. In addition, some landowners have received variances from Thurston County that allowed development to occur without a requirement to set aside areas for pocket gophers.

A population of Olympia pocket gophers is located at and around the Port of Olympia's Olympia Airport, which is sited on the historical Bush Prairie. Gophers on Bush Prairie are currently vulnerable to negative impacts from proposed future development by the Port of Olympia and ongoing development by adjacent landowners. The Port of Olympia has plans to develop large portions of the existing grassland that likely supports the largest population of the Olympia pocket gopher in Washington (Stinson 2007, in litt.; Port of Olympia and WDFW 2008, p.1; Port of Olympia 2012). The Olympia Airport is realigning the airport runway, which is in known occupied habitat. They continue to work with the Service and WDFW on mitigating airport expansion activities that may negatively impact gophers (Tirhi, in litt. 2010).

The Olympia pocket gopher has a population at the Olympia Airport that spans several hundred acres, and there are two translocated populations: one at West Rocky Prairie Wildlife Area (some individuals from the Olympia Airport) and one at Wolf Haven (individuals from the Olympia Airport and some from near the intersection of Rich Road and Yelm Highway). The population centered on the Olympia Airport could be negatively impacted by plans for development both on and off the airport, while the two translocated populations are currently secure from intense commercial and residential development pressures as they occur on conserved lands.

The Roy Prairie pocket gopher is known to occur across a large expanse of prairie on JBLM, which is currently secure from the threat of development. The Tenino pocket gopher has a single known population, which has been detected during surveys on the Rocky Prairie NAP, although the intermittent nature of these detections suggests it must be part of a larger metapopulation that occurs across nearby areas that have not been accessible for surveys. No known development poses a threat to the NAP, but any future conversion of the surrounding area to incompatible land use would likely hinder the recovery of this subspecies. The Yelm pocket gophers on Tenalquot prairie (which is owned in large part by JBLM) and Scatter Creek Wildlife Area are also secure from such residential and commercial development, but the Yelm pocket gopher habitat on Rock Prairie north of Old Highway 99 is in an area that is likely to be developed soon, which may negatively affect any local populations in the vicinity.

Loss or Curtailment of Natural Disturbance Processes: The suppression and loss of ecological disturbance regimes across vast portions of the landscape, such as fire, has resulted in altered vegetation structure in the prairies and meadows and has facilitated invasion by native and nonnative woody vegetation, rendering habitat unusable for the four Thurston/Pierce subspecies of Mazama pocket gopher. The basic ecological processes that maintain prairies and meadows have disappeared from, or have been altered on, all but a few protected and managed sites.

Historically, the prairies and meadows of the south Puget Sound region are thought to have been actively maintained by native peoples, who lived here for at least 10,000 years before the arrival of Euro-American settlers (Boyd 1986; Christy and Alverson 2011, p. 93). Frequent burning reduced the encroachment and spread of shrubs and trees (Boyd 1986; Chappell and Kagan 2001, p. 42), favoring open grasslands with a variety of native plants and animals. Following Euro-American settlement of the region in the mid-19th century, fire was actively suppressed on grasslands, allowing encroachment by woody vegetation into the remaining prairie habitat and oak woodlands (Agee 1993, p. 360; Altman et al. 2001, p. 262; Boyd 1986; Franklin and Dyrness 1973, p. 122; Kruckeberg 1991, p. 287).

Fires on the prairie create a mosaic of vegetation conditions, which serve to maintain native prairie plant communities. In some prairie patches fires will kill encroaching woody vegetation and reset succession back to bare ground, creating early successional vegetation conditions suitable for many native prairie species. Early succession forbs and grasses are favored by pocket gophers. The historical fire frequency on prairies has been estimated to be 3 to 5 years (Foster 2005, p. 8). On sites where regular fires occur, there is a high complement of native plants and fewer invasive species. These types of fires maintain the native short-statured plant communities favored by pocket gophers.

The result of fire suppression has been the invasion of the prairies and oak woodlands by native and nonnative plant species (Dunn and Ewing 1997a, p. v; Tveten and Fonda 1999, p. 146), notably woody plants such as the native Douglas-fir (*Pseudotsuga menziesii*) and the nonnative Scot’s broom. On tallgrass prairies in midwestern North America, fire suppression has led to degradation and the loss of native grasslands (Curtis 1959, pp. 296, 298; Panzer 2002, p. 1297). On northwestern prairies, fire suppression has allowed Douglas-fir to encroach on and outcompete native prairie vegetation for light, water, and nutrients (Stinson 2005, p. 7). This increase in woody vegetation and nonnative plant species has resulted in less available prairie habitat overall and habitat that is unsuitable for and avoided by many native prairie species, including pocket gophers (Olson 2011a, pp. 12, 16; Pearson et al. 2005, pp. 2, 27; Tveten and Fonda 1999, p. 155).

Pocket gophers prefer early successional vegetation as forage. Woody plants shade out the forbs and grasses that pocket gophers prefer to eat, and high densities of woody plants make travel both below and above the ground difficult. In locations with poor forage, pocket gophers tend to have larger territories, which may be difficult or impossible to establish in densely forested areas. The probability of pocket gopher occupancy is much higher in areas with less than 10 percent woody vegetation cover (Olson 2011a, p. 16).

On JBLM alone, over 16,000 acres (6,477 ha) of prairie has converted to Douglas-fir forest since the mid-19th century (Foster and Shaff 2003, p. 284). Where controlled burns or direct tree removal are not used as a management tool, this encroachment will continue to cause the loss of open grassland habitats for pocket gophers and is an ongoing threat to the species.

Restoration in some of the south Puget Sound grasslands has resulted in temporary control of Scot's broom and other invasive plants through the careful and judicious use of herbicides, mowing, grazing, and fire. Fire has been used as a management tool to maintain native prairie composition and structure and is generally acknowledged to improve the health and composition of grassland habitat by providing a short-term nitrogen addition, which results in a fertilizer effect to vegetation, thus aiding grasses and forbs to sprout.

Unintentional fires ignited by military training burn patches of prairie grasses and forbs on JBLM on an annual basis. These light ground fires create a mosaic of conditions within the grassland, maintaining a low vegetative structure of native and nonnative plant composition, and patches of bare soil. Because of the topography of the landscape, fires create a patchy mosaic of areas that burn completely, some areas that do not burn, and areas where consumption of the vegetation is mixed in its effects to the habitat. One of the benefits of fire in grasslands is that it tends to kill regenerating conifers, and reduces the cover of nonnative shrubs such as Scot's broom, although Scot's broom seed stored in the soil can be stimulated by fire (Agee 1993, p. 367). Fire also improves conditions for many native bulb-forming plants, such as *Camassia spp.* (Agee and Dunwiddie 1984). On sites where regular fires occur, such as on JBLM, there is a high complement of native plants and fewer invasive species. These types of fires maintain the native, short-statured plant communities favored by pocket gophers.

Management practices such as intentional burning and mowing require expertise in timing and technique to achieve desired results. If applied at the wrong season, frequency, or scale, fire and mowing can be detrimental to the restoration of native prairie species. Excessive and high-intensity burning can result in a lack of vegetation or encourage regrowth of nonnative grasses. Where such burning has occurred over a period of more than 50 years on the artillery ranges of JBLM, prairies are covered by nonnative forbs and grasses instead of native perennial bunchgrasses (Tveten and Fonda 1999, pp. 154, 155).

Pocket gophers are not commonly found in areas colonized by Douglas-fir trees because pocket gophers require forbs and grasses of an early successional stage for food (Witmer et al. 1996a, p. 96). Pocket gophers observed on JBLM did not occur in areas with high cover of Scot's broom (Steinberg 1995, p. 26). A more recent study on JBLM also found that pocket gopher presence was negatively associated with Scot's broom (Olson 2011a, pp. 12, 13, 16). Some subspecies may disperse through forested areas or may temporarily establish territories on forest edges, but there is currently not enough data available to determine how common this behavior may be or which subspecies employ it. The four Thurston/Pierce subspecies of the Mazama pocket gopher occur on prairie-type habitats, many of which, if not actively managed to maintain vegetation in an early-successional state, have been invaded by shrubs and trees that either preclude pocket gophers or limit their ability to fully occupy the landscape. Typical management at civilian airports prevents woody vegetation from encroaching onto surrounding areas for flight safety reasons. Woody vegetation encroachment is therefore not a threat at civilian airports.

Military Training: Pocket gopher populations occurring on JBLM are exposed to differing levels of training activities on the base. The Department of Defense's (DOD) proposed actions under their "Grow the Army" initiative include stationing 5,700 new soldiers, new combat service support units, a combat aviation brigade, facility demolition and construction to support the increased troop levels, and additional aviation, maneuver, and live fire training (75 FR 55313, September 10, 2010). The increased training activities will affect nearly all training areas at JBLM, resulting in an increased risk of accidental fires, and habitat destruction and degradation attributable to vehicle use in occupied areas, mounted and dismounted training, bivouac activities, and digging. Even though the training areas on the base are degraded, with implementation of agreed-upon conservation measures, these areas still provide habitat for the Roy Prairie and Yelm pocket gopher.

JBLM's recently signed Endangered Species Management Plan (ESMP) for the Mazama pocket gopher will serve to minimize threats across the base by redirecting some training activities to areas outside of occupied habitat, designating areas where no vehicles are permitted, designating areas where vehicles will remain on roads only, and designating areas where no digging is allowed, among other conservation measures. JBLM has further committed to enhancing and expanding suitable habitat for the Roy Prairie and Yelm pocket gophers in "priority habitat" areas on base (areas that were proposed as critical habitat); enforcing restrictions on recreational use of occupied habitat by dog owners and horseback riders; and continuing to support the off-base recovery of the four Thurston/Pierce subspecies of the Mazama pocket gopher.

Several moderate- to large-sized areas supporting pocket gophers have been identified on JBLM. These areas are within the historical ranges of the Roy Prairie (Pierce County) and Yelm (Thurston County) pocket gophers. Their absence from some sites of what is presumed to have been formerly suitable habitat may be related to compaction of the soil due to years of mechanized vehicle training (Steinberg 1995, p. 36).

Training infrastructure (e.g., roads, firing ranges, bunkers) also degrades pocket gopher habitat and may lead to reduced use of these areas by pocket gophers. For example, JBLM has plans to add a third rifle range on the south impact area where it overlaps with a densely occupied pocket gopher site. The area may be usable by pocket gophers when the project is completed; however, construction of the rifle range may result in removal of forage and direct mortality of pocket gophers through crushing of burrows (Stinson, in litt. 2011).

Recent survey access to the center of the artillery impact area on 91st Division Prairie, where bombardment is presumably of the highest intensity, did detect some unspecified level of occupancy by the Roy Prairie pocket gopher (WDFW 2013b, enclosure 1, p. 6). This apparently suitable central portion of the 91st Division Prairie is subject to repeated and ongoing bombardment, which may create an ecological trap for dispersing juveniles.

JBLM training areas have varying levels of use; some allow excavation and off-road vehicle use, while other areas have restrictions that limit off-road vehicle use. The ESMP specifically requires coordination between the JBLM Fish and Wildlife personnel and the JBLM entities responsible for training activities (e.g., Range Support, battalion commanders, and/or first field grade officers) to ensure all parties are aware of where occupied areas occur in relation to training activities, the effects of training, and the potential ramifications of habitat destruction or animal mortality. Since military training has the potential to directly or indirectly harm or harass pocket gophers, we conclude that these activities will negatively impact the Roy Prairie and Yelm pocket gophers.

JBLM has committed to operational restrictions on portions of the base in order to avoid and minimize potential impacts to Roy Prairie and Yelm pocket gophers. Currently-occupied areas will be buffered from training activities, with an emphasis on occupied habitat in "priority habitat" areas. Regular surveys will be conducted with the goals of determining distribution, protecting pocket gophers and their habitat from disturbance or destruction, and determining population status. Where possible, JBLM will alleviate training pressure by transferring activities to unoccupied areas where encroaching forest has been removed. This strategy has the effect of both releasing large areas of land that were historically prairie and providing unoccupied areas where training is free of the risk of negatively impacting Roy Prairie or Yelm pocket gophers. While the Service fully supports the implementation of these impact minimization efforts and will continue to collaborate with DOD to address all aspects of training impacts on the species, not all adverse impacts on pocket gophers can be fully avoided. Military training continues to pose a threat to the Roy Prairie and Yelm subspecies at this time. No military training occurs in the ranges of the Olympia or Tenino subspecies of the Mazama pocket gopher.

Poor Connectivity Between Small and Isolated Populations

Most species' populations fluctuate naturally, responding to various factors such as weather events, disease, and predation. Populations that are small, fragmented, or isolated by habitat loss or modification of naturally patchy habitat, and other human-related factors, are more vulnerable to extirpation by natural randomly occurring events, cumulative effects, and to genetic effect (collectively known as small population effects). These effects can include genetic drift (loss of recessive alleles), founder effects (over time, an increasing percentage of the population inheriting a narrow range of traits), and genetic bottlenecks leading to increasingly lower genetic diversity, with consequent negative effects on evolutionary potential.

To date, of the eight subspecies of Mazama pocket gopher in Washington, only the Olympic pocket gopher has been documented as having low genetic diversity (Welch and Kenagy 2008, p. 7), although the six other extant subspecies have local populations that are small, fragmented, and physically isolated from one another.

The four Thurston/Pierce subspecies of the Mazama pocket gopher face threats from loss or fragmentation of habitat. Historically, pocket gophers probably persisted by continually recolonizing habitat patches after local extinctions. However, widespread development and conversion of habitat has resulted in widely separated populations, and intervening habitat corridors are now gone, with the effect of impeding or stopping much of the natural recolonization that historically occurred (Stinson 2005, p. 46).

Although pocket gophers are not known to have low genetic diversity, small population sizes at most sites, coupled with disjunct and fragmented habitat, may contribute to further population declines. Little is known about the local or rangewide reproductive success of pocket gophers found in Washington State.

Predation and Pest Control

Predation: Predation influences the distribution, abundance, and diversity of species in ecological communities. Generally, predation leads to changes in both the population size of the predator and that of the prey. In unfavorable environments, prey species are stressed or living at low population densities such that predation is likely to have negative effects on all prey species, thus lowering species richness. In addition, when a nonnative predator is introduced to the ecosystem, negative effects on the prey population may be higher than those from co-evolved native predators. The effect of predation may be magnified when populations are small, and the disproportionate effect of predation on declining populations has been shown to drive rare species even further towards extinction (Woodworth 1999, pp. 74, 75).

Predation has an impact on populations of the four Thurston/Pierce subspecies of Mazama pocket gopher. Urbanization, particularly in the south Puget Sound region, has resulted in not only habitat loss, but also increased exposure to feral and domestic cats and dogs. Domestic cats are known to have serious impacts on small mammals and birds and have been implicated in the decline of several endangered and threatened mammals, including marsh rabbits (*Sylvilagus palustris*) in Florida and the salt-marsh harvest mouse (*Reithrodontomys raviventris*) in California (Ogan and Jurek 1997, p. 89).

Domestic cats and dogs have been specifically identified as common predators of pocket gophers (Case and Jasch 1994, p. B-21; Henderson 1981, p. 233; Wight 1918, p. 21) and at least two pocket gopher locations were found as a result of house cats bringing home pocket gopher carcasses (WDFW 2001). Informal interviews with area biologists document multiple incidents of domestic pet predation on pocket gophers (Chan, in litt. 2013; Clouse, in litt. 2012 Skriletz 2013 in litt., Wood 2013 in litt.). There is also one recorded instance of a WDFW biologist being presented with a dead Mazama pocket gopher by a dog during an east Olympia, Washington, site visit in 2006 (Burke Museum 2012 McAllister 2013 in litt.). Some local populations of the pocket gopher occur in areas where people recreate with their dogs, bringing these potential predators into environments that may otherwise be relatively free of them, consequently increasing the risks to individual pocket gophers and populations that may be small and isolated

The four Thurston/Pierce subspecies of Mazama pocket gopher occur in rapidly developing areas. Local populations that survive commercial and residential development (adjacent to and within habitat) are potentially vulnerable to extirpation by domestic and feral cats and dogs (Case and Jasch 1994, p. B-21; Henderson 1981, p. 233).

As stated previously, predation is a natural part of the pocket gopher's life history; however, the effect of predation may be magnified when populations are small and habitat is fragmented. The disproportionate effect of additional predation on declining populations has been shown to drive rare species even further towards extinction (Woodworth 1999, pp. 74, 75). Predation, particularly from nonnative species, will likely continue to be a threat to the four Thurston/Pierce subspecies of the Mazama pocket gopher now and in the future. This is particularly likely where development abuts gopher habitat, resulting in increased numbers of cats and dogs in the vicinity, and in areas where people recreate with their dogs – particularly if dogs are off-leash and not prevented from harassing wildlife. In such areas, where local populations of pocket gophers are already small, this additional predation pressure (above natural levels of predation) is expected to further negatively impact population numbers.

Pest Control: Pocket gophers are often considered a pest because they sometimes damage crops and seedling trees, and their mounds can create a nuisance. Several site locations were found as a result of trapping conducted on Christmas tree farms, a nursery, and in a livestock pasture (WDFW 2001). The type locality for the Cathlamet pocket gopher is on a commercial tree farm. Pocket gophers from Thurston County were used in a rodenticide experiment as recently as 1995 (Witmer et al. 1996a, p. 97).

In Washington State it is currently illegal to trap or poison Mazama pocket gophers, or to trap or poison moles where they overlap with Mazama pocket gopher populations, but not all property owners are cognizant of these laws, nor are most citizens capable of differentiating between moles, pocket gophers, or the signs of their habitation (e.g., soil disturbance). In light of this, it is reasonable to believe that mole trapping or poisoning still has the potential to adversely affect pocket gopher populations. Local populations that survive commercial and residential development (adjacent to and within habitat) may be subsequently extirpated by trapping or poisoning. Lethal control by trapping or poisoning is most likely to be a threat to the four Thurston/Pierce subspecies where their ranges overlap residential properties.

Status of Critical Habitat

On April 9, 2014, the Service published a final rule in the Federal Register listing four subspecies of the Mazama pocket gopher as threatened throughout their ranges in the State of Washington (79 FR 19760; April 9, 2014). The Service also published a final rule designating critical habitat for three of the four subspecies (79 FR 19712; April 9, 2014). In conjunction with the listing and designation, the Service evaluated current habitat conditions across the range of the four subspecies in Pierce and Thurston Counties, Washington, and the need for a critical habitat designation that would ensure long term recovery and conservation of the subspecies.

On April 9, 2014, the Service designated critical habitat for three subspecies of the Mazama pocket gopher (the Olympia pocket gopher, *Thomomys mazama pugetensis*; the Tenino pocket gopher, *T. m. tumuli*; and the Yelm pocket gopher, *T. m. yelmensis*). In total, approximately 1,607 acres (650 ha) in Thurston County, Washington, fall within the boundaries of the final critical habitat designation for the Olympia, Tenino, and Yelm pocket gophers (79 FR 19712; April 9, 2014). All critical habitat proposed for the Roy Prairie pocket gopher (*T. m. glacialis*), in Pierce County, Washington, is exempted under section 4(a)(3)(B)(i) of the Act.

Physical and Biological Features

In determining which areas to designate as critical habitat, we identify the physical or biological features that are essential to the conservation of the species and which may require special management considerations or protection. These include, but are not limited to:

1. Space for individual and population growth, and for normal behavior;

2. Food, water, air, light, minerals, or other nutritional or physiological requirements;

3. Cover or shelter;

4. Sites for breeding, reproduction, or rearing and development of offspring; and,

5. Habitats that are protected from disturbance or are representative of the historical, geographical, and ecological distributions of a species.

We derive the specific physical or biological features required for each subspecies from studies of their habitat, ecology, and life history.

Pocket gophers have low vagility, meaning they have a limited dispersal range (Williams and Baker 1976, p. 303). *Thomomys mazama* pocket gophers are smaller in size than other sympatric (occurring within the same geographic area; overlapping in distribution) or parapatric (immediately adjacent to each other but not significantly overlapping in distribution) *Thomomys* species (Verts and Carraway 2000, p. 1). Both dispersal distances and home range size are therefore likely to be smaller than for other *Thomomys* species.

Potential barriers to dispersal include, but are not limited to, forest edges, roads (paved and unpaved), abrupt elevation changes, Scot's broom (*Cytisus scoparius*) thickets (Olson 2012, p. 3), highly cultivated lawns, inhospitable soil types (Olson 2008, p. 4) or substrates, development and buildings, slopes greater than 35 percent, and open water. Barriers may be permeable, meaning that they may impede movement from place to place without completely blocking it, or they may be impermeable, meaning they cannot be crossed. Permeable barriers, as well as lower-quality dispersal habitats, may present an intensified risk of mortality to animals that use them (e.g., open areas where predation risk is increased during passage or a paved area where vehicular mortality is high).

The home range of a pocket gopher is composed of suitable breeding and foraging habitat. Home range size varies based on factors such as soil type, climate, and density and type of vegetative cover (Case and Jasch 1994, p. B-21; Cox and Hunt 1992, p. 133; Hafner et al. 1998, p. 279). Little research has been conducted regarding home range size for individual Mazama pocket gophers. Witmer et al. (1996b, p. 96) reported an average home range size of about 1,076 square feet (100 square meters) at one location in Thurston County, Washington. Pocket gopher density varies greatly due to local climate, soil suitability, and vegetation types (Case and Jasch 1994, p. B-21; Howard and Childs Jr. 1959, pp. 329-336), and densities are likely to be higher when habitat quality is better. Therefore, this one report on the Mazama pocket gopher (Witmer et al. 1996b) is unlikely to represent the average density across all soil types, vegetation types, and other unique site characteristics across the ranges of the four Thurston/Pierce subspecies of the Mazama pocket gopher.

Work done by Converse et al. (2010, pp. 14, 15) estimated that a local population of pocket gophers could persist for at least 50 years if it occurred on a habitat patch that was equal to or greater than 50 acres (20 ha) in size. We acknowledge the uncertainty with this estimate, but there are currently no studies regarding minimum patch size available for the pocket gopher, nor are there any obvious means by which a better answer can be obtained. Thus, the best available scientific data in this case is the opinion of an informed expert panel. Based on this information, we identify patches of breeding and foraging habitat that are equal to or greater than 50 acres (20 ha) in size, or within dispersal distance of each other, as well as corridors of suitable dispersal habitat, as physical or biological features essential to the conservation of the four Thurston/Pierce subspecies of the Mazama pocket gopher.

Of the glacial outwash prairie soils or prairie-like soils present in western Washington, the four Thurston/Pierce subspecies of Mazama pocket gopher are most often found in deep, well-drained, friable soils capable of supporting the forbs, bulbs, and grasses that are the preferred forage for pocket gophers (Stinson 2005, pp. 22, 23). Areas supporting these forage plants tend to be largely free of shrubs and trees.

Although some soils used by pocket gophers are relatively sandy, gravelly, or silty, those most frequently associated with the four Thurston/Pierce subspecies of Mazama pocket gopher are loamy and deep, have slopes generally less than 15 percent, and have good drainage or permeability. Soil series or soil series complexes where individuals of the four Thurston/Pierce subspecies of the Mazama pocket gopher may be found include, but are not limited to Alderwood, Cagey, Everett, Everett-Spanaway complex, Everett-Spanaway-Spana complex, Godfrey, Indianola, Kapowsin, McKenna, Nisqually, Norma, Spana, Spana-Spanaway-Nisqually complex, Spanaway, Spanaway-Nisqually complex, and Yelm.

Predation, specifically feral and domestic cat and dog predation, is a threat to the four Thurston/Pierce subspecies of the Mazama pocket gopher. Urbanization exacerbates this threat with the addition of feral and domestic cats and dogs into the matrix of pocket gopher habitat.

Many pets are not controlled by their owners in the semi-urban and rural environments. Where local populations of native wild animals are small or declining, predation can drive populations farther toward extinction (Woodworth 1999, pp. 74, 75). Due to their solitary and territorial nature, many sites occupied by pocket gophers may contain a small number of individuals, and occur in a matrix of residential and agricultural development with feral and domestic pets in the vicinity. Some occupied areas may also occur in places where people recreate with their dogs, bringing these potential predators into environments that may otherwise be relatively free of them. Pocket gophers need areas free of the threat of predation by feral and domestic cats and dogs.

Primary Constituent Elements

The primary constituent elements (PCEs) of critical habitat are those elements of physical or biological features that provide for a species' life-history processes and which are essential to the conservation of the species. The Service has identified the following PCEs for the four Thurston/Pierce subspecies of Mazama pocket gopher:

1. Soils that support the burrowing habits of the Mazama pocket gopher, and where the four Thurston/Pierce subspecies of the Mazama pocket gopher may be found. These are usually friable, loamy, and deep soils, some with relatively greater content of sand, gravel, or silt, all generally on slopes less than 15 percent. Most are moderately to well-drained, but some are poorly drained. The range of each subspecies of the Mazama pocket gopher overlaps with a subset of potentially suitable soil series or soil series complexes. Here we describe the suitable soil series or soil series complexes that may occur within the range of each subspecies. All of the soil series or soil series complexes listed above could potentially be suitable for any of the four Thurston/Pierce subspecies of the Mazama pocket gopher.

    a. Olympia pocket gopher (*T. m. pugetensis*) soils include the following soil series or soil series complex:
        - i. Alderwood;
        - ii. Cagey;
        - iii. Everett;
        - iv. Godfrey;
        - v. Indianola;
        - vi. Kapowsin;
        - vii. McKenna;
        - viii. Nisqually;
        - ix. Norma;
        - x. Spana;
        - xi. Spanaway;
        - xii. Spanaway-Nisqually complex; and
        - xiii. Yelm.

b. Roy Prairie pocket gopher (*T. m. glacialis*) soils include the following soil series or soil series complexes:
   i. Alderwood;
   ii. Everett;
   iii. Everett-Spanaway complex;
   iv. Everett-Spanaway-Spana complex;
   v. Nisqually;
   vi. Spana-Spanaway-Nisqually complex; and
   vii. Spanaway.

c. Tenino pocket gopher (*T. m. tumuli*) soils include the following soil series or soil series complex:
   i. Alderwood;
   ii. Cagey;
   iii. Everett;
   iv. Indianola;
   v. Kapowsin;
   vi. Nisqually;
   vii. Norma;
   viii. Spanaway;
   ix. Spanaway-Nisqually complex; and
   x. Yelm.

d. Yelm pocket gopher (*T. m. yelmensis*) soils include the following soil series or soil series complex:
   i. Alderwood;
   ii. Cagey;
   iii. Everett;
   iv. Godfrey;
   v. Indianola;
   vi. Kapowsin;
   vii. McKenna;
   viii. Nisqually;
   ix. Norma;
   x. Spanaway;
   xi. Spanaway-Nisqually complex; and
   xii. Yelm.

2. Areas equal to or larger than 50 acres (20 ha) in size that provide for breeding, foraging, and dispersal activities, found in the soil series or soil series complexes listed in (1), above, that have:

   a. Less than 10 percent woody vegetation cover;

b. Vegetative cover suitable for foraging by pocket gophers. The pocket gophers' diet includes a wide variety of plant material, including leafy vegetation, succulent roots, shoots, tubers, and grasses. Forbs and grasses that pocket gophers are known to eat include, but are not limited to: *Achillea millefolium* (common yarrow), *Agoseris* spp. (agoseris), *Cirsium* spp. (thistle), *Bromus* spp. (brome), *Camassia* spp. (camas), *Collomia linearis* (tiny trumpet), *Epilobium* spp. (several willowherb spp.), *Eriophyllum lanatum* (woolly sunflower), *Gayophytum diffusum* (groundsmoke), *Hypochaeris radicata* (hairy cat's ear), *Lathyrus* spp. (peavine), *Lupinus* spp. (lupine), *Microsteris gracilis* (slender phlox), *Penstemon* spp. (penstemon), *Perideridia gairdneri* (Gairdner's yampah), *Phacelia heterophylla* (varileaf phacelia), *Polygonum douglasii* (knotweed), *Potentilla* spp. (cinquefoil), *Pteridium aquilinum* (bracken fern), *Taraxacum officinale* (common dandelion), *Trifolium* spp. (clover), and *Viola* spp. (violet); and

c. Few, if any, barriers to dispersal within the unit or subunit. Barriers to dispersal may include, but are not limited to, forest edges, roads (paved and unpaved), abrupt elevation changes, Scot's broom thickets (Olson 2012, p. 3), highly cultivated lawns, inhospitable soil types (Olson 2008, p. 4) or substrates, development and buildings, slopes greater than 35 percent, and open water.

Critical Habitat Units and Subunits

For each of the Thurston/Pierce subspecies of the Mazama pocket gopher we proposed critical habitat only in areas within the geographical area we consider likely occupied at the time of listing. All units and subunits that were proposed as critical habitat for the Olympia, Tenino, and Yelm pocket gopher were currently occupied as determined by recent surveys, within 5 years prior to the publication of the proposed rule (Krippner 2011, pp. 25–29, JBLM 2012, WDFW 2012), and all provide one or more of the physical or biological features that may require special management considerations or protection. As the result of exclusions under section 4(b)(2) of the Act, the areas that best met our criterion for documented occupancy in two of the proposed subunits (proposed Subunit 1–D and 1–H) are no longer included in this final designation; therefore the occupancy of the remaining critical habitat is more uncertain. Although we conclude the areas in question are likely occupied, to be conservative we have additionally evaluated these remaining areas as if they are not occupied at the time of listing, and determined that they are nonetheless essential to the conservation of the species. Finally, although critical habitat proposed for the Roy Prairie pocket gopher also met these fundamental criteria for occupancy, critical habitat proposed for the Roy Prairie pocket gopher has been exempted from this final designation under section 4(a)(3)(B)(i) of the Act.

In accordance with section 4(a)(3)(B)(i) of the Act, we have determined that the lands subject to the JBLM INRMP, and the conservation efforts identified in the ESMP under the INRMP, will provide a conservation benefit to the Mazama pocket gopher (Roy Prairie and Yelm pocket gopher) that occur on DOD lands in Thurston and Pierce Counties. Therefore, lands within this installation are exempt from critical habitat designation under section 4(a)(3)(B)(i) of the Act.

The Service has designated three units totaling 1,607 acres (650 ha) as critical habitat for the Olympia, Tenino, and Yelm subspecies of the Mazama pocket gopher (critical habitat for the Roy Prairie subspecies is exempted). Each unit is presently occupied, or likely to be occupied, by the subspecies for which it is designated, and contains one or more of the PCEs to support essential life-history processes for that subspecies. Some areas designated as final critical habitat may not be considered occupied at the time of listing. In these cases, we have evaluated each of these areas applying the standard under section 3(5)(A)(ii) of the Act, and have determined that all such areas included in this designation are essential to the conservation of the species.

The critical habitat areas we describe constitute our current best assessment of areas that meet the definition of critical habitat for the Olympia, Tenino, and Yelm pocket gophers. The three units we designate as critical habitat are: (1) Olympia Pocket Gopher Critical Habitat - Olympia Airport Unit; (2) Tenino Pocket Gopher Critical Habitat - Rocky Prairie Unit; and (3) Yelm Pocket Gopher Critical Habitat - Tenalquot Prairie Subunit and Rock Prairie Subunit. The approximate area and landownership for each critical habitat unit and subunit is described in Table 1.

Table 1. Designated Critical Habitat Units and Subunits for the Olympia, Tenino, and Yelm Subspecies of the Mazama Pocket Gopher (79 FR 19712; April 9, 2014).

Critical habitat unit	Location name	Subunit as identified in proposed rule	Federal	State	Private	Other*
			Ac (Ha)	Ac (Ha)	Ac (Ha)	Ac (Ha)
Olympia Pocket Gopher Critical Habitat.	Olympia Airport Unit	1–C	0	0	0	676 (274)
Tenino Pocket Gopher Critical Habitat.	Rocky Prairie Unit	1–D	0	0	399 (162)	0
Yelm Pocket Gopher Critical Habitat.	Tenalquot Prairie Subunit	1–E	0	0	154 (62)	135 (55)
	Rock Prairie Subunit	1–H	0	0	243 (98)	0
Totals			0	0	796 (322)	811 (329)

* Other = Local municipalities and nonprofit conservation organization.
Note: Area sizes may not sum due to rounding.

All units are subject to some or all of the following threats: Development on or adjacent to the unit; incompatible management practices; predation; and habitat degradation or destruction as the result of the inadequacy of existing regulatory mechanisms. The threats of loss of ecological disturbance processes, invasive species and succession, and control as a pest species are threats to the Tenino pocket gopher in the Rocky Prairie Unit and the Yelm pocket gopher in the Tenalquot Prairie and Rock Prairie Subunits.

In all units, the physical or biological features essential to the conservation of each subspecies may require special management considerations or protection to restore, protect, and maintain the essential features found there. Special management considerations or protection may be required to address: Direct or indirect habitat loss due to conversion to other uses; invasion of woody plant species; use of equipment that may compact soils; development; construction and maintenance of roads and utility corridors; habitat modifications; predation by feral or domestic animals; or use of trapping or poisoning techniques by landowners or land managers of the units themselves or adjacent landowners or land managers.

Olympia Pocket Gopher Critical Habitat - Olympia Airport Unit: This unit consists of 676 acres (274 ha) and is made up of land owned by the Port of Olympia, a municipal corporation. The Olympia Airport Unit is located south of the cities of Olympia and Tumwater, in Thurston County, Washington. This unit is occupied by the Olympia pocket gopher and contains the physical or biological features essential to the conservation of the subspecies due to the underlying soil series (Cagey, Everett, Indianola, and Nisqually), suitable forb and grass vegetation present onsite, and its large size. The physical or biological features in this subunit are threatened by: Loss of habitat through conversion to incompatible uses, such as development; predation; and the habitat degradation or destruction due to the inadequacy of existing regulatory mechanisms.

Tenino Pocket Gopher Critical Habitat - Rocky Prairie Unit: This unit consists of 399 acres (162 ha) and is owned by one commercial land owner and Burlington Northern Santa Fe Railroad. The Rocky Prairie Unit is located north of the city of Tenino, Thurston County, Washington; is likely occupied by the Tenino pocket gopher; and contains the physical or biological features essential to the conservation of the species due to the underlying soil series or soil series complex (Everett, Nisqually, Spanaway, and Spanaway-Nisqually complex), suitable forb and grass vegetation present onsite, and its large size. The physical or biological features in this subunit are threatened by: Loss of habitat through conversion to incompatible uses, such as pit mining; development on adjacent or surrounding areas; the loss of natural disturbance processes and invasion by woody plants; predation; small or isolated populations as a result of habitat fragmentation; habitat degradation or destruction as the result of the inadequacy of existing regulatory mechanisms; and control as a pest species. We additionally evaluated this area as if it were presently unoccupied by the Tenino pocket gopher, and have determined that it is nonetheless essential to the conservation of the species.

Yelm Pocket Gopher Critical Habitat - Tenalquot Prairie Subunit: This subunit consists of 289 acres (117 ha) and contains lands owned by one commercial landowner and The Nature Conservancy. This subunit is located northwest of the city of Rainier, Thurston County, Washington. As proposed, subunit 1–E (Tenalquot Prairie Subunit) included 1,505 acres (609 ha) of JBLM land, which has been exempted based on a completed ESMP. This 4(a)(3)(B)(i) exemption, based on this species specific management plan, has been determined to provide a conservation benefit to the Yelm pocket gopher. The Tenalquot Prairie Subunit is occupied by the Yelm pocket gopher and contains the physical or biological features essential to the conservation of the species due to the underlying soil series (Spanaway), suitable forb and grass vegetation present onsite, and its large size. The physical or biological features in this subunit are threatened by: Loss of habitat through conversion to incompatible uses, such as development; the loss of natural disturbance processes and invasion by woody plants; inadequacy of existing regulatory mechanisms; and control as a pest species.

Yelm Pocket Gopher Critical Habitat - Rock Prairie Subunit: This subunit consists of 243 acres (98 ha) and contains lands owned by one private residential and commercial landowner. As proposed (subunit 1–H), this subunit included 378 acres (153 ha) of private ranch land, which has been excluded under section 4(b)(2) of the Act. The Rock Prairie Subunit is likely occupied by the Yelm pocket gopher and contains the physical or biological features essential to the conservation of the species due to the underlying soil series or soil series complex (Spanaway and Spanaway-Nisqually complex), suitable forb and grass vegetation present onsite, and its size. The physical or biological features in this subunit are threatened by: Loss of habitat through conversion to incompatible uses, such as development; the loss of natural disturbance processes and invasion by woody plants; predation; inadequacy of existing regulatory mechanisms; and control as a pest species. We additionally evaluated this area as if it were presently unoccupied by the Yelm pocket gopher, and have determined that it is nonetheless essential to the conservation of the species.

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